COURT MANAGEMENT AND
THE MASSACHUSETTS CRIMINAL JUSTICE SYSTEM
by
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ABSTRACT

COURT MANAGEMENT AND THE MASSACHUSETTS CRIMINAL JUSTICE SYSTEM

BY

William A. Shaffer

Submitted to the Alfred P. Sloan School of Management

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The growth in crime during the last two decades has placed severe stress on state and local criminal justice agencies. With the funding and encouragement of the federal government, state and local governments have pursued efforts to perform criminal justice planning with a systems viewpoint. This planning has met with difficulties, because of, among other reasons, the complexities of the criminal justice system. Dispersed among a number of jurisdictions, the agencies form a system of interacting components often too complex for unaided intuition.

This study discusses system dynamics modeling of the criminal justice system, with emphasis on the courts. The study presents two models. The smaller model focuses on the major feedback loops in the criminal justice system. Of interest is the way the major components of the system, police, courts, and corrections, influence the probability of imprisonment and the length of sentence actually served by offenders. These factors are assumed to influence the deterrence of crime. The study discusses the evidence supporting the effect of legal sanctions on crime and analyzes the impact of this effect on the dynamics of crime.
The larger model, based on the first one, focuses on prison capacity and police and court manpower and on the more detailed decision-making processes within the courts.

Simulations with the models suggest that the deterrence of crime may be insensitive to changes in court policies, the number of police, and the number of judges. However, prison capacity may well play an important role. The models in this study are prototypes of perhaps more detailed models for use in criminal justice planning.

Thesis Supervisor: John F. Collins
Title: Consulting Professor of Urban Affairs
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The Honorable Edward F. Hennessey, Chief Justice of the Massachusetts Supreme Judicial Court
Mr. Nat Pitoff, Esquire, Massachusetts Defenders Committee
Mr. Edward Sullivan, Clerk of Courts, Massachusetts Superior Court Sitting in Middlesex County
Views expressed in this paper are the sole responsibility of the author and do not necessarily reflect the views of any of the above people or the agencies they represent.

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CHAPTER I
MODELS AND CRIMINAL JUSTICE PLANNING

1.1 Introduction

The growth in crime during the last two decades has placed severe stress on state and local criminal justice agencies. Consequently, in the late 1960's the federal government started encouraging and funding criminal justice planning at the state and local level. This planning has met with difficulties. Although a collection of fairly autonomous agencies dispersed among a number of jurisdictions, the components of the criminal justice system do, in fact, form a system of considerable complexity. Increasingly, criminal justice planning has tried to view these agencies as a system, but this task has been made difficult by a lack of understanding about how a systems point of view translates into specific planning tools and policy recommendations. Other problems include discovering policies and programs which are likely to have the most impact, directing data collection, and evaluating programs.

This study discusses system dynamics modeling of the criminal justice system, with emphasis on the courts. The study presents two
models of the criminal justice system. The smaller model emphasizes the important feedback loops. The larger model, called the Court Management Model, focuses on the broad impact of prison capacity and police and court manpower on crime and also focuses on more detailed decision making processes within the courts.

The study comes at a time when the courts are receiving increased attention. Simulations with the model suggest that deterrence of crime may be insensitive to changes in court policies, the number of police, and the number of judges. However, prison capacity may well play an important role.

The models presented here are prototypes of perhaps more detailed models for use in criminal justice planning. Models like these fulfill a need in planning by translating a systems view of criminal justice into specific tools for understanding how the interactions of decisions, resources, and workloads affect the behavior of the system. With this understanding, the model permits testing and identification of those policies which appear to have the most impact on the problem of crime. Moreover, the model guides collection of data and permits better evaluation of policies than could otherwise occur. With these benefits, dynamic modeling provides a valuable addition to the tools of the criminal justice planner.
1.2 The Impact of Crime on the Criminal Justice System

Massachusetts and the nation now stand at the end of two decades of escalating crime. During this period, crimes in Massachusetts, as measured by the FBI's Crime Index, have increased on the average by fourteen percent per year.\(^1\) The growth rate for the nation as a whole has been about eight percent.

Many people have perhaps come to expect this annual increase in crime as a part of modern life without appreciating its implications. The book *limits to Growth*\(^2\) discusses the unexpected problems that can result from quantities that grow exponentially, specifically, the dire consequences of population growing at two or three percent per year. By comparison, a growth of a quantity at fourteen percent a year for any period of years is staggering! At fourteen percent growth, a quantity doubles about every five years. Projecting high growth rates into the future can be subject to error. By its very nature, exponential growth brings into play forces which limit that growth. Quantities cannot continue to grow exponentially over long periods of time. Therefore, projection of growth is more an indicator of its problematic nature than a prediction of the future. Nevertheless, in 1974, the FBI reported three hundred thousand index crimes in Massachusetts. If crime continues to grow at fourteen percent, by 1984 the crime index in Massachusetts will stand at 1.2 million crimes per year.

Understandably, the exponential growth in crime has placed severe
stress on the police, courts, and corrections. These agencies which form the criminal justice system have seen their deterrence capabilities deteriorate.

- From 1966 to 1971 the fraction of index crimes followed by arrest in Massachusetts dropped from an estimated twenty percent to an estimated sixteen percent.

- From 1961 to 1971 the delay in processing criminal cases in the state's Superior Court rose from approximately three months to approximately ten months.

- During the same period, the estimated fraction of arrests for crimes against persons and property which resulted in the offender being imprisoned declined from 0.17 to 0.10.

- From 1955 to 1971 the estimated average sentence served by offenders for crimes against persons and property in both Massachusetts' state and county institutions dropped from approximately twenty months to approximately ten months. In the face of growing crime, the ability of the state's criminal justice system to apprehend, convict, and punish has declined.

1.3 Criminal Justice Planning

The growth of crimes and the resulting problems in state and local criminal justice agencies led to involving the federal government not only in funding improvements in the individual agencies, but
also in assisting these agencies to do comprehensive planning in criminal justice. In 1965 President Johnson established the President's Commission on Law Enforcement and Administration of Justice (the Crime Commission) to study and recommend improvements in criminal justice. Based in part on the Commission's recommendations, the U. S. Congress established in 1968 the Law Enforcement Assistance Administration to:

(1) encourage States and units of general local government to prepare and adopt comprehensive plans based upon their evaluation of State and local problems of law enforcement; (2) authorize grants to States and units of local government in order to improve and strengthen law enforcement; and (3) encourage research and development directed toward the improvement and the development of new methods for the prevention and reduction of crime and the detection and apprehension of criminals.\(^4\)

Several features or aims of criminal justice planning occur in discussions of LEAA's role.

1. The federal government should assist the states and local governments to do planning in the criminal justice area.

2. This planning should be comprehensive or have a systems focus.

3. Planning should help coordinate the various components of the criminal justice system.

4. Planning should be oriented toward attacking the problem of crime and not just funding existing agencies.

5. The planning should help achieve a balance between the police and the rest of the criminal justice system.

**Federal Role in Planning.** At the founding of LEAA, the general
PHASE 1

1. BASIC DATA ANALYSIS
2. PROBLEM IDENTIFICATION AND PRIORITIZING
3. STRATEGIC PLANNING
4. TACTICAL PLANNING

PHASE 2

5. EVALUATION PLANNING

PHASE 3

6. PROJECT IMPLEMENTATION AND DATA COLLECTION

PHASE 4

7. EVALUATION

2. Specified or Inferred Problem Statements Supported by Analysis and Prioritizing of Problems
3. Programs/Goals
4. Projects/Objectives
5. Evaluation Plans/Evaluation Components
6. Grant Applications/Progress Reporting/Evaluation Reporting
7. Evaluation Reports/Final Project Reports

TABLE 1-1: CRIME ORIENTED PLANNING PROCESS

Source: Greenfeld, Preliminary Analysis of Crime-Oriented Planning in Eight Cities of High Impact Anti-Crime Program
perception was that crime was growing and state and local governments lacked the financial resources to deal with the problem. However, more than providing funds, LEAA was also to have provided guidance in criminal justice planning.

In the High Impact Anti-Crime Program, a program designed by LEAA to demonstrate in eight large cities the effectiveness of comprehensive, crime-specific programs in reducing stranger-to-stranger crime and burglary, the federal agency outlined a crime-oriented planning process shown in Table 1-1. The process starts with Basic Data Analysis, which involves analyzing data according to victim, offender, and environment categories.

The process continues with problem identification and "prioritizing", strategic planning, tactical planning, evaluation planning, project implementation, and evaluation. Then the process iterates back to problem identification and "prioritizing".

Systems View. Included in its recommendations and findings, the Crime Commission's Science and Technology Task Force noted that "the criminal justice system must be viewed as an integrated whole, especially in formulating budgets and in developing programs at State and local levels."

Police, court, and corrections officials all share the objective of reducing crime. But each uses different, sometimes conflicting, methods and so focuses frequently on inconsistent subobjectives. The police role, for example, is focused on deterrence. Most modern correctional thinking, on the other hand, focuses on rehabilitation and argues that placing the offender back into society under a supervised community treatment program provides the best chance for his rehabilitation as a law-abiding
citizen. But community treatment may involve some loss of deterrent effect, and the ready arrest of marginal offenders, intended to heighten deterrence, may by affixing a criminal label complicate rehabilitation. The latent conflicts between the parts may not be apparent from the viewpoint of either subsystem, but there is an obvious need to balance and rationalize them so as to achieve optimum overall effectiveness.

This process of balancing and rationalizing potentially inconsistent subobjectives is done at present, when it is done at all, on a largely subjective basis rather than through measured assessment of the consequences of various alternatives. The allocation of necessarily limited budgets and the choice of methods with which to handle various offenses and offenders could be done more accurately if such overall system assessment could be made.8

Coordination. One of the principal benefits of viewing criminal justice as a system is to avoid problems caused by the lack of coordination among the various agencies. Observers saw that programs in one agency often had detrimental effects in another and that sometimes agencies were unaware of programs in other agencies.

...A good example of this (unexpected effects across various government agencies) occurred... in New Jersey. A change in the state law (providing that juveniles taken into custody for noncriminal conduct can no longer be placed in detention facilities with criminal delinquents) was implemented in state courts with immediate repercussions on county corrections. Unwarned and unprepared, juvenile authorities in 12 of New Jersey's 21 counties were obliged to make public appeals for short-term "crisis" housing, housing, that is, even for one night.9

Yet components of the system often ignore each other, and data and general information seem to be in short supply. In New York City, for example, the Plimpton Panel found recently after a 16-month study, that many judges were unaware of the functions "and sometimes even of the existence" of various correctional and drug treatment agencies... Crime control projects thus need to be implemented with careful regard for ramifications within the system, if the ability of the whole criminal justice machinery to deal with crime is not to be seriously diminished.10
Crime Orientation. While much of criminal justice planning had been oriented toward alleviating problems in the individual agencies, recent programs, like the High Impact Anti-Crime Program mentioned above, sought to direct criminal justice planning toward crime reduction as the central goal.

Prior to January, 1972, when the High Impact Program was announced by LEAA, criminal justice planning had, as discussed earlier, generally concentrated its efforts and resources upon the improvement of agency operations within the criminal justice system. Planners surveyed the existing criminal justice system, identified problem areas and needs, and proposed annual action plans and multi-year plans to reduce perceived gaps. These planning efforts were focused upon the capability of the agencies to provide services in terms of adequate numbers of police, prosecutors, judges, probation officers, etc. Consistent with this approach, facilities and equipment also received emphasis as the basic tools for system improvement. Thus, objectives and priorities were developed by planners reflecting the need to upgrade the institutional capability of the criminal justice system.

The Impact Program presented a new approach to planning in which the reduction in crime became the central objective. From this perspective, those attributes and variables associated with specific crimes would be identified and program development and planning would focus upon these targets. The major objective, therefore, would now be to examine the crime problem and specifically determine what types of crime, committed by what types of offenders, committed in which geographic areas, and having what type of victim would be susceptible to measurable reduction.

Creating a Balance. To some, an important aspect of criminal justice planning and LEAA assistance was to produce a better balance between police resources and the resources of the other components. While levels of spending alone do not indicate whether there is an imbalance, the perception among some observers is that an imbalance exists.
One of LEAA's most important tasks, therefore, has been to help correct the extraordinary imbalance (pointed out by the President's Commission on Law Enforcement and Administration of Criminal Justice in 1967) existing between total expenditures for police, on the one hand, and for courts and corrections on the other. Although some progress is now being made via LEAA incentives for corrections spending, for example, it was still true in 1972 that of $3.5 billion from all sources spent on the criminal justice system in 384 large cities, more than 81% went to police protection.\textsuperscript{12}

1.4 Problems in Criminal Justice Planning

Comprehensive crime-oriented planning imposes several problems on planners. Some of these problems arise from political considerations and the lack of trained manpower in this area.\textsuperscript{13} Of interest here are methodological issues involved in the planning process. Specifically,

1. How is the concept of a system translated into planning tools and specific policy analysis?

2. How can effective policies and programs be identified?

3. How is data collection guided?

4. How are the products of planning to be used in evaluating programs?

Translating the Concept of System into Planning. One problem with the idea of a systems orientation to planning is to know exactly what the concept means. The word "system" itself is used in various ways. Thus, while some people are calling for viewing criminal jus-
tice as a system, others are saying that it is not a system. This seeming contradiction results from the difference in meaning. Those who hold that the criminal justice agencies do not form a system, use this word in terms of a unified whole with coordinated direction and management. Those who speak of viewing criminal justice as a system, use this word in terms of a collection of components interacting with each other. There is little doubt that the actions of the police affect the work of the courts, that the processing of cases by the courts affects corrections, and so on. Thus the purpose of viewing the problem of crime in a system context is to understand how the various components affect one another and to develop policies which improve the effectiveness of the entire system. But this understanding is not easily achieved. Systems with the number of interconnections present in criminal justice behave in ways which are not easily understood through intuition.

Perhaps the difficulty of converting a systems approach into specific planning was one reason for insufficient comprehensive planning by many of the states. Critics asserted that in most states they surveyed, the development of the annual, comprehensive plan, although a lengthy process, frequently did little to improve the allocation of funds or to make programs more effective. 14

**Identifying More Effective Policies and Programs.** The complexity of criminal justice as a system leads to the second problem in comprehensive criminal justice planning: the identification of effective policies and programs. A program, merely because it addresses a prob-
lem in one component of the system, does not necessarily improve the performance of the entire system. Due to the complex linkages, effective policies are often difficult to identify. Instead, planners may be tempted to promote a wide variety of programs in various areas. Thus, a systems approach changes to a "shot gun" approach. Perhaps partly for this reason, critiques of LEAA block grant programs have cited a lack of priority funding where the problems were greatest.\(^{15}\)

Some planners note a lack of adequate tools for identifying programs. The Subcommittee on the Planning Process and Urban Development notes as one of six of "the more obvious and serious of the problems that seem to have compromised the effectiveness of the planning process" that:

Tools and data for social and other measurement are not sophisticated enough for predicting the achievements of programs designed to serve congressional and agency goals or for rigorously assessing programs after they have been put into practice.\(^{16}\)

**Data Collection.** To aid in understanding the criminal justice system, statistical data must be collected. Data collection is an expensive and time-consuming task. In many criminal justice agencies numerous records are kept by hand. The agencies themselves have difficulty providing sufficient data for operations, let alone producing extra data for outside planners. The collection of statistical data for planning, therefore, should be done only when there is a recognizable need and when such data would add to the understanding of the system sufficiently to justify the cost. Planners need a means of identifying data requirements and evaluating the benefits of extra data
before trying to collect much of it. The strategy of starting the planning cycle with data collection, as in the crime oriented planning process, seems inadvisable.

**Program Evaluation.** Planners need to do more than set out goals and recommend policies for meeting them. The planning process should produce enough information about the functioning of policies to permit evaluators to track the progress of programs. It is not often possible to observe the effects of policies directly. The Science and Technology Task Force pointed out:

> Even more important for policy guidance is the need for information on the likely consequences of actions that change the system. One way to collect data about such relationships would be to make changes in the operations and observe the effects directly. Wherever practical, this kind of controlled experimentation is clearly to be preferred. Not only are the costs often prohibitive, but normal operations are frequently too sensitive to be disrupted.⁷

But the task force also took a fairly optimistic view of the evaluation process:

> Information about the consequences of actions by the criminal justice system is essential for improving those actions. In this sense the criminal justice system may be compared to a blind man far down the side of a mountain. If he wants to reach the top, he first must move. And it matters little whether his first move is up or down because any movement with subsequent evaluation will tell him which way is up. A step by step process of experimentation, evaluation, and modifying must be undertaken. Both innovation and the subsequent evaluation of its consequences are essential to climbing up. This process is inherently slow and expensive, and it must be conducted with care to avoid misleading results.⁸

Without considering whether this process can occur within the political framework of the criminal justice agencies, there are features
of the dynamics of criminal justice which make the process difficult to use. First, there are delays in the impact of policies. The effectiveness of a policy on crime may require years before a measurable impact on the volume of crime occurs, even in the best of circumstances. In the meantime, the planning process needs to supply enough information to make a partial evaluation of events. Therefore, planners need to have some notion of the timing of events. Second, a policy may be effective, but the results do not appear because of some additional factor not considered in the planning. Thus, planners need to provide tools with enough flexibility that additional information can be incorporated into planning after a policy has been implemented. Evaluators need a reasonably thorough understanding of how the program should progress, so that the right variables can be tracked and intermediate evaluation performed.

1.5 System Dynamics Modeling

The Science and Technology Task Force noted the utility of computer simulation models in addressing the difficulties in criminal justice planning. Surprisingly, relatively few models of whole criminal justice systems have been developed and applied in the criminal justice system, in contrast to private industry and other areas of the public sector where such models have a much more extensive usage. A recent survey of criminal justice models lists five; three of the best
known are:

1. Blumstein and Larson's JUSSIM model
2. Blumstein and Larson's JUSSIM II, based on the previous model but with feedback
3. The model for the State of California built by Space-General Corporation.

Most models used in criminal justice planning are models of specific operational problems in a single agency, for example, models of police response or patrol.

**System Dynamics.** This study develops two models of a total criminal justice system.

The models and analysis are based on the methodology of system dynamics. System dynamics is the particular use of feedback system analysis to study business, economic, and social problems. Developed by Jay W. Forrester and his associates at the Massachusetts Institute of Technology, it has been applied to a wide range of problems such as regional economic development, urban growth and decline, and narcotics addiction. Cline Fraser, Gary Hirsch, and Henry Weil have applied system dynamics to the Massachusetts criminal justice system. Others have also studied the problem of crime using this methodology.

The system dynamics practitioner analyzes a firm, a city, or a public institution as a system of flows of people, funds, goods, and information. These flows are controlled by an interrelated set of decisions. The analyst represents those flows and the decisions as...
equations in a computer language. This set of equations forms a model which can be operated on a computer to study the behavior of the system.

The advantages of system dynamics modeling have been well described by Levin, Roberts and Hirsch.

The system dynamics approach begins with an effort to understand the system of forces that has created a problem and continues to sustain it. Relevant data are gathered from a variety of sources, including literature, informed persons (experts, practitioners, victims, perpetrators) and specific quantitative studies. As soon as a rudimentary measure of understanding has been achieved, a formal model is developed. This model is initially in the format of a set of logical diagrams showing cause-and-effect relationships. As soon as feasible the visual model is translated into a mathematical version. The model is exposed to criticism, revised, exposed again and so on in an iterative process that continues as long as it proves to be useful. Just as the model is improved as a result of successive exposure to critics, a successively better understanding of the problem is achieved by the people who participate in the process. Their intuition about the probable consequences of proposed policies frequently proves to be less reliable than the model’s meticulous mathematical approach.

This is not as surprising as it may first appear. Socioeconomic systems contain as many as 100 or more variables that are known to be relevant and believed to be related to one another in various nonlinear fashions. The behavior of such a system is complex far beyond the capacity of intuition. Computer simulation is one of the most effective means available for supplementing and correcting human intuition.

A computer simulation model of the kind described here is a powerful conceptual device that can increase the role of reason at the expense of rhetoric in the determination of policy. A model is not, as is sometimes supposed, a perfectly accurate representation of reality that can be trusted to make better decisions than people. It is a flexible tool that forces the people who use it to think harder and to confront one another, their common problems and themselves, directly and factually.
A computer model differs principally in complexity, precision and explicitness from the informal subjective explanation or "mental model" that men ordinarily construct to guide their actions toward a goal. It is an account of the total set of forces that are believed to have caused and to sustain some problematic state of affairs. Like the informal mental model, it is derived from a variety of data sources including facts, theories and educated guesses. Unlike the mental model, it is comprehensive, unambiguous, flexible and subject to rigorous logical manipulation and testing.

The flexibility of a model is its least understood virtue. If you and I disagree about some aspect of the causal structure of a problem, we can usually in a matter of minutes run the model twice and observe its behavior under each set of assumptions. I may on the basis of its behavior be forced to admit you were correct. Very often, however, we will both discover that our argument was trifling, since the phenomenon of interest to us may be unchanged by a change in assumptions.

A computer model constructed and used by a policy-making group has the following advantages:

1. It requires policymakers to improve and complete fully the rough mental sketch of the causes of the problem that they inevitably have in their heads.

2. In the process of formal model-building the builders discover and resolve various self-contradictions and ambiguities among their implicit assumptions about the problem.

3. Once the model is running, even in a rudimentary fashion, logical "bootstrapping" becomes possible. The consequences of promising but tentative formulations are tested in the model. Observation of model behavior gives rise to new hypotheses about structure.

4. Once an acceptable standard of validity has been achieved formal policy experiments reveal quickly the probable outcomes of many policy alternatives; novel policies may be discovered.

5. An operating model is always complete, though in a sense never completed. Unlike many planning aids, which tend to be episodic and terminal (they provide assistance only at the moment the "report" is presented, not before or after), a model is organic and iterative. At any moment the model contains in readily accessed form the present best understanding of the problem.

6. Sensitivity analysis of the model reveals the areas in which genuine debate (rather than caviling) is needed and guides empirical investigation to important questions. If the true values of many parameters are unknown (which is generally the case in social planning), the ones that most affect model behavior need to be investigated first.
7. An operating model can be used to communicate with people who were not involved in building the model. By experimenting with changes in policies and model parameters and observing the effects of these changes on behavior, these people can be helped to better understand the dynamic forces at work in the real-world system.

**Feedback.** The principal concept underlying system dynamics is feedback. Feedback exists when the characteristics of a system lead to decisions which affect those characteristics, thereby affecting further decisions. Figure 1-1 depicts two instances of feedback drawn from the models presented later.

The arrows indicate causal relations among variables. In the top diagram, the perceived imprisonment ratio measures the perceived probability of imprisonment for a crime. It is a function of the volume of crimes and the flow of total offenders imprisoned. If crimes increase, and the flow of offenders remains constant, the perceived imprisonment ratio, or the probability of imprisonment for a crime, declines. If it is assumed, as assumed in the models presented later, that a lower probability of imprisonment for a crime reduces deterrence and permits crimes to increase, then the feedback loop is completed. An increase in crime, for a fixed flow of offenders, reduces the perceived imprisonment ratio, which results in a further increase in crime. A loop like this, which reinforces changes in variables, is called a positive feedback loop. Chapter 2 discusses the formulation and behavior of this loop in more detail.
Figure 1-1: Examples of Feedback Loops
The lower loop in Figure 1-1 is a feedback loop of a different type. In this instance, the assumptions are: an increase in crimes produces an increase in arrests; the increase in arrests results in an increase in convictions; and the increase in convictions produces an increase in offenders imprisoned, which raises the perceived imprisonment ratio. This change tends to lower crimes. Unlike the top loop, this loop tends to resist changes in variables. Thus, an increase in crime results in forces which tend to reduce it again. This type of loop is called a negative loop.

Obviously, the two loops are tied by their two common variables, crimes and the perceived imprisonment ratio. Other loops also exist, which are tied to these two. Thus, the system is built up of several interlocking feedback loops, called the structure of the system. The structure determines the system's behavior.

Feedback is important in criminal justice for two reasons. First, decision making over any period of time occurs within feedback loops, which relate those decisions to the performance of the criminal justice agencies, their pressures, standards, and traditions. Second, many social processes like crime possess feedback components. Evidence of feedback is seen in the
exponential growth of crime, since exponential growth results
from positive feedback.

1.6 Overview of the Study

The remaining chapters present two system dynamics models of a
state criminal justice system, a small model called the Basic Criminal
Justice Model and the principal model called the Court Management
Model.

Purposes of the Study. The Court Management Model represents
important aspects of the Massachusetts criminal justice system. The
purpose of the model is to assist in examining the functioning and
policies of the state's criminal justice system, with emphasis on the
courts.

Recent events have indicated the importance of analyzing court
policies. First, the large backlog of cases and the court delay, al-
though a concern of officials for a number of years, have become par-
ticularly severe in the last five years. Second, this problem, as well
as a concern for the overall functioning of the courts, has prompted
new efforts in improving court administration. As an example, Governor
Dukakis of Massachusetts recently appointed a panel headed by Archibald
Cox to study the Massachusetts courts and make recommendations to im-
prove their operation. Third, the policies of state criminal courts
in general are receiving increased scrutiny. Plea negotiations in these courts are being questioned. Some people are supporting such changes as mandatory sentencing for a number of crimes. Fourth, as the number of crimes continues to grow in the state and the nation, officials and laymen alike are looking for solutions. Some people are suggesting that the courts, since they are at the center of the criminal justice system, provide a situ of considerable leverage in controlling crime.

Another purpose of the model is to study the broad impact of changes in prison capacity and police and court manpower. Is there an imbalance of resources? Do we need more police, more judges, more prison capacity, or some mix of all three?

Limitations of the Study. The reader should keep in mind what this study is not. First, it is not an analysis of the causes of crime. The various hypotheses about what causes people to commit crimes is a fascinating area of inquiry, with numerous, and sometimes conflicting, hypotheses. I do not attempt to resolve the debates, or incorporate into the model all the possible causes.

The model does contain assumptions that the criminal justice system, through the imposition of legal sanctions, is able to affect crime through deterrence, incapacitation, and the impact of the prison experience on offenders. Chapter 2 discusses the exact form of these assumptions and the evidence
for and against them.

In the model, there is a variable called crimes which represents the number of crimes committed in Massachusetts per month. This variable is a function of the population of various groups and the impact of legal sanctions on crimes. Some people may interpret this variable as an assertion that crimes are affected only by these factors and not by any others. This interpretation is unintended.

In essence, the crime variable is a measure representing the contribution of changes in other model variables. The crime variable exhibits only part, although probably an important part, of changes that might occur under a host of possible influences external to the model. Omitting the influences of external factors improves the understanding of the dynamics of the criminal justice system as exhibited in the simulations.

Some people may also question the use of any relationship between crime and legal sanctions, on the grounds that such an assumption is unproven. First, as discussed in Chapter 2, a growing body of evidence, both statistical and historical, is accumulating which supports the effect of legal sanctions on crime. Second, the assumption of a relation between crime and legal sanctions underlies much of criminal justice planning, whether that assumption is proven or not. Therefore, it is appropriate to investigate the implications of that assumption and how it affects policies. In particular, negative findings are of interest in this situation. If certain anti-crime policies are ineffective given the assumptions of deterrence, they are not
going to be of any use if legal sanctions do not deter. The presence of relations between crime and legal sanctions is a step toward a more comprehensive understanding of criminal justice policies.

Although the study considers several factors affecting the quality of justice, other important factors are not explicitly considered. The study does deal with factors affecting the quality of justice like the number of crimes, workload on judges and prosecutors, and the availability of defense counsel. However, several other factors like the probabilities of false conviction and the failure to convict a defendant who is guilty are not handled explicitly. The policies discussed in this study could affect these factors. Further modeling would be required to incorporate them explicitly in the models presented here.

Furthermore, this study is not an analysis of all possible criminal justice policies. Focusing primarily, although not exclusively, on policies in the courts, the study does not consider such areas as the community based correctional programs, police-community relations, or even many aspects of court management. Policies are viewed at a broad, aggregate level which is suitable for overall criminal justice planning, but which may not be suitable for decision making at a more detailed level. Modifications of the models presented here or new system dynamics models may be useful tools in analyzing these issues. The models in this study can be considered prototypes for new models which planners develop to meet their own needs.
Study Organization. Chapter 2 discusses the small model in detail using diagrams, simulations, and descriptions of the individual equations. The purpose here is to describe explicitly and precisely the major assumptions which go into the larger model, without having to deal with all the detail of the larger model.

Chapters 3 and 4 discuss the Court Management Model. Chapter 3 deals primarily with the Court Sector of the Massachusetts criminal justice system. The processing of cases is governed by a number of negative feedback loops or adjustment mechanisms. These permit the courts to cope with the heavy workloads of the past two decades. Chapter 4 describes the Police and Corrections Sectors of the model. The discussion in Chapters 3 and 4 is less detailed than Chapter 2, but an equation-by-equation description appears in Appendix A.

Chapter 5 discusses the behavior of the model, with emphasis on how the feedback loops generate that behavior. The chapter also compares the model behavior with actual data from the Massachusetts criminal justice system. The model generates within its internal structure many aspects of behavior observed in the Massachusetts criminal justice system, including the exponential growth in crime and the decline in the ability of the system to apprehend and punish offenders. Chapter 5 also describes the testing of a number of possible anti-crime policies, specifically:

1. Increased police
2. Increased judges
3. Increased plea bargaining
4. Mandatory Sentencing
5. Increased trial efficiencies
6. Court diversion program
7. Increased prison capacity

The chapter concludes with a discussion of how the policy results are affected by some of the assumptions in the model.

1.7 Policy Recommendations

Working with the model suggests several specific conclusions about criminal justice policies. These conclusions, discussed in Chapters 5 and 6, are tentative to the extent that they arise from a model whose assumptions are open to debate and probably can never be fully substantiated given the limitations of criminal justice research and data.

1. The feedback structure of the criminal justice system tends to amplify changes in the volume of crime from other sources.

2. Of those tested, the most effective policy in controlling crime is the increase in prison capacity. Prison capacity has unexpected importance in the deterrence value of the criminal justice system.

3. Increases in police over current levels appears to improve deterrence only slightly, not because the police are ineffective in making arrests, but because of the limitations of the entire system.
4. The courts do not appear to provide much leverage in affecting crime. Deterrence appears to be reasonably insensitive to changes in court policies. Specifically, the model suggests the following results of changes in court policies:

5. Increasing judges has little impact on crime.

6. Increasing the amount of plea bargaining has little effect on crime, but, under certain circumstances, may increase it.

7. Increases in the efficiency of conducting trials only marginally affects crime.

8. Mandatory sentencing has some impact on crime, but mostly through restrictions on parole, rather than restrictions on plea bargaining. However, restrictions on parole might lead to serious overcrowding in prisons.

8. A court diversion program tends to have relatively small effect on crimes, but also does not reduce the court delay as much as might be expected.

1.8 Implications for Criminal Justice Planning

Besides the specific recommendations, the development, testing, and use of the model suggest some rather broad implications for criminal justice planning.

Translating the Concept of System into Planning. With the system dynamics approach, the vague notion of a systems view
translates into concrete models. The system becomes a set of interlocking decisions governing the flow of persons and cases and the utilization of manpower and other resources. The planner can utilize models of varying complexity with different foci, purposes, and levels of detail. His selection of models will depend on the use to which he intends to subject them. An important benefit of modeling is that the planner must explicitly state what he is including in his system.

**Identifying Effective Policies and Programs.** The planner can use his models to test various policies and to identify those that have the best chance of improving system performance. The planner will see that the results of various policy changes are difficult to predict without the use of the model, even when the underlying causal relations are well understood.

The simulations suggest that many policies are likely to have little effect on crime, even though they appear to increase deterrence. This lack of sensitivity is particularly true in the Court Sector where the several adjustment mechanisms tend to compensate for policy changes, reducing their impact.

**Data Collection.** Since the model provides a statement of what variables are currently of interest, data needs are much clearer than with a non-quantitative approach to planning. During model construction, the planner must define variables more precisely than otherwise. He must also determine the amount of disaggregation. Thus, the planner improves his understanding of the types of data he needs to collect.
Since the planner is unlikely to find readily the data he needs, he should have some means of determining the most important data for planning. Through sensitivity tests, the model indicates which assumptions, and therefore which data, are most important to the results of proposed programs.

Moreover, planning need not be held up while data are being collected. Unlike many formal modeling approaches which produce few results unless they have reasonably complete numerical data, system dynamics models can make use of qualitative estimates based on opinions of experts, or even the planner's best guess. The planner can run his model with these preliminary estimates until he has obtained better ones. He is able, therefore, to obtain useful insights before data collection is complete.

Program Evaluation. The model, by providing an explicit representation of how policies affect the system, aids in the evaluation of programs in several ways. First, the model indicates when the feedback structure of the criminal justice system may hide causal relations in the system, thereby causing the evaluation to be misleading. For example, the Court Management Model shows how substantially increasing police can produce relatively little change in deterrence. The immediate impression from such a result is that the police are ineffective in controlling crime; but a closer look shows that it is the rest of the system, courts and corrections, that hinders the effectiveness of the police. Second, by providing a detailed picture of the movement and timing of variables, the planner is able to identify a
number of variables which can be tracked during the evaluation. Third, by showing the delays between program implementation and measurable results, the model helps the planner avoid overly high expectations, which, when not met immediately, result in a loss of confidence and a lack of sustained effort in those programs which produce long term benefits. Simulations in this study suggest that the response time of the criminal justice system is long, on the order of several decades. The response time is the length of time necessary to see the full dynamic behavior of the system. The long response time raises questions about the advisability of trying to evaluate criminal justice programs in only a year or year and a half. Although full evaluation obviously cannot await the elapse of decades, the evaluator should be aware of the long response times involved and should plan for evaluation to occur as a continuing part of criminal justice planning.

The insights achieved through dynamic modeling suggest that such models constitute a valuable addition to the tools of the criminal justice planner.


3. Methods of calculation and sources of data are described in Appendix B. These figures are estimates based on data which may be inconsistent of otherwise subject to error. The precise values may be somewhat in error, although the trends are believed to be correct.


10 Ibid., p. 12

11 Greenfeld, op. cit., p. 6

12 Chelinsky, op. cit., p. 11

13 Subcommittee on the Planning Process and Urban Development, op. cit., p. 39

14 Ibid., p. 37

15 Ibid., p. 38

16 Ibid., p. 8

17 Science and Technology Task Force, op. cit., p. 54

18 Ibid., p. 8


21 Ibid.

22 California, Youth and Adult Corrections Agency, "Prevention and Control of Crime and Delinquency," 1965 (prepared by Space-General Corporation, El Monte, California)

Of the two other models, one was in an unpublished paper, Stanley C. Abraham, "Simulation Modelling in Criminal Justice: An Approach and Demonstration Using System Dynamics," Graduate School of Management, University of California, Los Angeles, CA, July 1972. For the second model, the authors of the survey appear to have given the wrong reference. I was unable to check it further. Other models exist, including two cited below, but they have not received enough circulation to appear in the survey.

23 The first book in system dynamics was Jay W. Forrester, Industrial Dynamics (Cambridge, MA: MIT Press, 1961)


28 Stanley C. Abraham, op. cit.


Willard Fey, H. M. Wadsworth, and D. B. Young; Criminal Justice System Training Model, U. S., Department of Justice, Law Enforcement Assistance Administration, Final Report for Grant 73-TN-04-0001(S-1), May 31, 1974

29 Levin, Roberts, and Hirsch, op. cit., pp. 4-6
CHAPTER II

CRIME, DETERRENCE, AND THE STRUCTURE OF THE CRIMINAL JUSTICE SYSTEM

2.1 Introduction

Within a state's criminal justice system, crime, deterrence, and law-enforcement resources can be viewed as interrelated through a set of feedback loops. The criminal justice system seeks to control crime partly by apprehending and imprisoning offenders, thereby deterring potential offenders. The ability to imprison offenders depends on the resources of the system compared to the volume of cases it must handle. An increase in crime may overload the system to the point where deterrence is reduced and crime is stimulated further.

This chapter presents a model which introduces the basic feedback loops relating crime, resources, and deterrence. This model, a simplified version of the larger model presented in later chapters, has two purposes. First, because the model is small, the most important feedback loops can be easily isolated, emphasized, and analyzed. Second, the model provides an example for explaining the features of System Dynamics modeling. The chapter serves as an introduction for readers unfamiliar with this methodology. Starting with a causal loop diagram and a verbal description of the assumptions, the chapter
develops the DYNAMO equations comprising the model. In some instances the assumptions are presented with only a brief discussion of their justification. A more detailed discussion will occur in later chapters. The chapter presents simulations showing the behavior of the model. Some of these simulations are tests of possible criminal justice policies. However, a detailed discussion of policy implications is left for later chapters.

Several results emerge from the model:

1. The structure of the criminal justice system amplifies the effect of external factors which increase crime. A small increase in crime due to an external source can initiate a substantial rise in crime.

2. The period of response of the criminal justice system is probably long, on the order of twenty to forty years. The period of response is the amount of time necessary to see the full pattern of dynamic behavior of the system.

3. Speeding up the acquisition of police and court capacity can dampen the growth of crime enough to eliminate the necessity for more capacity in the long run.

4. Attempts to alleviate growing backlogs in the criminal justice system through plea bargaining may result in an added stimulus to crime.

5. Increasing prison capacity may be the most important step which the criminal justice system can take to control crime.
2.2. Deterrence and the Criminal Justice System

Can the criminal justice system in fact deter crime? The question has been the source of controversy. Traditionally, the police, prosecutors, and many judges have justified the existence of the system primarily for deterrence. The deterrence of legal sanctions has a certain face validity. James Q. Wilson states:

Most of us are prepared to accept the notion that effective application of penalties, even rather modest ones, will deter certain forms of behavior. Everyone who has traveled to Los Angeles from the East Coast observes with awe the extent to which routine traffic laws, including those against jaywalking, are obeyed. The explanation is obvious: For decades, the police have enforced those laws with sufficient vigor to make the average Angeleno feel that the risks of breaking the law are sufficiently great, and the costs of observing the law sufficiently small, to make it worthwhile to obey.¹

However, Tittle and Logan² note that until recently most criminologists and sociologists felt that legal sanctions had little impact on serious crime. The sociologists rejected deterrence, first, because the model of rational man, on which Bentham and others had originally based the deterrence hypothesis, seemed simplistic and inaccurate to the sociologists. Their own theories, stressing social organization, family setting, and peer-group pressures, gave little attention to legal sanctions. Second, what research on penalties existed suggested that deterrence has little impact. For example, studies of capital punishment compared homicide rates in states with and without the death penalty.³ In general they revealed no deterrent effect from the death penalty. In another line of research, studies of released convicts showed that recidivism rates tended to be high.⁴
Researchers inferred from these studies that imprisonment had little deterrent effect.

Recently, researchers have been reevaluating the evidence and performing new studies, many of which lend support to the deterrence hypothesis. Since much of the research is discussed in Tittle and Logan, I will summarize only some of it here.

First, the research on capital punishment failed to account for the probability of receiving the death penalty. The mere presence of the death penalty on the law books does not accurately measure whether it is in fact likely to be invoked. Moreover, whether or not capital punishment deters more than imprisonment does fails to address the issue of whether imprisonment deters crime.

Second, the studies of recidivism tend to confuse two types of deterrence, special deterrence and general deterrence. Special deterrence refers to the effects of sanctions on the behavior of the person being punished. General deterrence refers to the effects of the threat of punishment on members of society in general. Special deterrence may fail, while general deterrence is effective. The released prisoner may be stigmatized as a criminal. Unable to find employment, he may have to resort to crime to support himself. However, the potential offender who has not gone to prison may, nevertheless, be deterred, not only by imprisonment, but by the difficulties following release.

Third, a number of historical events suggest that legal sanctions affect crime. During police strikes in Boston and Liverpool in 1919,
looting and other thefts became so prevalent that the military had to be called to restore order. In 1944 the German troops occupying Denmark arrested the Danish police. A citizens' watch corps, which replaced the police, could do little to punish crimes, unless the criminals were caught in the act. Reported thefts increased considerably. In each of these instances, a drop in the probability of arrest and, consequently, a drop in the probability of incurring legal sanctions was followed by an increase in crime.

Fourth, several empirical studies performed since 1960 have supported the effect of legal sanctions on crime. Of particular interest are Ehrlich's estimates of the impact of the probability of imprisonment and the length of sentence on crime. Ehrlich's measure of the probability of imprisonment was the ratio of the number of persons committed to state (and, in the case of auto theft, federal) prisons in a given state to the number of offenses known to the police in the same year. The measure of the length of sentence was the average time actually served by offenders in state prisons, as opposed to the court-imposed sentence. Ehrlich used data from 1940, 1950, and 1960. Cited by Wilson as the "most detailed statistical analysis of the effects of criminal sanctions," Ehrlich's research supports the hypothesis that both the probability of imprisonment and the average length of sentence affect the crime rate.

The evidence, both historical and statistical, fails to prove the deterrent effect of imprisonment conclusively. Wilson points out that
Figure 2-1: Causal Loop Diagram of Basic Criminal Justice Model
statistical studies

are not immune to criticism: They are based on police reports of crimes committed (which are in error to some degree), they are based on comparison sentencing behavior among states (which are very large units within which much variation no doubt occurs), and they are not experimental studies (that is, they do not show what happens when one deliberately changes the pattern of sentencing while holding everything else constant).

As with most questions in social policy, the data are inconclusive, the historical evidence is sometimes contradictory, and opinions sometimes reflect ethical beliefs and methodological orientation more than empirical evidence. Nevertheless, there is ample evidence to warrant assuming that legal sanctions do affect crime.

2.3. An Overview of the Basic Assumptions

Working from assumptions about the impact of deterrence on crime, the first step in formulating a model of the criminal justice system is to describe a set of assumptions about the interactions among deterrence, crime, and the criminal justice system. Figure 2-1 depicts the causal loop diagram of the Basic Criminal Justice Model discussed in this chapter. Diagrams like Figure 2-1 are useful for showing the important causal relations and feedback loops in a model. An arrow between two variables indicates that the variable at the tail of the arrow affects the variable at the head of the arrow. The plus or minus sign at the head of the arrow indicates the direction of the effect. For example, in Figure 2-1 the arrow with a plus sign
connecting crimes with crimes reported indicates that an increase in crimes will cause an increase in crimes reported. The causal relations in the diagram are the direct, ceteris paribus effects, or the relationships that occur when all other variables remain constant.

The left side of Figure 2-1 depicts the factors affecting the number of crimes per month. These factors fall into two categories, deterrence factors and the number of ex-offenders in the population. The deterrence factors include the probability of imprisonment and the length of sentence. This formulation is a simplification of the various ways the criminal justice system influences deterrence. For certain types of crimes and people, the possibility of a public accusation or police investigations can act as deterrents. Individuals in positions of respect may suffer loss of prestige due simply to an arrest. A court conviction can further damage an individual's reputation and may bar him from exercising certain privileges, even if he receives a suspended sentence. However, for some individuals the deterrent effect of arrest or even conviction without a prison sentence may provide a negligible deterrent. The professional thief or the member of a youth gang is probably little affected simply by the arrest. The model presented here deals primarily with serious crimes against persons and property. These crimes include burglary, assault, rape, and auto theft. Given the seriousness of the crimes and, in many instances, the substantial financial rewards derived from property crimes, arrest or conviction without imprisonment is probably only a marginal deterrent. Therefore, for simplicity the
probability of imprisonment and the length of sentence are the only factors affecting deterrence in the model.

The perceived imprisonment ratio is the average number of offenders imprisoned each month divided by the average number of crimes per month. The term "perceived" indicates that a quantity is a delayed or otherwise distorted measure of another quantity. The potential offender has no way of knowing the precise number of crimes currently being committed or the precise number of offenders being imprisoned, but he does have some idea of the past volume of crime and how many offenders end up in prison. He may receive information from acquaintances or through personal contact with the system. On this basis, he forms an opinion of the chances of going to prison. A small chance is assumed to reduce the deterrence for the potential offender.

The potential offender also has a notion of the average length of sentence offenders serve. This sentence, called the average effective sentence, is shorter than the court-imposed sentence, because limited prison capacity requires paroling most prisoners before they have served the full court-imposed sentence. A short average effective sentence is assumed to deter crimes less than longer sentences.

The number of ex-offenders also affects crime. The ex-offender is defined here as a person released from prison within the previous five years. While the threat of arrest and imprisonment is assumed to deter crimes, the actual imprisonment is assumed to reinforce the
criminal tendencies of the offender. The ex-offender with a prison record faces considerable difficulty in "going straight." Consequently, ex-offenders are assumed to have a higher likelihood of committing crimes than the potential offender who has never been in prison.

The lower middle part of Figure 2-1 depicts the assumptions about processing cases through the criminal justice system. For simplicity, the police and courts are aggregated. Crimes reported to the police add to the backlog of cases in the criminal justice system. If the inflow is larger than the flow of cases adjudged and dismissed, the backlog grows. With it grows the workload. The workload is the backlog of cases relative to the capacity of the criminal justice system to process cases. As the workload grows, the police and courts are assumed to move cases faster: the police concentrate on only the more serious crimes, dropping the more trivial ones. The courts engage in plea negotiations to avoid trials. An increasing percentage of court cases are dismissed. The overall effect is to reduce the fraction of defendants going to prison and to reduce the sentence imposed by the courts for those who do go to prison.

A growing workload is assumed to affect the fraction of cases reported to the police. If the workload is high, citizens perceive the criminal justice system as overburdened and unresponsive. Sensing that the system can do little to apprehend offenders, the citizens report a smaller percentage of crimes than if the workload were low.
The lower part of Figure 2-1 depicts the assumptions about acquisition of criminal justice capacity. Criminal justice capacity represents the resources, primarily manpower, for processing cases. A high workload produces pressures to increase capacity. Officials then hire new people to reduce the workload on the present staff.

The upper part of Figure 2-1 depicts the assumptions about the influence of prison capacity on the movements of prisoners. The flow of new and ex-offenders imprisoned depends on the cases adjudged and dismissed and the fraction of defendants imprisoned. If offenders imprisoned exceed the flow of released prisoners, the number of prisoners increases. A prison population in excess of capacity pressures administrators to release prisoners early, thereby reducing the average effective sentence. The increased flow of released prisoners enlarges the pool of ex-offenders.

2.4 Model Equations

To build a simulation model of the system described above, the causal relations must be described in a set of equations. Relations must be quantified, and, in some instances, important non-linearities must be recognized. Additional variables and relations must be added to complete the model. The resulting equations must be expressed in a language which a computer can utilize. The equations then form a set of instructions which direct the computer to calculate how the
model's variables change over time.

This model is programmed in the DYNAMO simulation language. The model can be depicted in a second type of diagram, the DYNAMO flow diagram. Each symbol in the flow diagram corresponds to a type of variable in the model.

One type of variable is the level. Represented by a rectangle, a level is an accumulation of some flow in the system. For example, in the flow diagram of case processing (Figure 2-8), the criminal justice backlog is a level or accumulation of cases awaiting processing. Prisoners (Figure 2-22) form a level or accumulation of people in correctional institutions.

Another type of variable is the rate. Represented by a valve symbol, rates are flows of entities into and out of levels. For example, the rate, crimes reported (Figure 2-8), is a flow of cases into the criminal justice backlog. New offenders imprisoned (Figure 2-22) is a rate increasing prisoners.

A third type of variable is the auxiliary. Represented by a circle, an auxiliary is an intermediate step in calculating rates. For example, workload (Figure 2-8) is an auxiliary which is an intermediate step in computing rates like crimes reported and cases adjudged and dismissed.

Level, rate, and auxiliary equations are called active equations because they compute variables which change over time. However, there are model parameters which are constant during the simulation. These include constants and initial values. Examples of these will be
Figure 2-2: Flow Diagram of the Relations Between Crimes and the Perceived Imprisonment Ratio
given later.

In flow diagrams, lines with arrows indicate how variables affect each other. A solid line indicates how the rates affect the levels. For example, the solid line in Figure 2-8 connecting crimes reported and the criminal justice backlog indicates that crimes reported increase the criminal justice backlog. The dashed lines indicate transfers of information which affect variables. For example, the dashed line connecting workload and capacity utilization (Figure 2-8) indicates that information about the workload influences the policies governing the utilization of capacity.

The rest of this section describes each equation. Groups of equations are isolated to show how they behave and how they contribute to the behavior of the entire model.

**Crimes.** The first set of equations calculates the number of crimes per month based on the population of potential new offenders and ex-offenders and the perceived imprisonment ratio. Figure 2-2 depicts the flow diagram of these equations.

In Equation 31 the number of crimes per month CRIME is the sum of crimes by new offenders CRINO and crimes by ex-offenders CRIXO.

\[
\begin{align*}
\text{CRIME,}_K &= \text{CRIXO,}_K + \text{CRINO,}_K \\
\text{CRIME} &= 10000 \\
\text{CRIME} &= \text{CRIMES (CASES/MONTH)} \\
\text{CRIXO} &= \text{CRIMES BY EX-OFFENDERS (CASES/MONTH)} \\
\text{CRINO} &= \text{CRIMES BY NEW OFFENDERS (CASES/MONTH)}
\end{align*}
\]
DYNAMO equations like Equation 3 use notation similar to the notation in other computer languages like FORTRAN. Variable names consist of several letters and numbers. One difference between DYNAMO and other computer languages is the use of timescripts, for example the ".K"'s following variable names in Equation 3. Timescripts indicate the time relations among variables. ".K" refers to a particular time period, ".J" (not used in Equation 3) refers to a time a short period before ".K", and ".L" refers to a time a short period after ".K". Equation 3 uses only ".K"'s, because the relation holds among variables at the same point in time.

Crimes by new offenders CRINO (Equation 4) is the product of four factors. The first is the population of potential new offenders PNO. Potential new offenders are defined as those who are neither prisoners or ex-offenders. The second factor is the crime rate normal for potential new offenders CRINO. CRNNO is the average number of crimes committed by new offenders per potential new offender per month when the deterrence of the criminal justice system is normal. An initial value equation calculates CRNNO so that, given the population of potential new offenders, ninety percent of the initial number of crimes per month are committed by new offenders. The resulting value of CRNNO is 0.00181 crimes per person per month. Initial value equations do not use timescripts, since the relations are independent of time. The third factor affecting CRINO is the effect of deterrence on crime EDC. The fourth factor is the variable TEST.
CRINO.K=(PNO.K)(CRNNO\(EDC.K)(TEST.K)  
CRINO=(CRIME)(1-IFXO)  
CRNNO=(CRIME)(1-IFXO)/PNO  
IFXO=0.1

CRINO - CRIMES BY NEW OFFENDERS (CASES/MONTH)  
PNO - POTENTIAL NEW OFFENDERS (PERSONS)  
CRNNO - CRIME RATE FOR POTENTIAL NEW OFFENDERS  
(CASES/PERSON-MONTHS)  
EDC - EFFECT OF DETERRENCE ON CRIME  
(DIMENSIONLESS)  
TEST - TEST INPUT (DIMENSIONLESS)  
CRIME - CRIMES (CASES/MONTH)  
IFXO - INITIAL FRACTION OF EX-OFFENDERS COMMITTING  
CRIMES (DIMENSIONLESS)

TEST (Equation 5) provides a step input for checking the behavior of the model. Figure 2-4 depicts an example of this test input. In the real world a number of factors outside of the criminal justice system may affect crime, including recessions in the economy, changes in the age distribution of the population, and shifts in the socio-economic character of communities. These factors will jar the system in a complex, random fashion. The step input does not replicate this complex exogeneous input but, instead, provides a controlled input which is more useful for understanding the dynamic behavior of the model. If the system were driven by a complex exogeneous input, the internal dynamics might be difficult to separate from the influence of the exogeneous input.
The procedure for using TEST in a simulation is as follows. The model is initialized in equilibrium. In other words, when the simulation starts, the rates flowing into each level equal the rates flowing out of the level, so that the levels do not charge over time. At some point in the simulation, the step input is triggered, causing the model to depart from equilibrium and to exhibit its dynamic behavior.

Crimes by ex-offenders CRIXO (Equation 6) is computed analogously to crimes by new offenders. The crime rate normal for ex-offenders is 0.0741 cases per person per month. The reason for this being significantly higher than the crime rate normal for new offenders will be discussed below.
The effect of deterrence on crime (Equation 7) combines the effect of sentence on crime ESC and the effect of imprisonment on crime EIC. ESC will be discussed later.

\[
EDC, K = (EIC, K)(ESC, K) \\
EDC = 1
\]

- EFFECT OF DETERRENCE ON CRIME (DIMENSIONLESS)
- EFFECT OF IMPRISONMENT ON CRIME (DIMENSIONLESS)
- EFFECT OF SENTENCE ON CRIME (DIMENSIONLESS)

The effect of imprisonment on crime EIC (Equation 8) incorporates the influence of the risk of imprisonment on individuals' decisions to commit crimes. The measure of the risk is the perceived imprisonment ratio PIR (Equation 9). PIR is the ratio of perceived offenders imprisoned to perceived crime, divided by the initial value of that ratio. The practice of dividing a variable by its initial value is called normalizing. Normalizing eases the task of establishing functional relations between variables and of initializing the model in equilibrium. By normalizing, the variable starts with a value of one and will vary about one, instead of an initially unknown value which will depend on other variables in the model.

Equation 8 uses the function TABLE to compute EIC. This function permits the modeler to specify an arbitrary continuous functional relation between two variables as a series of line segments. The TABLE function uses a table statement like Equation 8.1 to specify the relation. The details of the function need not be explained here,
**Figure 2-3:** Relation Between the Perceived Imprisonment Ratio and the Effect of Imprisonment on Crime
since any relation using a TABLE function will be depicted graphically. The DYNAMO II User's Manual describes how to use this function.

\[
\begin{align*}
\text{EIC.K} &= \text{TABLE}(\text{EICT}, 1.44 \times \ln(\text{PIR.K}), -2, 2, 0.5) & 8, A \\
\text{EICT} &= 3.20/3.00/2.50/1.60/1.00/0.64/0.40/0.24/0.15 & 8.1, T \\
\text{EIC} & \quad \text{EFFECT OF IMPRISONMENT ON CRIME} \\
& \quad \text{(DIMENSIONLESS)} \\
\text{TABLE} & \quad \text{TABLE LOOK-UP FUNCTION} \\
\text{EICT} & \quad \text{EFFECT OF IMPRISONMENT ON CRIME TABLE} \\
\text{LOGN} & \quad \text{NATURAL LOGARITHM FUNCTION} \\
\text{PIR} & \quad \text{PERCEIVED IMPRISONMENT RATIO} \\
& \quad \text{(DIMENSIONLESS)} \\
\text{PIR.K} &= (\text{POI.K}/\text{PCRIM.K})/\text{NIF} & 9, A \\
\text{'NIF'} &= (\text{NOI}+\text{XOI})/\text{CRIME} & 9.1, A \\
\text{PIR} & \quad \text{PERCEIVED IMPRISONMENT RATIO} \\
& \quad \text{(DIMENSIONLESS)} \\
\text{POI} & \quad \text{PERCEIVED OFFENDERS IMPRISONED (PERSONS/Month)} \\
\text{PCRIM} & \quad \text{PERCEIVED CRIME (CASES/Month)} \\
\text{NIF} & \quad \text{NORMAL IMPRISONMENT FRACTION (PERSONS/CASE)} \\
\text{NOI} & \quad \text{NEW OFFENDERS IMPRISONED (PERSONS/Month)} \\
\text{XOI} & \quad \text{EX-OFFENDERS IMPRISONED (PERSONS/Month)} \\
\text{CRIME} & \quad \text{CRIMES (CASES/Month)}
\end{align*}
\]

Figure 2-3 depicts three possible relations between PIR and EIC. The linear relations A and B will be used to display the behavior of individual feedback loops. The non-linear relation C is the one used when simulating the entire model as well as when performing individual loop tests. Decreasing monotonically, all three relations reflect the assumption that a decline in the perceived imprisonment ratio causes an increase in crime. The scales for the variables are logarithmic, so that equal percentage changes in the variables are represented by equal distances on the graph.
TABLE 2-1

SLOPES OF THE RELATIONS BETWEEN THE PERCEIVED IMPRISONMENT RATIO AND THE EFFECT OF IMPRISONMENT ON CRIME AND BETWEEN THE PERCEIVED AVERAGE EFFECTIVE SENTENCE RATIO AND THE EFFECT OF SENTENCE ON CRIME AS SUGGESTED BY EHRLICH'S ESTIMATES

<table>
<thead>
<tr>
<th>Type of Crime</th>
<th>EIC</th>
<th>ESC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robbery</td>
<td>-1.303</td>
<td>-0.372</td>
</tr>
<tr>
<td>Burglary</td>
<td>-0.724</td>
<td>-1.127</td>
</tr>
<tr>
<td>Larceny</td>
<td>-0.371</td>
<td>-0.602</td>
</tr>
<tr>
<td>Auto Theft</td>
<td>-0.407</td>
<td>-0.246</td>
</tr>
<tr>
<td>Larceny and Auto Theft</td>
<td>-0.546</td>
<td>-0.626</td>
</tr>
<tr>
<td>Property Crimes</td>
<td>-0.796</td>
<td>-0.915</td>
</tr>
<tr>
<td>Murder</td>
<td>-0.852</td>
<td>-0.087</td>
</tr>
<tr>
<td>Rape</td>
<td>-0.896</td>
<td>-0.399</td>
</tr>
<tr>
<td>Murder and Rape</td>
<td>-0.828</td>
<td>-0.350</td>
</tr>
<tr>
<td>Assault</td>
<td>-0.724</td>
<td>-0.979</td>
</tr>
<tr>
<td>Crimes against Persons</td>
<td>-0.803</td>
<td>-0.495</td>
</tr>
<tr>
<td>All Offenses</td>
<td>-0.991</td>
<td>-1.123</td>
</tr>
</tbody>
</table>


Note: Slopes are two-stage least-square estimates based on 1960 cross-sectional data for states.
Using logarithmic scales has a second advantage. The slopes of the linear relations correspond to the parameters estimated by Ehrlich. The correspondence is not exact because Ehrlich's measure of the probability of prison is the ratio of imprisonments to offenses known to the police, while PIR is the ratio of imprisonments to total crimes. Moreover, Ehrlich uses data from various states, while the model refers to a single state. However, Ehrlich's estimates do provide a reference for comparing assumptions. Table 2-1 lists some of Ehrlich's estimates. Depending on the type of crime, the estimates range from -0.371 to -1.303. The estimate for all index crimes is -0.991. In Figure 2-3 Relation A has a slope of -1.2, on the high end of the range of Ehrlich's estimates, Relation B has a slope of -0.75, and the slope of Relation C ranges from -1.36 to nearly level.

Perceived crime PCRIM (Equation 10) is an average of past values of CRIME. Equation 10 computes the exponential average of CRIME. This average is similar to a moving average. Forrester discusses why an equation like Equation 10 computes an average. The averaging results in a delayed value of crime. The potential offender does not know the instantaneous flow of crimes. He has a notion of how many crimes are committed through his contact with the street life or acquaintances. The perception is built up over time from observations and contacts. The perception is, therefore, a delayed and somewhat smoothed value of the instantaneous flow of crimes.
Similarly, Equation 11 computes an exponential average of the number of offenders imprisoned each month. The potential offender's perception of the flow of defendants imprisoned is likely to be distorted in the same way as his perception of the flow of crimes.

\[ \text{PCRIM} = \text{PCRIM} + (\text{DT} / \text{DPT}) \times (\text{CRIME} - \text{PCRIM}) \]

\[ \text{PCRIM} = \text{PCRIM} \quad \text{DT} = \text{INTEGRATION INTERVAL (MONTHS)} \]
\[ \text{DPT} = \text{DETERRENCE PERCEPTION TIME (MONTHS)} \]
\[ \text{CRIME} = \text{CRIMES (CASES/MONTH)} \]

\[ \text{POI} = \text{POI} + (\text{DT} / \text{DPT}) \times (\text{TOI} - \text{POI}) \]

\[ \text{POI} = \text{POI} \quad \text{DT} = \text{INTEGRATION INTERVAL (MONTHS)} \]
\[ \text{DPT} = \text{DETERRENCE PERCEPTION TIME (MONTHS)} \]
\[ \text{TOI} = \text{TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)} \]

The variables presented so far form two important feedback loops. Loop 1 (Figure 2-2) is a positive feedback loop relating crimes, perceived crimes, and the perceived imprisonment ratio. Loop 1 is positive because an increase in crimes, by increasing perceived crimes and reducing the perceived imprisonment ratio, produces further increases in crime. Loop 2 (Figure 2-2) is contained completely within the averaging equation for perceived crimes. Loop 2 is goal-seeking. It tends to change perceived crime so that it equals crimes. Goal-seeking loops are called negative feedback loops.

The behavior of a positive and a negative loop combined as in Figure 2-2 depends on which loop dominates, which, in turn, depends
Figure 2-4: Simulation of Loops 1 and 2: Exponential Growth

Figure 2-5: Simulation of Loops 1 and 2: Equilibrium
on the relationships among variables in the loops.

Figure 2-4 depicts the behavior of Loops 1 and 2 when Relation A (Figure 2-3) between PIR and EIC is used. Relation A has a slope of -1.2. In this simulation, as in the next two, perceived offenders, ex-offenders, and the effect of sentence on crime are held constant. A twenty percent step increase in TEST initiates the behavior. The graph depicts the exponential growth in crimes characteristic of Loop 1. An increase in crime causes further increases of greater and greater magnitude. Perceived crime lags behind crime, behavior characteristic of the averaging process used to compute perceived crime.

Figure 2-5 depicts a second simulation of Loops 1 and 2, with relation B (Figure 2-3) substituted for Relation A. Relation B has a slope of -0.75. Unlike the previous simulation, this simulation is dominated by the negative loop. Crimes and perceived crime no longer grow exponentially, but instead rise to an equilibrium.

These two simulations depict the importance of the slope of the EIC relation. When the absolute value of the slope is greater than one, the positive loop dominates, tending to lead to exponential growth in crime. When the absolute value of the slope is less than one, crime rises to an equilibrium. When exactly one, crime increases linearly. In each of these cases, the feedback structure in Figure 2-2 amplified the initial increase in crime. Even when crimes taper off into equilibrium, the final increase in crime is larger than the initial change caused by TEST.
Figure 2-6: Simulation of Loops 1 and 2: Sigmoidal Growth

Figure 2-7: Simulation of Case Processing Equations
Figure 2-6 depicts a third simulation of Loops 1 and 2 in which Relation C (Figure 2-3) is used. Initially, Loop 1 operates in a range where the slope of Relation C is -1.36. As crime grows, the loop moves into a range where the absolute value of the slope is less than one. The behavior mode changes from exponential growth to equilibrium seeking. The non-linearity in Relation C can cause the dominance of the loops to shift.

In simulations involving the entire model, Relation C will be used. Some sort of non-linear formulation seems more realistic than a linear one. For instance, if the state pursued a policy of imprisoning no one, the crime rate would not increase without bound, as implied by the linear relation. At some point, the reduction in the probability of prison would cease to have an effect on crime. A leveling off in the EIC relation seems appropriate.

Case Processing. In the previous simulations, the number of offenders imprisoned per month was held constant. A complete model must contain structures for determining how the number of offenders imprisoned changes with variations in crime. The next set of equations deals with part of that structure, the processing of cases through the police and courts. For simplicity, I have aggregated the police and courts together. Later chapters deal with these agencies separately.

As cases proceed through the police and courts, they are weeded out of the system until relatively few cases result in the offender going to prison. The basic assumption underlying the equations
describing the criminal justice system is that the fraction of cases resulting in imprisonment depends on how overloaded the system becomes. As the system becomes increasingly overloaded, a smaller and smaller percent of cases results in imprisonment.

Figure 2-8 depicts the flow diagram of the case processing equations. The criminal justice backlog CJB (Equation 1?) is the aggregate of cases awaiting processing by the police and courts. Crimes reported to the police increase the backlog and cases adjudged and dismissed deplete the backlog.

\[
\begin{align*}
CJB.K &= CJB.J + (DT)(CRRPT.JK - CADJ.J) \\
CJB &= (ICJDL)(CJCAP) \\
ICJDL &= 5
\end{align*}
\]

**CJB** - CRIMINAL JUSTICE BACKLOG (CASES)
**DT** - INTEGRATION INTERVAL (MONTHS)
**CRRPT** - CRIMES REPORTED (CASES/MONTH)
**CADJ** - CASES ADJUDGED AND DISMISSED (CASES/MONTH)
**ICJDL** - INITIAL CRIMINAL JUSTICE DELAY (MONTHS)
**CJCAP** - CRIMINAL JUSTICE CAPACITY (CASES/MONTH)

Only a fraction of all crimes are reported to the police. Therefore, in Equation 13 crimes reported CRRPT equals crimes times the fraction of crimes reported FCR. This fraction is assumed to depend on how overloaded the system is.

\[
CRRPT.KL = (CRIME.K)(FCR.K)
\]
Figure 2-9: Relation Between Workload and the Fraction of Crimes Reported

Figure 2-10: Relation Between Workload and the Capacity Utilization Factor
Figure 2-9 depicts the relation between workload WL (Equation 15) and the fraction of crimes reported FCR (Equation 14). The workload WL is the ratio of the criminal justice backlog to the criminal justice capacity normalized by the initial criminal justice delay. Workload measures the number of cases the system must handle relative to the resources of the police and courts. As the workload grows, the police are assumed to be increasingly incapable of devoting time to people's complaints. Perceiving the police as overburdened and unresponsive, citizens are assumed to report a smaller fraction of cases than when the workload is light.

\[
\begin{align*}
FCR.K &= \text{TABLE(FCRT, WL.K, 0.5, 1)} & 14, A \\
FCRT &= 0.70/0.50/0.40/0.32/0.27/0.25 & 14.1, T \\
FCR &= \text{- FRACTION OF CRIMES REPORTED (DIMENSIONLESS)} \\
\text{TABLE} &= \text{- TABLE LOOK-UP FUNCTION} \\
\text{FCRT} &= \text{- FRACTION OF CRIMES REPORTED TABLE} \\
WL &= \text{- WORKLOAD (DIMENSIONLESS)} \\
WL.K &= (\text{CJB.K}/\text{CJCAP.K})/\text{ICJDL} & 15, A \\
\text{CJB} &= \text{- WORKLOAD (DIMENSIONLESS)} \\
\text{CJB} &= \text{- CRIMINAL JUSTICE BACKLOG (CASES)} \\
\text{CJCAP} &= \text{- CRIMINAL JUSTICE CAPACITY (CASES/MONTH)} \\
\text{ICJDL} &= \text{- INITIAL CRIMINAL JUSTICE DELAY (MONTHS)}
\end{align*}
\]

The workload also affects the cases adjudged and dismissed CADJ (Equation 16). CADJ is the flow of cases either dismissed by the police or processed by the courts. CADJ is the product of the criminal justice capacity and the capacity utilization factor.
The criminal justice capacity CJCAP is the number of cases that the system can process in a month when the workload is normal (equal to one). The capacity utilization factor CUF (Equation 20) measures the intensiveness with which capacity is utilized. Figure 2-10 depicts the relation between workload and the capacity utilization factor. As the workload rises, officials in the criminal justice system are under pressure to work longer hours to reduce the backlog. The police may work overtime and judges may sit more days out of the year. In addition, cases may receive less attention on the average. The police may dismiss the less important cases and prosecutors may negotiate more guilty pleas rather than let cases go to trial. If the workload drops below normal, capacity is used less intensively. Police may spend more time on each case, and prosecutors may be more demanding in plea negotiations, resulting in more cases going to trial. At the limit, if workload is zero, then no cases can be processed and utilization becomes zero.
The variables depicted in Figure 2-8 form two negative feedback loops, Loops 3 and 4. Figure 2-7 depicts the simulation of these loops in response to a step increase in crime with the criminal justice capacity held constant. The increase in crime causes an initial jump in crimes reported. The backlog begins to swell. With an increasing workload, the fraction of crimes reported starts dropping, resulting in a decline in crimes reported. Thus Loop 3 acts to decrease crimes reported until it equals the flow of cases adjudged and dismissed.

At the same time, the increasing workload raises the capacity utilization factor, thereby increasing the cases adjudged and dismissed. Thus Loop 4 acts to increase cases adjudged and dismissed until the flow equals crimes reported.

When the flow of crimes reported equals cases adjudged and dismissed, the backlog ceases to grow and the system attains a new equilibrium, differing in a number of ways from the original equilibrium. Backlog and workload are higher. Indeed, the pressure from the higher backlog in the model is necessary to reduce the fraction of crimes reported and increase the capacity utilization factor, so that the backlog remains in equilibrium. The case delay, \(16\) or the average time for a case to work its way through the backlog, is higher. The system is able to adjust to the increase in crime, but in several ways the resulting equilibrium is unsatisfactory. A smaller fraction of crimes is reported, the workload is higher, and the delay is longer.
Figure 2-11: Flow Diagram of Capacity Acquisition
Capacity Acquisition. A high workload increases the pressures for more capacity. In this model, criminal justice capacity CJCAP (Equation 18) is an aggregate of police and court resources. CJCAP has units of cases per month, since resources are expressed in terms of the normal number of cases the system can handle. Figure 2-11 depicts the flow diagram of the feedback loops that relate workload to capacity acquisition.

\[
\text{CJCAP} = \text{CJCAP} \cdot (\text{DT}) \cdot (\text{CAPAC} \cdot (\text{CRIME}) \cdot (\text{TABLE} \cdot (\text{FCRT}, 1051)))
\]

CJCAP - CRIMINAL JUSTICE CAPACITY (CASES/MONTH)
DT - INTEGRATION INTERVAL (MONTHS)
CAPAC - CAPACITY ACQUISITION (CASES/MONTH-MONTH)
CRIME - CRIMES (CASES/MONTH)
TABLE - TABLE LOOK-UP FUNCTION
FCRT - FRACTION OF CRIMES REPORTED TABLE

Capacity acquisition CAPAC (Equation 19) depends on current capacity, the pressure to acquire capacity PACAP (Equation 20), and the capacity adjustment time CAT. CAT is a constant which can be changed from one simulation to another to test the effects of speeding up and slowing down the acquisition of capacity. The larger CAT, the slower capacity is acquired.

\[
\text{CAPAC} = \frac{(\text{CJCAP} \cdot (\text{PACAP} \cdot (\text{K} - 1)))}{\text{CAT}}
\]

CAPAC - CAPACITY ACQUISITION (CASES/MONTH-MONTH)
CJCAP - CRIMINAL JUSTICE CAPACITY (CASES/MONTH)
PACAP - PRESSURE TO ACQUIRE CAPACITY (DIMENSIONLESS)
CAT - CAPACITY ADJUSTMENT TIME (MONTHS)
Figure 2-12: Relation Between Relative Workload and the Pressure to Acquire Capacity
The pressure to acquire capacity PACAP (Equation 20) represents the pressures from high workload to increase the resources of the police and courts. However, PACAP depends on the relative workload instead of directly on workload. The relative workload RWL (Equation 21), or the ratio of workload to the workload standard, measures the size of the workload relative to what officials and the legislature consider normal. Figure 2-12 depicts the relation between the relative workload and the pressure to acquire capacity. Figure 2-12 uses logarithmic scales to show the effect of percentage changes in RWL. When RWL is greater than one (workload exceeds workload standards), PACAP is equal to RWL. However, if RWL drops below one, PACAP drops off much less slowly. When PACAP is less than one, capacity acquisition is negative and capacity declines. A value of PACAP less than one indicates pressures to reduce resources because the workload is lower than normal. The non-linearity in Figure 2-12 reflects the assumption that the criminal justice system is more willing to expand manpower than to reduce it.

\[
PACAP.K = TABLE(PACAPT, 1.44\times \log(RWL.K), -2, 2, 1)\]
\[
PACAPT = 0.65/0.80/1.00/2.00/4.00\]

- PACAP - PRESSURE TO ACQUIRE CAPACITY (DIMENSIONLESS)
- TABLE - TABLE LOOK-UP FUNCTION
- PACAPT - PRESSURE TO ACQUIRE CAPACITY TABLE
- LOGN - NATURAL LOGARITHM FUNCTION
- RWL - RELATIVE WORKLOAD (DIMENSIONLESS)

\[
RWL.K = WL.K / WLS.K\]

- RWL - RELATIVE WORKLOAD (DIMENSIONLESS)
- WL - WORKLOAD (DIMENSIONLESS)
- WLS - WORKLOAD STANDARD (DIMENSIONLESS)
The workload standard WLS (Equation 22) is the workload which the police, court officials, and legislators feel is tolerable. These people may not all agree on what is desirable, but, on the average, organizational demands and political pressures are assumed to balance to create a standard or reference point. As long as the workload remains at that standard, there is no action to change capacity.

The workload standard is a level affected by the change in workload standard CWLS (Equation 23). CWLS depends on the relative workload and the standard adjustment time SAT. When the relative workload is above one, CWLS is positive, causing the workload standard to rise. The rate of change depends on SAT. If SAT is large, the standard adjusts slowly. If SAT is small, the standard adjusts quickly.

\[
\text{WLS}_K = \text{WLS}_J + (\text{DT})(\text{CWLS}_J K) \\
\text{WLS}_1 \text{ SAT} = 120
\]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLS</td>
<td>Workload Standard (Dimensionless)</td>
<td></td>
</tr>
<tr>
<td>DT</td>
<td>Integration Interval (Months)</td>
<td></td>
</tr>
<tr>
<td>CWLS</td>
<td>Change in Workload Standard (1/Month)</td>
<td></td>
</tr>
<tr>
<td>CWLS</td>
<td>Change in Workload Standard (1/Month)</td>
<td></td>
</tr>
<tr>
<td>WLS</td>
<td>Workload Standard (Dimensionless)</td>
<td></td>
</tr>
<tr>
<td>RWL</td>
<td>Relative Workload (Dimensionless)</td>
<td></td>
</tr>
<tr>
<td>SAT</td>
<td>Standard Adjustment Time (Months)</td>
<td></td>
</tr>
</tbody>
</table>

Three feedback loops regulate capacity, the workload, and the workload standard. Loop 5 (Figure 2-11) tries to maintain the workload equal to the workload standard. If workload rises above the standard, the pressure to acquire capacity rises and criminal justice
Figure 2-13: Simulation of Capacity Acquisition

Figure 2-14: Simulation of Case Processing and Capacity Acquisition
capacity increases, thereby reducing the workload. Loop 6 also tries to bring the workload in line with the standard. As workload rises, new capacity is added, increasing the flow of cases adjudged and reducing the backlog. A declining backlog results in a lower workload. The standard itself is imbedded in Loop 7. This loop tries to bring the workload standard into line with the workload. An increase in RWL increases CWLS and, in turn, the workload standard.

Figure 2-13 depicts a simulation of the capacity acquisition equations. This simulation was created using a forty percent increase in crime. Loops 3 and 4 were incapacitated, so that crimes reported are always a constant fraction of crimes, and cases adjudged and dismissed equal criminal justice capacity.

The most marked characteristic of this simulation is the oscillations in capacity, workload, and other variables. The capacity acquisition policies are structured so that the system must oscillate under these conditions. The increase in crimes and crimes reported causes the backlog and workload to increase. The relative workload (not shown) rises above one and new capacity is acquired, thereby increasing the flow of cases adjudged and dismissed (Loops 5 and 6 at work). At about 65 months, capacity equals crimes reported and backlog levels off. However, workload is still above the workload standard. Capacity must expand further to draw down the backlog as well as keep pace with new cases. As capacity continues to increase, the backlog and workload decline further. At 108 months workload equals the workload standard and capacity acquisition stops. But capacity is greater than
crimes reported, causing the backlog to continue to decline. Workload drops below workload standard, producing a decline in capacity. When capacity drops below crimes reported, backlog starts to increase again. Then workload climbs above the workload standard and the process starts over again. The amplitude of each swing is less than that of the previous swing. After a while, the system settles into an equilibrium (not shown in this simulation).

The simulation in Figure 2-13 also shows how variations in workload affect the workload standard. As the workload rises above the standard, pressures build to increase the standard. Although the standard adjusts to workload, it oscillates with a smaller amplitude.

Strong fluctuations in capacity like those in Figure 2-13 are unlikely to occur in an actual criminal justice system. The feedback loops in the system tend to eliminate them. Figure 2-14 depicts a simulation similar to the previous one except that Loops 3 and 4 (Figure 2-8) are allowed to operate. Instead of oscillating, capacity grows and then levels off. The simulation exhibits a feature of feedback systems: the addition of negative feedback loops can eliminate oscillations. In Figure 2-14 the increase in workload following the step increase in crime causes the capacity utilization factor (not shown) to rise above one. Cases adjudged and dismissed rise faster than capacity. At the same time, the workload reduces the fraction of crimes reported (not shown), so that crimes reported drop after an initial jump. By 48 months cases adjudged and dismissed and crimes reported nearly equal each other. Backlog levels out.
Since workload still lies above workload standard, capacity continues to expand, causing the workload to drop. As it declines, capacity utilization declines and the fraction of crimes reported increases. Thus, the crimes reported and cases adjudged rise. But the increase in the cases adjudged is less than indicated by the increase in capacity, because the decline in capacity utilization partially compensates for the increase in capacity. Throughout the simulation capacity never exceeds crimes reported. This feature is why Loops 3 and 4 eliminate the oscillations in capacity. They permit the workload to be drawn down without capacity expanding above its final equilibrium value.

**Sentencing.** To expand capacity utilization, the police and courts must pay a price in terms of the severity of sentence imposed on convicted offenders. The police and courts may increase the fraction of cases dismissed (or not prosecuted), or the courts may impose lighter sentences and grant more probations.

The total offenders imprisoned TOI (Equation 24) are the total new and ex-offenders sentenced to prison. TOI depends on the cases adjudged and dismissed and the fraction of defendants imprisoned.

\[
\text{TOI}_K = \frac{\text{CADJ}_K}{\text{CPS}} \times \frac{\text{FDI}_K}{24, A} \\
\text{CPS}=1 \quad 24.1, \ C \\
\text{TOI} \quad - \text{TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)} \\
\text{CADJ} \quad - \text{CASES ADJUDGED AND DISMISSED (CASES/MONTH)} \\
\text{CPS} \quad - \text{CASES PER SUSPECT (CASES/PERSON)}
\]
Figure 2-15: Relation Between Workload and the Pressure on Imprisonment from Workload

Figure 2-16: Relation Between Workload and the Pressure on Sentence from Workload
Equation 25 computes the fraction of defendants imprisoned FDI. FDI is the product of two terms, the normal fraction of defendants imprisoned NFDI and the pressure on imprisonment from workload PIW (Equation 26). NFDI, a constant, is defined as the fraction of all cases processes through the police and courts resulting in a defendant being imprisoned, when the workload is normal.

\[
\text{FDI.K} = (\text{NFDI})(\text{PIW.K})
\]

\[
\text{NFDI} = .05
\]

NFDI - NORMAL FRACTION OF DEFENDANTS IMPRISONED (DIMENSIONLESS)

PIW - PRESSURE ON IMPRISONMENT FROM WORKLOAD (DIMENSIONLESS)

25, A

25.1, C

The pressure on imprisonment from workload PIW (Equation 26) represents the influence of workload on imprisonment. Figure 2-15 depicts the relation assumed in the model. As the workload increases, PIW decreases, causing the fraction of defendants imprisoned to decline.

\[
\text{PIW.K} = \text{TABLE(PIWT, WL.K, 0, 5, 1)}
\]

\[
\text{PIWT} = 1.30/1.00/0.80/0.60/0.50/0.40
\]

PIW - PRESSURE ON IMPRISONMENT FROM WORKLOAD (DIMENSIONLESS)

TABLE - TABLE LOOK-UP FUNCTION

PIWT - PRESSURE ON IMPRISONMENT FROM WORKLOAD TABLE

WL - WORKLOAD (DIMENSIONLESS)

26, A

26.1, T

The court-imposed sentence CIS (Equation 27) is the average sentence imposed on convicted defendants who receive prison sentences.
In Massachusetts, as in other states, the defendant may receive a range of time, for example, three to five years. In this case, the court-imposed sentence can be defined as the minimum of the range. **CIS is the product of three terms.** The first is the normal court-imposed sentence. It is a constant, defined as the court-imposed sentence when the workload is normal. The third term includes a step function to increase the court-imposed sentence as a policy test. The second term is the pressure of sentence on workload.

\[
CIS\cdot K = (\text{NCIS}) (\text{PSW} \cdot K) (1 + \text{STEP}(\text{ACS}, \text{SSW}))
\]

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIS</td>
<td>COURT-IMPPOSED SENTENCE (MONTHS)</td>
</tr>
<tr>
<td>NCIS</td>
<td>NORMAL COURT-IMPOSED SENTENCE (MONTHS)</td>
</tr>
<tr>
<td>PSW</td>
<td>PRESSURE ON SENTENCE FROM WORKLOAD (DIMENSIONLESS)</td>
</tr>
<tr>
<td>STEP</td>
<td>STEP FUNCTION</td>
</tr>
<tr>
<td>ACS</td>
<td>ADDITION TO COURT-IMPOSED SENTENCE (DIMENSIONLESS)</td>
</tr>
<tr>
<td>SSW</td>
<td>SENTENCE SWITCH (MONTHS)</td>
</tr>
</tbody>
</table>

The pressure of sentence on workload PSW (Equation 28) represents the effect of workload on the length of the court-imposed sentence. Figure 2-16 depicts the assumed relation. As workload increases, PSW decreases, resulting in reduced sentence. Similarly, as workload decreases, PSW and the sentence increase. The plea negotiation process which could produce this relation is examined in more detail in the next chapter.
Figure 2-17: Causal Loop Diagram of Loops 1 and 8
Interaction of Crime and Imprisonment Ratio. The model structure discussed so far forms two major feedback loops, depicted in Figure 2-17. Loop 1 is the same as in Figure 2-2. It is a positive loop relating crimes, perceived crime, and the perceived imprisonment ratio. Loop 8 in Figure 2-17 is a negative loop relating crime, total offenders imprisoned, and the imprisonment ratio. Imbedded within Loop 8 are the case processing, sentencing, and capacity acquisition equations. For analysis, these equations form the police-court subsystem with one input, crimes, and one output, total offenders imprisoned. The rectangle with cross-hatchings in Figure 2-17 represents this subsystem.

Before looking at the behavior of Loops 1 and 8 combined, it is useful to test the behavior of the police-court subsystem. Figure 2-18 shows two such tests. In the simulations, the subsystem is subjected to a fifty percent step increase in crime. The graphs depict the behavior of crimes, perceived crimes, total offenders imprisoned, and perceived offenders imprisoned. The scales of the graphs are set so that when the line depicting crimes overlaps the line depicting total offenders imprisoned, the fraction of crimes resulting in the offenders being imprisoned equals the initial value of this fraction.
Figure 2-18: Simulations of Police-Court Subsystem
Also, when the line depicting perceived crimes overlaps the line depicting perceived offenders imprisoned, the perceived imprisonment ratio is one.

Of particular interest in these tests is how fast total offenders imprisoned increase in response to the step increase in crimes and whether a gap develops between the lines depicting crimes and total offenders imprisoned. If the increase in total offenders imprisoned is slow, the perceived imprisonment ratio can drop further than if the increase were faster. Later on in the chapter, this type of test will be used to evaluate policies in the police and courts. Many policies will affect the speed of response and, therefore, the ability of the police and courts to maintain deterrence. The presence of a gap between crimes and total offenders imprisoned when the system reaches equilibrium indicates an inability of the subsystem to regain its previous deterrent value following an increase in crime.

Graph A in Figure 2-18 depicts a simulation of the subsystem when the workload standard remains fixed. The step increase in crimes causes a rise in total offenders imprisoned. After approximately 240 months, total offenders imprisoned has risen high enough so that the perceived imprisonment ratio returns to one. There is no gap between total offenders imprisoned and crimes, but the response of the subsystem is slower than might be expected.

Graph B depicts a simulation of the subsystem when the workload standard varies. The step increase in crimes again causes a rise
**Figure 2-19:** Simulation of Loops 1 and 8: Fixed Standards

**Figure 2-20:** Simulation of Loops 1 and 8: Variable Standards
in total offenders imprisoned. But the rise is less than in the previous simulation and an equilibrium gap exists.

The gap shows one affect of the variation in standards. In Graph A, the fixed standards create the pressures for building up capacity until the original fraction of crimes resulting in imprisonment is attained. With variable standards, part of the pressure for more capacity is shut off by the rising standard. The criminal justice system becomes tolerant of the higher workload, and, consequently, of plea bargaining and a lower fraction of crimes reported.

The combination of Loops 1 and 8 (Figure 2-17) produces a system consisting of a positive loop which amplifies changes in crime and a negative loop which adjusts the total offenders imprisoned in response to an increase in crime. The next two simulations show how these loops interact.

Figure 2-19 depicts a simulation of the two loops with a fixed workload standard. A fifty percent step increase in the test input initiates the behavior. During the first sixty months, Loop 1 produces exponential growth in crimes. At month 60 the perceived imprisonment ratio declines below 0.5, so that Loop 1 is operating in a flatter portion of the EIC relation (Relation C, Figure 2-3). The growth in crime begins to slow. At the same time, the total offenders imprisoned is increasing faster than before. By month 72, perceived offenders imprisoned is rising faster than perceived crimes, so that the perceived imprisonment ratio reverses direction. Now, the amplification in Loop 1 works in reverse. The initial decline in crimes
is amplified producing further declines. After 120 months, crimes begin to drift into equilibrium.

Figure 2-20 depicts the same situation except that the workload standard is allowed to vary. Conceivably, since the variable standard permits an equilibrium gap to occur in the tests of the police-court subsystem, the variable standard might prevent the decline in crime seen in the previous simulation. In fact, it does not. The variable standard does lengthen the period of response and results in a higher peak in crimes, but the behavior is otherwise similar to the previous run.

**Corrections.** The corrections section of the model traces the flow of offenders through prison to ex-offender status and back into prison. Disaggregating the population into prisoners, ex-offenders, and potential new offenders has two purposes. First, prison restrains some potential offenders, thereby preventing some crime. (For the purposes of this model, I ignore crimes within prison.) Second, the prison experience is assumed to reinforce the criminal tendencies of offenders once they are released.

Does the experience of incarceration (as opposed to the threat of incarceration) reinforce the criminal tendencies of offenders? Like the impact of sanctions on crime, the impact of incarceration is a debated issue.

Several mechanisms can be proposed to explain why prison might reinforce criminal tendencies. First, prison can be a school for crime, where offenders acquire criminal skills from each other.
Second, prison can stigmatize the offender, so that, upon release, he may find employers reluctant to hire him. Third, prison can be generally debilitating to the offender's mental abilities and ambitions. The offender may lose touch with the outside world, and, therefore, face a difficult adjustment when released. Due to any of these mechanisms, legitimate employment becomes more difficult to obtain and crime becomes more attractive.

While these hypotheses seem plausible, demonstrating their effect with data has proven difficult. Studies of recidivism among probationers and ex-prisoners seem at first glance to demonstrate the effect. Levin, in a review of several studies comparing recidivism among offenders who received probation and those who had been incarcerated, notes that probationers have significantly lower rates of recidivism. However, these results do not demonstrate that prison produces the higher recidivism rate. Judges may place on probation those offenders who appear least likely to commit further crimes. The results may reflect the effect of judicial selection more than the effects of prison. Martinson has reviewed several studies comparing imprisonment to probation and other non-institutional correctional programs. Noting that most of these studies have flaws, Martinson concludes, "These [studies] provide some slight evidence that, at least under some circumstances, probation may make an offender's future chances better [that he not commit crimes] than if he had been sent to prison."
Figure 2-21: Flow Diagram of Corrections
In the model, ex-offenders are assumed to have a much higher crime rate normal than potential new offenders. Part of the difference arises from the categories themselves. Potential new offenders include the broad spectrum of the population, many of whom, like the elderly and the very young, have a negligible propensity to commit serious street crimes. Ex-offenders most often come from the population of adolescent and young-adult males, whose propensity for crime is higher than the average member of the entire population, independent of any effect of incarceration. The second reason for a higher propensity is to investigate the implications of the possible impact of prison on criminal tendencies. The assertion that incarceration does increase the criminal tendencies of offenders is used to argue against imprisonment. If the assertion is correct, then the criminal justice system faces a potential dilemma. If it places a larger fraction of offenders on probation, then it avoids the adverse effects of the prison experience, but it weakens deterrence. Which is more important, deterrence or the effects of incarceration? To give adequate attention to the impact of the prison experience, I have assumed a substantial effect.

Figure 2-21 depicts the flow of offenders in the corrections section. New offenders imprisoned NOI (Equation 29) and ex-offenders imprisoned XOI (Equation 30) depend on the total offenders imprisoned and the fraction of ex-offenders imprisoned.
NOI.KL=(TOI.K)(1-FXOI.K) \(29, \ R\)

NOI - NEW OFFENDERS IMPRISONED (PERSONS/MONTH)
TOI - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)
FXOI - FRACTION OF EX-OFFENDERS IMPRISONED
(DIMENSIONLESS)

XOI.KL=(TOI.K)(FXOI.K) \(30, \ R\)

XOI - EX-OFFENDERS IMPRISONED (PERSONS/MONTH)
TOI - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)
FXOI - FRACTION OF EX-OFFENDERS IMPRISONED
(DIMENSIONLESS)

The fraction of ex-offenders imprisoned FXOI (Equation 31) is the fraction of imprisoned offenders who have been imprisoned within the previous five years. FXOI equals the ratio of crimes by ex-offenders to total crimes. This assumption may be somewhat incorrect for two reasons. First, the defendant with a prison record is probably more likely to receive a sentence upon conviction than a new offender. Second, the ratio uses the current values of crimes and crimes by ex-offenders instead of the values when the offenders were arrested. Since the ratio does not change substantially in model simulations, the timing problem does not create much error. Equation 31 is used here for simplicity. The model described later uses a more realistic formulation.

FXOI.K=CRIXO.K/CRIME.K \(31, \ A\)

FXOI - FRACTION OF EX-OFFENDERS IMPRISONED
(DIMENSIONLESS)
CRIXO - CRIMES BY EX-OFFENDERS (CASES/MONTH)
CRIME - CRIMES (CASES/MONTH)
New and ex-offenders imprisoned enter the pool of prisoners. The equations governing prisoners and the release of prisoners are contained in the macro PROUT, discussed below. PROUT stands for prisoners out. The flow of released prisoners enters the pool of ex-offenders XO (Equation 32). Unless reimprisoned, the ex-offender will age out of ex-offender status in five years. Ex-offenders aging out XOA0 (Equation 33) accounts for this process.

\[
\begin{align*}
XO.K &= XO.J + (DT)(PRRL.JK - XOI.JK - XOA0.JK) \\
XO &= (NOI)(XOLT)
\end{align*}
\]

Members of the population who are neither ex-offenders or prisoners are defined as potential new offenders. The total population is set at five million people and is assumed constant.

\[
\begin{align*}
XOA0.KL &= XO.K / XOLT \\
XOLT &= 60
\end{align*}
\]

\[
\begin{align*}
PNO.K &= \text{POP} - (LTS)(XO.K + PRSN.K) \\
LTS &= 1 \\
POP &= 5000000
\end{align*}
\]
Prisons. Prison authorities have strong incentives to keep the prison population at approximately the prison capacity. Overcrowding can degrade security and create unrest among prisoners. It also leads to budgetary problems. An unforeseen rise in the prison population increases costs above those planned for in the budget.

The PROUT macro represents the assumptions about the regulation of the prison population. Like other DYNAMO macros, PROUT is invoked by using the macro in an equation. In this instance, the macro is used in the equation for prisoners released PRRL (Equation 35).

\[
PRRL.KL=PROUT(NOI.JK, XOI.JK, STIN.K, PRCAP.K, PRSN.K, AES.K, FPOC.K) \\
\text{PRL} - \text{PRISONERS RELEASED (PERSONS/MONTH)} \\
\text{PROUT} - \text{PRISONERS OUT (PERSONS/MONTH)} \\
\text{NOI} - \text{NEW OFFENDERS IMPRISONED (PERSONS/MONTH)} \\
\text{XOI} - \text{EX-OFFENDERS IMPRISONED (PERSONS/MONTH)} \\
\text{STIN} - \text{SENTENCE TIME IN (PERSON-MONTHS/MONTH)} \\
\text{PRCAP} - \text{PRISON CAPACITY (PERSONS)} \\
\text{PRSN} - \text{PRISONERS (PERSONS)} \\
\text{AES} - \text{AVERAGE EFFECTIVE SENTENCE (MONTHS)} \\
\text{FPOC} - \text{FRACTION OF PRISON OVERCAPACITY (DIMENSIONLESS)}
\]

The PROUT macro uses four inputs, new offenders imprisoned, ex-offenders imprisoned, sentence time in, and prison capacity. New offenders imprisoned and ex-offenders imprisoned have been discussed above. Sentence time in STIN (Equation 36) is the total man-months which the offenders currently being sentenced must serve, if they are to serve their full court-imposed sentence. STIN is, therefore, the total offenders imprisoned times the court-imposed sentence. As discussed later, STIN is used in computing the average
Figure 2-22: Flow Diagram of PROUT Macro
court-imposed sentence for prisoners. Prison capacity PRCAP (Equation 37) is the normal or planned capacity of correctional facilities.

Equation 37 permits prison capacity to increase at a specified time as a policy test. Unlike the criminal justice capacity, prison capacity is assumed to have no feedback loops regulating it.

\[ \text{STIN}_K = (\text{TOI}_K)(\text{CIS}_K) \]

\[ \text{STIN} \quad \text{SENTENCE TIME IN (PERSON-MONTHS/MONTH)} \]
\[ \text{TOI} \quad \text{TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)} \]
\[ \text{CIS} \quad \text{COURT IMPOSED SENTENCE (MONTHS)} \]

\[ \text{PRCAP}_K = (\text{IPRCAP})(1 + \text{STEP}(\text{APRCAP}, \text{PRSW})) \]

\[ \text{IPRCAP}=4000 \]
\[ \text{APRCAP}=0.5 \]
\[ \text{PRSW}=10000 \]

\[ \text{PRCAP} \quad \text{PRISON CAPACITY (PERSONS)} \]
\[ \text{IPRCAP} \quad \text{INITIAL PRISON CAPACITY (PERSONS)} \]
\[ \text{STEP} \quad \text{STEP FUNCTION} \]
\[ \text{APRCAP} \quad \text{ADDITION TO PRISON CAPACITY (DIMENSIONLESS)} \]
\[ \text{PRSW} \quad \text{PRISON SWITCH (MONTHS)} \]

The PROUT macro produces three variables as outputs, prisoners, the average affective sentence, and the fraction of prison overcapac- city. The macro itself returns a fourth output, much in the same way a function returns a value. PROUT equals the number of prisoners released each month.

Figure 2-22 depicts the structure of the PROUT macro. New and ex-offenders imprisoned feed the level of prisoner PRSN (Equation 1 in PROUT). Prisoners released or prisoners out depletes the level of prisoners.
PRSN.K=PRSN.J+(DT)(NOI.JK+XOI.JK-PROUT.J) 1, L  
PRSN=PRCAP 1.1, N  
PRSN - PRISONERS (PERSONS)  
DT - INTEGRATION INTERVAL (MONTHS)  
NOI - NEW OFFENDERS IMPRISONED (PERSONS/MONTH)  
XOI - EX-OFFENDERS IMPRISONED (PERSONS/MONTH)  
PROUT - PRISONERS OUT (PERSONS/MONTH)  
PRCAP - PRISON CAPACITY (PERSONS)  

Prisoners out PROUT (Equation 2 in PROUT) equals the number of prisoners divided by the average effective sentence AES.

PROUT.K=PRSN.K/AES.K 2, A  
PROUT - PRISONERS OUT (PERSONS/MONTH)  
PRSN - PRISONERS (PERSONS)  
AES - AVERAGE EFFECTIVE SENTENCE (MONTHS)  

The average effective sentence AES (Equation 3 in PROUT) is the average sentence actually served by offenders. It is the product of the average court-imposed sentence and the reduction in sentence through parole.

AES.K=($ACIS.K)($RSP.K) 3, A  
AES - AVERAGE EFFECTIVE SENTENCE (MONTHS)  
$ACIS - AVERAGE COURT IMPOSED SENTENCE (MONTHS)  
$RSP - REDUCTION IN SENTENCE THROUGH PAROLE (DIMENSIONLESS)  

The reduction in sentence through parole $RSP (Equation 4 in PROUT) represents the pressure on sentence arising from prison crowding. $RSP is the product of three factors, the normal reduction in sentence through parole, the effect of prison capacity on sentence,
and the sentence restrictions on parole.

\[
\$\text{RSP.k} = (\$\text{NRSP.k})(\$\text{EPCS.k})(\$\text{SRP.k})
\]

\[
\text{RSP} \quad \text{REDUCTION IN SENTENCE THROUGH PAROLE (DIMENSIONLESS)}
\]

\[
\text{NRSP} \quad \text{NORMAL REDUCTION IN SENTENCE THROUGH PAROLE (DIMENSIONLESS)}
\]

\[
\text{EPCS} \quad \text{EFFECT OF PRISON CAPACITY ON SENTENCE (DIMENSIONLESS)}
\]

\[
\text{SRP} \quad \text{SENTENCE RESTRICTION ON PAROLE (DIMENSIONLESS)}
\]

The normal reduction in sentence through parole \(\$\text{NRSP}\) (Equation 5 in \text{PROUT}) is the traditional reduction based on past experience. Equation 5 calculates \(\$\text{NRSP}\) by averaging past values of \(\$\text{RSP}\).

\[
\$\text{NRSP.k} = \$\text{NRSP.j} + (\text{DT}/\text{PRLAT})(\$\text{RSP.j} - \$\text{NRSP.j})
\]

\[
\$\text{NRSP} = \text{PRCAP}/\text{STIN}
\]

\[
\text{NRSP} \quad \text{NORMAL REDUCTION IN SENTENCE THROUGH PAROLE (DIMENSIONLESS)}
\]

\[
\text{DT} \quad \text{INTEGRATION INTERVAL (MONTHS)}
\]

\[
\text{PRLAT} \quad \text{PAROLE ADJUSTMENT TIME (MONTHS)}
\]

\[
\text{RSP} \quad \text{REDUCTION IN SENTENCE THROUGH PAROLE (DIMENSIONLESS)}
\]

\[
\text{PRCAP} \quad \text{PRISON CAPACITY (PERSONS)}
\]

\[
\text{STIN} \quad \text{SENTENCE TIME IN (PERSON-MONTHS/MONTH)}
\]

The effect of prison crowding on sentence \(\$\text{EPCS}\) (Equation 6 in \text{PROUT}) depends on the fraction of prison overcrowding \(\text{FPOC}\) (Equation 7 in \text{PROUT}). \(\text{FPOC}\) is the ratio of prisoners to prison capacity. Figure 2-23 depicts the relation between \(\text{FPOC}\) and \(\$\text{EPCS}\). As \(\text{FPOC}\) rises above one, \(\$\text{EPCS}\) drops below one, resulting in a reduction in the average effective sentence. As \(\text{FPOC}\) declines, \(\$\text{EPCS}\) rises slightly, reflecting a relaxation of pressures on parole.
Figure 2-23: Relation Between the Fraction of Prison Overcapacity and the Effect of Prison Capacity on Sentence.
Sentence restriction on parole $\$SRP$ (Equation 8 in PROUT) is the third factor affecting the reduction in sentence through parole. $\$SRP$ represents the legal restrictions on parole. In Massachusetts parole officials do not have complete discretion over sentences served. Generally, an offender sentenced to a state institution must serve at least one-third of his court-imposed sentence.\(^{19}\) Prison officials must also release offenders when their maximum sentence has expired. Therefore, regardless of prison capacity, sentences cannot be reduced or extended beyond a certain range.

Figure 2-24 depicts the relation between the normal reduction in sentence through parole and the sentence restriction on parole. As $\$NRSP$ increases beyond one, $\$SRP$ declines to zero, thereby restricting further increases in $\$RSP$, $\$NRSP$, and the average effective sentence. As $\$NRSP$ declines toward zero, $\$SRP$ increases, thereby preventing a decline in $\$RSP$, $\$NRSP$, and the average effective sentence. For values of $\$NRSP$ between 0.4 and 0.8, $\$SRP$ equals one and has no effect on $\$RSP$. 
Figure 2-24: Relation Between the Normal Reduction in Sentence Through Parole and the Sentence Restriction on Parole
$SRP.K$=TABLE($SRPT,SRP.K,0,1.2,0.2$) 8, A
$SRP$ - SENTENCE RESTRICTION ON PAROLE (DIMENSIONLESS)
TABLE - TABLE LOOK-UP FUNCTION
$SRPT$ - SENTENCE RESTRICTION ON PAROLE TABLE
$NRSP$ - NORMAL REDUCTION IN SENTENCE THROUGH PAROLE (DIMENSIONLESS)

The average court-imposed sentence $ACIS$ (Equation 9 in PROUT) is computed using the level $TST$ (Equation 10 in PROUT). This level accumulates the total man-months to be served by the current population of prisoners. The input to $TST$, the sentence time in STIN, is the court-imposed sentence times the total offenders imprisoned. The sentence time out $STOUT$ is the average court-imposed sentence that was given to those prisoners who are now being released. $ACIS$ is the total man-months to be served by prisoners $TST$ divided by the prison population PRSN.

$ACIS.K$=$TST.K/PRSN.K$ 9, A
$ACIS$ - AVERAGE COURT IMPOSED SENTENCE (MONTHS)
$TST$ - TOTAL SENTENCE TIME (PERSON-MONTHS)
PRSN - PRISONERS (PERSONS)

$TST.K$=$TST.J+(DT)\times(STIN.J-\$STOUT.JK)$ 10, L
$TST$ = TOTAL SENTENCE TIME (PERSON-MONTHS)
$DT$ - INTEGRATION INTERVAL (MONTHS)
STIN - SENTENCE TIME IN (PERSON-MONTHS/MONTH)
$STOUT$ - SENTENCE TIME OUT (PERSON-MONTHS/MONTH)
PRCAP - PRISON CAPACITY (PERSONS)
NOI - NEW OFFENDERS IMPRISONED (PERSONS/MONTH)
XOI - EX-OFFENDERS IMPRISONED (PERSONS/MONTH)

$STOUT.KL$=(PROUT.K)($ACIS.K$) 11, R
$STOUT$ - SENTENCE TIME OUT (PERSON-MONTHS/MONTH)
PROUT - PRISONERS OUT (PERSONS/MONTH)
$ACIS$ - AVERAGE COURT IMPOSED SENTENCE (MONTHS)
Figure 2-25: Simulation of PROUT Macro: Step Increase in Offenders Imprisoned

Figure 2-26: Simulation of PROUT Macro: Step Increase in Court-Imposed Sentence
The prison adjustment mechanisms in the PROUT macro contain several feedback loops, two of which are of particular interest. Loop 9 (Figure 2-22) controls the average effective sentence based on the fraction of prison overcapacity. Loop 10 (Figure 2-19) controls the prison population directly by increasing the flow of prisoners out of prison as the number of prisoners increases. The operation of these loops can be seen in a simulation of the PROUT macro.

Figure 2-25 depicts the behavior of PROUT when subjected to a step increase in new and ex-offenders. The court-imposed sentence is held constant. The increased flow of sentenced defendants causes the prison population to rise initially. Loop 10 causes the flow of prisoners released to increase. If Loop 9 were inoperative, prisoners released would rise to equal the flow of offenders into prison, and the prison population would settle into equilibrium. However, the equilibrium population would exceed prison capacity. To counteract the overcrowding, Loop 9 reduces the average effective sentence, causing the flow of prisoners released to rise above the inflow of offenders. The prison population declines until it equals the prison capacity, but the average effective sentence is lower than before.

Figure 2-26 depicts a second simulation of the PROUT macro in which the flow of offenders imprisoned is held constant, but there is a step increase in the court-imposed sentence. This increase produces a gradual increase in the average court-imposed sentence.
**Figure 2-27:** Relation Between the Perceived Average Effective Sentence Ratio and the Effect of Sentence on Crime
and an initial rise in the prison population and the average effective sentence. Prisoners in excess of capacity produce pressures for reducing the average effective sentence, so that by 75 months both the prison population and the average effective sentence have returned to their original values. Except during an adjustment period, increasing the court-imposed sentence does not, on the average, increase the actual sentence served, if prisons are filled to capacity.

**Effect of Sentence on Crime.** The final component of the model is the relation between the average effective sentence and deterrence. Figure 2-27 depicts the relation between the perceived average effective sentence ratio PAESR (Equation 39) and the effect of sentence on crime ESC (Equation 38). The perceived average effective sentence PAES (Equation 40) is a delayed perception of the average effective sentence. The delay occurs because potential offenders do not have current information about sentence length, only information about past sentences gained through acquaintances and rumor. PAESR is the ratio of PAES to its initial value. In Figure 2-27 as PAESR decreases, the effect of sentence on crime increases. The graph reflects the assumption that decreases in sentence hurt deterrence and increase crime. In the opposite direction, increases in sentence length increase deterrence and reduce crime up to a point, after which increases in sentence have little effect.
The impact of sentence length on crime is the subject of debate, even more so than the impact of the probability of prison. A common assumption is that the length of sentence has less effect on crime than the probability of prison. Several studies have failed to demonstrate any relation between the length of sentence and crime. For example, Schwartz found no effect on the number of rapes in Philadelphia from an increase in the prescribed penalties. However, Ehrlich found statistically significant relations (listed in Table 2-1) between length of sentence and crime. These estimates correspond to the slope of a linear segment of the relation in Figure 2-27. Some of Ehrlich's results show a steeper slope for sentence length than for
Figure 2-28: Simulation of Basic Criminal Justice Model: Base Run
Figure 2-28 (Cont.)
probability of imprisonment. Despite these results, the model contains the assumption that sentence length has less effect than perceived imprisonment ratio.

2.5. Dynamics of the Criminal Justice System

The Basic Criminal Justice Model is now complete and can be used to study the implications of the model assumptions. In the simulations that follow, a five percent step increase on TEST dislodges the system from equilibrium and initiates the behavior shown in the graphs.

**Base Run.** Figure 2-28 depicts the Base Run of the model. Crimes exhibit growth and then level out at about four times the initial value before starting to turn down. Workload rises to over two and a half times its initial value, then declines to slightly less than two and a half times the initial value. The perceived imprisonment ratio declines below 0.5 and then rises again. The average effective sentence drops from sixteen months to less than seven months. The pool of ex-offenders doubles. To the extent the model is valid, the behavior demonstrates two problems with the dynamic structure of the criminal justice system. First, the structure amplifies increases in crime from external causes. Second, once these increases occur, the system tends to stagnate at a low value of deterrence. The behavior suggests several questions: Why do crimes grow? Why do crimes level off? Why do crimes not decline back to their original value more rapidly? Also, why is the period of response so long?
Three positive feedback relations cause the exponential growth of crime and amplify external increases in crime. I have already discussed the first loop, Loop 1 in Figure 2-2, in some detail. As the simulation in Figure 2-6 shows, this loop produces exponential growth in crime. The second loop involves the average effective sentence. Unless prison capacity is increased, increasing the flow of imprisoned offenders decreases the average effective sentence and reduces deterrence. The reduction results in further increases. In the third loop, an increase in crime produces a rise in offenders imprisoned and, therefore, a rise in ex-offenders. Since ex-offenders have a higher crime rate than potential new offenders, the larger pool of ex-offenders further increases crime.

The leveling off in crime arises from the non-linearity in the EIC relation and the increase in capacity acquisition. Around month 240, the perceived imprisonment ratio drops below 0.5, causing Loop 1 to operate in the left-most portion of the EIC curve (Relation C, Figure 2-3) where the slope is less than one. Loop 1 ceases to dominate Loop 2, and crime begins to level off. By month 264, workload has risen sufficiently far above the standard that capacity is being acquired faster than the backlog is growing. Workload begins to turn down, and the fraction of crimes reported and the fraction of defendants imprisoned begin to increase. Consequently, the total offenders imprisoned expand faster than crimes, and the perceived imprisonment ratio reverses direction.

Even by month 480 crimes fail to drop much. If the simulation
were carried out another 480 months, crimes would slowly drop to near the original value. Compared to Figure 2-20, the response time is longer. One result of the correctional structure and the effect of sentence on crime is to lengthen the response time of the system. This lengthening arises from the tradeoffs and reinforcing effects introduced by the correctional structure. As noted above, during the growth phase of crime, both the declining imprisonment ratio and the declining sentence contribute to the growth in crimes, each reinforcing the other. But when total offenders imprisoned start to grow faster than crimes, the average effective sentence is still being pushed down. At this point, there is a tradeoff between the number of offenders imprisoned and the average effective sentence. As the system tries to increase deterrence by increasing the total offenders imprisoned, it decreases the average effective sentence, thereby tending to reduce deterrence. The two effects fail to completely offset one another. The effect of the perceived imprisonment ratio on crime is stronger than the effect of sentence on crime. Around month 420 the imprisonment ratio is increasing enough that crime begins to decline.

At first glance, the period of response of the system seems unusually long. The period of response is the time necessary to see the full dynamic behavior of the system. In this instance, the period is several decades. Since the time necessary to process criminal cases is only several months, the long period of response seems surprising.
Other structures in the model besides the case processing equations determine the period of response. First, the rate of growth in Loop 1 and 2 determines how fast the system responds. As seen in Figure 2-6, growth in Loops 1 and 2 require between one and two decades to level out. Second, the response of police-court subsystem also influences the period of response. As seen in Figure 2-18, the increase in total offenders imprisoned is long enough that over a decade elapses before the variable reaches equilibrium. The interaction between Loops 1 and 2 and the police-court subsystem produces behavior that has an even longer period of response than the individual structures.

**Increasing Capacity.** Increasing judges and police is frequently advocated for fighting crime and makes a natural policy to test with the model. There are two approaches to testing this type of policy. In the first approach, the model is programmed to produce an increase in criminal justice capacity at a specified time. This approach is sometimes called "open loop" because no feedback loop controls the increase. In the second approach, the increase in capacity is controlled through one of the feedback loops of the model. This approach is sometimes called "closed loop." Given the time span of the simulations and the structure of the model, a closed loop approach is appropriate. Over the course of forty years in an actual criminal justice system, there will be a series of adjustments in capacity in response to conditions.

Figure 2-29 depicts a run in which a given discrepancy between
Figure 2-29: Simulation of Basic Criminal Justice Model: Faster Capacity Acquisition
Figure 2-29 (Cont.)
workload and the standard produces one and a half times as much capacity as in the Base Run. This simulation initially exhibits the same exponential growth as does the Base Run, but after month 240 crime rises much less than in the Base Run. One feature of the run is that this reduction in crimes from the Base Run is accomplished with less capacity.

Comparing Figures 2-28 and 2-29, both simulations show similar behavior during the first 240 months. However, in Figure 2-29 criminal justice capacity is larger and the workload is smaller than in Figure 2-29. Since workload is smaller, the fraction of defendants imprisoned and the fraction of crimes reported (both not shown) are higher, and consequently the perceived imprisonment ratio PIR does not drop as far as in the Base Run. In month 228, PIR begins to turn upward, about 80 months before it turns in the Base Run. The effect of deterrence on crime and crimes levels out. As a result, fewer offenders are imprisoned and the average effective sentence drops less, thereby causing less degradation of deterrence. Since the crime rate is lower than in the Base Run, the workload remains lower and there is less need for additional capacity after month 240. Hence, it does not rise as high as in the Base Run.

The simulation suggests that faster acquisition of capacity will reduce crime, a predictable conclusion. But, the slow acquisition of capacity to avoid expenditures on the criminal justice system appears self-defeating, because such a policy generates the need for much greater capacity in the future. Despite these benefits, in
Figure 2-30: Relations for Revised Plea Bargaining Policy
(Solid lines are revised policies. Dotted lines are original policies)
Figure 2-30: (Cont.)
month 480 crime is more than twice as great as the initial value. The reason is clear from the average effective sentence and ex-offenders. The average effective sentence does not drop as far as in the Base Run, but it nevertheless drops below half of its original value. Similarly, the ex-offender population increases by more than fifty percent.

**Plea Bargaining.** In lieu of increasing capacity, the criminal justice system may choose to increase the plea bargaining and other means of increasing the flow of cases without adding more personnel. The next simulation tests the policy of increased plea bargaining. The new policy is implemented by changing three tables in the model. Figure 2-30 depicts the revised tables for capacity utilization, the pressure on imprisonment, and the pressure on sentence from workload. In the assumed policy, capacity utilization increases much faster as workload increases, but a smaller fraction of defendants are imprisoned and the court-imposed sentence decreases more than in the original policy.

Figure 2-31 depicts the simulation using this revised policy. The results are inferior in most ways to the Base Run. Initially, crime grows at approximately the same rate as it does in the Base Run. But when it levels off, it levels off at a higher value than in the Base Run. Moreover, it remains at this high value and fails to drop as it does in the Base Run. (Simulations carried out to 960 months confirm that the system maintains this high value.)

Tests of the police-court subsystem show how plea bargaining
Figure 2-31: Simulation of Basic Criminal Justice Model: Revised Plea Bargaining Policy
Figure 2-31 (Cont.)
Figure 2-32: Simulations of Police-Court Subsystem: Effect of Revised Plea Bargaining Policy
affects the behavior of capacity and total offenders imprisoned. Figure 2-32 depicts two simulations of the police-court subsystem responding to a fifty percent increase in crime. Graph A is the simulation using the initial or base parameters. Graph B is the simulation using the revised plea bargaining policy.

Comparing Graphs A and B shows, first, that the increased plea bargaining has little effect on the total offenders imprisoned. At first they increase faster than in Graph A, but then they increase more slowly, so that by month 240 there are slightly fewer offenders being imprisoned each month than in Graph A. This result, of course, arises from the tradeoff in the policy. Cases are moved faster than in Graph A, but a smaller fraction of defendants are imprisoned. Consequently, plea bargaining has little direct affect on the perceived imprisonment ratio.

Comparing the two graphs shows, second, that the increased plea bargaining results in the system acquiring less capacity than in Graph A. The problem with increased plea bargaining is that it alleviates those pressures necessary to make the system acquire capacity. Plea bargaining, by accelerating the movement of cases and keeping the backlog from building up, reduces the pressures to acquire capacity.

Capacity, in excess of what the system believes is necessary, produces the reversal in crime during the last part of the Base Run. As seen in Figure 2-28, near the end of the simulation, workload drops below the workload standard, indicating that capacity is higher
than needed to maintain workload at the standard. Since capacity is discharged so slowly, the system is able to improve deterrence enough to cause a decline in crime. In contrast, the increased plea bargaining prevents the system from building up that excess capacity. Consequently, the system stagnates at a low value of deterrence.

**Increased Prison Capacity.** Figure 2-33 depicts the third policy simulation in which a fifty percent increase in prison capacity occurs in month 180. In this test, the policy is open loop, since a single increase in prison capacity occurs at a specified time independent of conditions in the system. The most notable result of this policy is the decline in crime after month 180.

Following the increase in prison capacity, pressures from overcrowding are relieved, so that the average effective sentence begins to rise toward the court-imposed sentence. Since workload is high at this point, criminal justice capacity is increasing faster than backlog, causing workload to decline. The increase in the flow of offenders to prison due to expanding capacity causes the perceived imprisonment ratio to start to rise. Without a compensating drop in sentence, overall deterrence increases and crimes begin to fall. At approximately month 240, the number of crimes has declined far enough that the total offenders imprisoned starts to drop off. The average sentence and the perceived imprisonment ratio are both rising. The feedback loops which tend to amplify the increases in crime are now working in reverse. A decline in crimes stimulates further declines in crime, until the system drifts into a position of low crime, a
Figure 2-33: Simulation of Basic Criminal Justice Model: Increased Prison Capacity
declining prison population, a high average effective sentence, and
a high perceived imprisonment ratio.

2.6 Conclusions

This chapter has introduced a way a model of a state's criminal
justice system might be formulated. The model demonstrates the feedback loops which can create problems for the administration of justice. These problems include the amplification of external disturbances on crime and, with certain policies, the tendency of the system to stagnate at a low level of performance.

The model suggests that faster acquisition of police and courts results in eliminating the need for a greater capacity in the long run. An important aspect of this policy change is viewing capacity acquisition policies as closed loop. Over the course of several decades, police and court capacity is not changed one or two times, but repeatedly to meet the needs of the system. What procedures does the criminal justice system have for changing capacity as needs dictate? Are they cumbersome and slow? Are they oriented toward individual changes, after which the problem is forgotten until the press of criminal cases necessitates another change? The model suggests that these procedures should be studied and streamlined to permit faster response to changes in the amount of crime.

The model suggests the importance of directing system pressures to the proper place in the system. Compare the simulation with faster
acquisition in capacity (Figure 2-29) to the simulation with more plea bargaining (Figure 2-31). In the first, workload pressures are absorbed by adding additional capacity, resulting in less crime and less capacity than in the Base Run. In the second, workload pressures are absorbed by plea negotiations that move cases faster. The result is more crime than in the Base Run. In a decentralized system composed of many autonomous organizations, the immediate pressures within the organization can easily become more compelling than the long term performance of the entire system. When administrators must direct these organizations with insufficient resources and an unclear vision of how their decisions affect the entire system, they may well choose to relieve workload pressures in what seems the quickest and easiest fashion. Policies like plea bargaining, therefore, seem attractive to judges and prosecutors. Nevertheless, effective overall system performance requires not that pressures be eliminated but that they be directed to the proper place.

The model suggests the importance of prison capacity in controlling crime. At a first glance, the role seems counterintuitive, because the length of sentence has less effect on crime than the probability of prison. The effect of prison capacity demonstrates how systems can respond to policies which do not at first appear to be the most obvious ones to pursue.

The results from the model are, of course, tentative. The model is only a very simplified picture of the criminal justice system. Criminal justice capacity is an aggregate of a number of resources.
Consequently, the simulations are based on the assumption that various types of resources are acquired together. To make a model suitable for actual policy analysis, the police and courts need to be separated into different sectors. In addition, a deeper analysis of court policies requires further disaggregation of the courts.

In addition to a more disaggregated model, more testing of assumptions is needed before the simulation results can be accepted. In particular, what changes in parameters might affect the simulation results? What if the effect of sentence on crime were different? Does the impact of prison capacity depend on the sudden, large increase in capacity compared to the gradual increase in criminal justice capacity? These and similar questions fall into the area of sensitivity testing.

The next chapters take a more detailed look at the criminal justice system. Chapter 3 discusses the structure of the Massachusetts criminal courts and the court sector of a larger model than the one in this chapter. Chapter 4 discusses the assumptions of the other sectors of this larger model. Chapter 5 presents several simulations and discusses the sensitivity testing and policy testing of the model.
FOOTNOTES


3 See, for example, Thorsten Sellin, Capital Punishment (New York: Harper and Row, 1967).

4 Eleanor Glueck and Sheldon Glueck, Criminal Careers in Retrospect (New York: The Commonwealth Fund, 1943)

5 Tittle and Logan, op. cit.

6 With the exception of the Boston police strike, these events are reported in Johannes Andenaes, "The General Preventive Effects of Punishment," University of Pennsylvania Law Review, CXIV (May, 1966), 949-983.


8 Wilson, op. cit., 174

9 Ibid., 174


11 Equation numbers are used to identify the equations. These numbers are assigned by a computer program called the DYNAMO documentor and are based on special conventions. As a result, equation numbers start with 3 instead of 1. These numbers appear to the right of each DYNAMO equation in the text. The letter following the number indicates the equation type.

12 Pugh, op. cit.

13 Ehrlich, op. cit.


15 Appendix B lists the DYNAMO statements for producing the graphs in this chapter.
16 The case delay is computed by dividing the backlog by the cases adjudged and dismissed.

17 Martin A. Levin, "Crime, Punishment, and Social Science," The Public Interest (Spring, 1972), 96-103

18 Robert Martinson, "What Works?—Questions and Answers About Prison Reform," The Public Interest (Spring, 1974), 41


20 Andenaes, op. cit., 964


23 Ehrlich, op. cit.
CHAPTER III

THE FEEDBACK STRUCTURE OF THE MASSACHUSETTS CRIMINAL COURTS

3.1 Overview of the Court Management Model

The Court Management Model is a computer simulation model of approximately one hundred thirty variables representing important aspects of the Massachusetts criminal justice system. The model has essentially the same boundary as the Basic Criminal Justice Model in Chapter 2 and uses several structural elements from the smaller model. The primary difference between the two is that the Court Management Model is more disaggregated, particularly in the court sector.

The purpose of the Court Management Model is twofold. First, it focuses on policies in the courts. The model deals in some detail with case processing in the Massachusetts criminal courts, so it can be used to address a variety of policy issues confronting the courts. Second, the model focuses on the interactions between the courts and the rest of the criminal justice system. Of interest is how the courts influence the deterrence of crime and how the other agencies affect the courts.

Model Organization. The Court Management Model is divided into
four sectors:

1. Crime Sector
2. Police Sector
3. Court Sector
4. Corrections Sector

Table 3-1 outlines the sectors and lists the important factors computed in each. Figure 3-1 depicts the important connections among sectors.

The Crime Sector contains the assumptions relating conditions in the criminal justice system to deterrence and the volume of crimes. The assumptions are the same as those discussed in Chapter 2. To summarize, three factors affect crime in the model:

1. The perceived imprisonment ratio,
2. The average effective sentence,
3. The population of potential new offenders and ex-offenders.
TABLE 3-1

OUTLINE OF SECTORS IN THE COURT MANAGEMENT MODEL

I. Crime Sector

Crimes Committed
Effect of Deterrence on Crime

II. Police Sector

Crimes Investigated
Police Capacity
Crimes Intercepted by Police
Fraction of Police Capacity on Patrol

II. Court Sector

A. Acquisition of Superior Court Judges

Superior Court Backlog
Superior Court Judges

B. Utilization of Judges in Superior Court Trials

Superior Court Trials
Restriction on Trials from Prosecutors and Defense Attorneys

C. Superior Court Dismissals

Superior Court Cases Dismissed
District Attorneys

D. Superior Court Guilty Pleas

Guilty Pleas

E. District Court

Cases Referred to Court Diversion Program
Cases Referred to Grand Jury
Fraction of Cases Convicted
Fraction of Convictions Imprisoned
Appeals to Superior Court
Pressure to Appeal from Sentence
Pressure to Appeal from Case Consideration
F. Impact of Defense Attorneys

Effect of Defense Attorneys on Trials
Effect of Defense Attorneys on Guilty Pleas
Effect of Defense Attorneys on Appeals
Defense Attorneys

G. Sentencing

Total Offenders Imprisoned
District Court Defendants Imprisoned
Superior Court Defendants Imprisoned after Trial
Superior Court Defendants Imprisoned after Guilty Pleas
Court-Imposed Sentences
   (1) District Court
   (2) Superior Court

IV. Corrections Sector

Offenders Imprisoned
Prisoners
Ex-Offenders and Potential New Offenders
Prison Capacity
Offenders in Court Diversion Program
Figure 3-1: Relations Among Sectors of the Court Management Model
As shown in Figure 3-1, the population of ex-offenders and potential new offenders and the average effective sentence are computed in the Corrections Sector. Total offenders imprisoned, from which the perceived imprisonment ratio is computed, is determined in the Court Sector.

Crimes form the input to the Police Sector. In this sector, a crime can result in an arrest in two ways. First, police patrols can intercept a crime in progress. Second, the case is reported to the police and then investigated. Cases "solved" through investigation, along with those intercepted, form the input to the Court Sector.

The Court Sector represents the processing of criminal cases through the Massachusetts courts. It determines the flow of total offenders imprisoned and the court-imposed sentence which form the inputs to the Corrections Sector.

The Corrections Sector traces the flow of people through prison to ex-offender status. The sector also determines the average effective sentence. This sentence and the population of ex-offenders and potential new offenders form inputs to the Crime Sector.

**Court Subsectors.** The Court Sector is divided into seven subsectors:

1. Acquisition of Superior Court Judges
2. Utilization of Judges in Superior Court Trials
3. Superior Court Dismissals
4. Superior Court Guilty Pleas
5. District Court
6. Impact of Defense Attorneys
7. Sentencing

With the exception of the last subsector, which deals with the
effects of prison overcrowding on sentences, each subsector deals with a mechanism for controlling workloads in the Superior Court. The Superior Court is the higher of the two courts most involved in criminal matters. Section 3.2 describes the formal organization of the Massachusetts courts. Augmenting the formal court organization are unwritten policies and traditions which influence the processing of cases. A number of these focus on the control of workload in the Superior Court, hence the organization of the subsectors to feature this aspect.

Workload. Workload has already been discussed in Chapter 2. In the Basic Criminal Justice Model, the workload is defined as the backlog of cases awaiting processing by the police and courts divided by the criminal justice capacity. Workload influences a number of decisions about case processing and capacity acquisition.

The Basic Criminal Justice Model contains just one workload; the Court Sector contains four. One, the Superior Court judicial workload is the ratio of the Superior Court backlog of cases to the Superior Court judges. Two, the prosecutor workload is the ratio of the Superior Court backlog to District Attorneys. Three, the defense attorney workload is the ratio of the Superior Court backlog to defense attorneys. Fourth, the Superior Court workload is the weighted average of the Superior Court judicial workload and the prosecutor workload.

As in the Basic Criminal Justice Model, each workload is normalized by dividing the ratio by its initial value. Normalizing is a convenience in modeling and analysis, but makes no difference in
the behavior of the model. The model could be structured about
unnormalized workloads. The rest of the discussion does not distinguish
between a normalized workload and an unnormalized workload. When
presenting actual data from Massachusetts, workloads are unnormalized.
When used in table functions or presented in model simulations, the
workloads are normalized.

Why should workload play a dominant part in a model of the courts?

For one reason, workload is a measure of the delay in processing
cases. The relation can be seen in the following example of the
Superior Court judicial workload. By definition,

\[ \text{SCJWL} = \frac{\text{SCB}}{\text{SCJ}} \]

where  
\( \text{SCJWL} \) is the Superior Court judicial workload 
\( \text{SCB} \) is the Superior Court backlog 
\( \text{SCJ} \) is the Superior Court judges

If each judge, on the average, handles \( N \) cases per month, the average
delay for a case passing through the backlog is:

\[ \text{DELAY} = \frac{\text{SCB} \times \text{TCPSC}}{\text{N} \times \text{SCJ}} = \frac{\text{SCJWL}}{\text{N}} \]

where  
\( \text{DELAY} \) is the average delay 
\( \text{SCB} \) is the Superior Court backlog 
\( \text{TCPSC} \) is the total cases processed in Superior Court 
\( \text{N} \) is the number of cases per judge per month 
\( \text{SCJ} \) is Superior Court judges 
\( \text{SCJWL} \) is the Superior Court judicial workload

If \( N \) were constant, the workload would be proportional to the court
delay. As the workload increases, the number of cases processed per
judge might be expected to increase also, but the workload provides a reference point for the decision to increase the number of cases per judge.

The court delay is especially important, since an excessive court delay can weaken the quality of justice in a state's criminal justice system. Innocent suspects suffer unfairly from not being cleared promptly. Suspects unable to make bail spend considerable time in jail, although they have not been found guilty of any crime. Delays increase the pressures to deal with cases perfunctorily, in order to move them faster. Consequently, judges have less time for careful study of each case. After a point, the older a case becomes, the more difficult it may be to prosecute successfully. Witnesses become unavailable, or their memories fade. Defendants who are actually guilty may be more likely to go free the longer the delay. Moreover, delays allow suspects on bail additional opportunities to commit crimes.

The literature on courts and interviews with officials suggest that the workload plays an important role in court policies. Sometimes, the concerns about workload are expressed in general terms about court congestion. In 1936 Warner and Cabot wrote: "Suggested reforms with regard to the Superior Court are practically all occasioned by congestion of its business and take the form usually of providing more judges." In other instances, the writer is clearly indicating that he is talking of workload in terms of backlog divided by manpower. In an address given in 1970, the Chief Justice of the Superior Court
said that in 1969 the court had a backlog of untried criminal indictments or complaints totalling 18,306. On the civil side, pending and untried, 65,295 cases. Divide that backlog by 46 Judges and you have a caseload per Judge of 1,805. Absolutely incredible. New Jersey which is a comparable state, has a caseload of 482; Connecticut, 710; Illinois, 649 . . . The Superior Court is whipped by a hurricane of civil and criminal business so that we can no longer effectively and with dispatch handle the business of our people.²

There is now a growing concern in the nation over the state courts' attempts to control workload and their impact on deterrence. Much of this concern centers on plea bargaining, discussed more fully later. In 1971 New York's police commissioner Patrick Murphy accused the courts of significantly contributing to the continual rise in crime. The commissioner felt that "the courts let too many criminals go free and gave others sentences that were too light."³

Recently, the *New York Times* studied the disposition of homicide cases in New York City.⁴ It found that eighty percent of the cases were settled by plea bargaining and that the suspects received lighter sentences than elsewhere in the state. Quoting Bronx District Attorney M. Merola, the *Times* reported:

Any time there's a plea negotiation and the defendant's lawyer knows we don't have the capacity to try the case, then the defendant gets a better deal.

Quoting former Manhattan District Attorney Richard Kug, the *Times* said:

In the last decade judges have become overly concerned with volume. The simplest thing to do is to wave bait and give light sentences. It isn't even done consciously. The pattern has developed because of the large caseload.

The concern over the operation of the courts has prompted several suggestions and proposals for changes in court policies. At least
part of many suggestions center on modifying the workload adjustment mechanisms in the courts. Some people propose to eliminate plea bargaining, others propose to increase it. Recently, mandatory sentencing, which restricts the ability to plea bargain, has received much attention. Court officials frequently propose more judges for the Superior Court in Massachusetts. Other suggested policies include court diversion programs to reduce the flow of cases into the courts and improved management techniques to increase the output of the courts. Testing of these policies, which is described in Chapter 5, requires a model containing the workload adjustment mechanisms.

Workload is not the only determinant of the policies of the courts. Obviously, several considerations, including the quality of justice, are involved in the courts' policy making. But the workload adjustment mechanisms are central to much of the operation of the courts and the current controversy over court policy.

Chapter Overview. The remainder of this chapter discusses the Court Sector. Since the sector is based on the processing of criminal cases in Massachusetts, the next section outlines how cases are handled. The following sections discuss how this processing leads to the mechanisms for controlling workload. Unlike Chapter 2, this chapter discusses the variables in the model without describing each equation. A description of each equation is contained in Appendix A.

Chapter 4 completes the description of the Court Management Model by discussing the Police and Corrections Sectors. The Crime Sector
Figure 3-2: Flow of Cases in the Massachusetts Criminal Courts
is not discussed in Chapter 4, since the assumptions in the sector are the same as those discussed in Chapter 2.

3.2 Processing Criminal Cases in Massachusetts

The Massachusetts court system consists of four levels of courts: the District Court, the Superior Court, the Appeals Court, and Supreme Judicial Court. Although all four levels handle both civil and criminal business, the model and this chapter deal only with the processing of criminal cases. The District Courts are the lowest level and receive the great bulk of criminal cases. As described below, some of these cases move their way up to the Superior Court. The Superior Court is described as "the great trial Court of the Commonwealth" because it both tries the most serious criminal cases and provides jury trials, unlike the lower court. The relation between the District Court and the Superior Court is discussed more fully below. Once a criminal case is tried in the Superior Court, it might be appealed to the Appeals Court or the Supreme Judicial Court, the highest court in the state. However, these appeal courts handle so few cases that they are not considered in the model.

Figure 3-2 depicts the flow of cases in the Massachusetts criminal courts. The rectangles depict case backlogs, and the valve symbols represent the movement of cases.

District Courts. Following arrest and arraignment, the great
majority of criminal cases are brought before the District Court, forming the backlog of cases in the lower court. The arraignment process is not explicitly represented in the model. Although prosecutors can bring some cases directly before a grand jury, these cases are only a small fraction of the total cases handled by the courts and have been omitted from the model for simplicity.

Whether or not a case is tried initially in the District Court or bound over to the Superior Court depends on whether the lower court has jurisdiction.

The district courts have original jurisdiction, concurrent with the Superior Court, to try all misdemeanors except libel, which is tried exclusively in the Superior Court. They also have original jurisdiction over all local ordinances and bylaws; as one example important in an urban area, district courts try landlords charged with violations of local housing codes, such as failure to provide heat, violation of the plumbing code, and maintenance of an unsafe building.

Together with the Superior Court, the district courts also have concurrent jurisdiction over felonies punishable by a sentence up to five years in State Prison. They have concurrent jurisdiction over a few felonies carrying even greater penalties. There are, however, important limitations upon the district court's felony jurisdiction. First, a district court may not send a defendant to State Prison. Only the Superior Court has this authority. Second, the houses of correction where the district court may send defendants hold only those sentenced for no longer than two and a half years. Thus, through the combination of these two limitations, the district courts, regardless of the crime's allowable maximum sentence, may not impose a sentence greater than two and a half years for each offense. These limitations often influence a judge to decline jurisdiction and send a case to Superior Court when enough evidence has been presented at a district court trial to persuade him that the defendant is probably guilty and deserves a severe sentence. The concurrent jurisdiction of district and superior courts allows the Superior Court to try defendants whose cases, whether misdemeanor or felony, have been declined by the district court.
In the majority of cases, the District Court retains jurisdiction. The defendant may then plead "not guilty" and receive a trial, or, if he wishes to avoid trial, he can make one of several pleas in which he in essence admits his guilt, but has different rights of appeal. He can plead guilty to one or more charges, but he then forfeits his right to appeal the case to the Superior Court. The defendant can admit to sufficient facts to warrant a finding of guilty; he in essence pleads guilty, but retains his right to appeal. In a few instances, a defendant may plead nolo contendere, in which case he may not appeal.

If the defendant pleads not guilty, he receives a non-jury trial before a District Court judge. No transcript of the trial is made. Usually, a police officer, either the arresting officer or a special police prosecutor, prosecutes the case.

If a defendant is found guilty in a trial or admits to sufficient facts, he has the right to appeal to the Superior Court to receive a completely new trial. The procedure is called trial de novo. Since no transcript of the District Court trial exists, the first trial plays no role in the subsequent trial in the Superior Court. The defendant can request a jury trial or a trial before a judge only. In some counties, misdemeanors may be retried before a jury of six with a District Court judge sitting in Superior Court.

If the District Court judge declines jurisdiction in a case, he holds a probable cause hearing to determine if the charges against the defendant are reasonable. In some instances, he dismisses the case. Otherwise, he refers it to a Grand Jury, thereby adding to the backlog
Figure 3-3: Screening Cases in the District Court
of cases awaiting Grand Jury consideration.

As a District Attorney presents cases to the Grand Jury, it votes on whether to issue an indictment. Cases indicted then enter the backlog of cases in the Superior Court.

The District Court screens cases for the rest of the Court Sector. Figure 3-3 depicts the process. The diagram shows the size of the flow of cases for crimes against property and persons for the year 1971. The top number for each flow is its size in cases per year and the number in parentheses is the flow as a percent of arrests. Minor crimes like drunkenness and traffic violations have been excluded from these data. Appendix B describes how the data were prepared.

At the top of the diagram, arrests form the flow of cases into the District Court. For the purposes of the Court Management Model, arrests are those cases actually brought before the District Court. Massachusetts does not currently have a formal court diversion program,10 but if one existed, cases would be diverted at the point indicated in the diagram. Next, about eighteen percent of arrests are referred to the Grand Jury for indictment and trial in the Superior Court. A sizable portion of the remaining cases, thirty-five percent of arrests, are dismissed or acquitted. The remainder are convictions, either guilty verdicts after trials or pleas other than not guilty. Most convictions result in a fine or suspended sentence. In 1971 only nine percent of arrests resulted in a prison sentence. Of those, the majority appealed to the Superior Court. Some defendants not receiving imprisonment appealed their cases also, so that about
Figure 3-4: Disposition of Cases in Superior Court
seven percent of arrests result in an appeal to the Superior Court.

Superior Court. The Superior Court differs markedly from the District Court. The lower court tries a large volume of relatively minor cases, and the time devoted to each is usually small. The Superior Court handles a much smaller volume of cases; but they are the most serious criminal charges, the trials are more carefully conducted, and the proceedings require much more time. The delay in the Superior Court is much longer and of greater concern than the delay in the District Court.

Cases in the Superior Court are processed in three ways, dismissals, trials, and guilty pleas. Figure 3-4 depicts the size of the three flows. As in Figure 3-3, the top numbers are the flows in cases per year in 1971, and the numbers in parentheses are the size of the flows as a percent of total cases processed in the Superior Court in 1971. The bulk of cases, sixty-six percent in 1971, are handled as guilty pleas. Much smaller fractions are dismissed or tried. Of the total processed, about thirty-two percent result in the defendant's being imprisoned.

Many criminal cases in the Superior Court are settled through plea negotiations. While it can take several forms, in each, the defendant relinquishes his right to trial in exchange for a reduced sentence, or, at least, improved prospects for a reduced sentence. For example, a defendant may agree to plead guilty in Superior Court to one charge against him in exchange for the other charges being dropped and, consequently, a lighter sentence. In another instance,
the defendant may plead to a lesser charge than the original indictment, thereby reducing the sentence he ultimately receives. In a third example, a defendant may plead guilty for the privilege of being sentenced by a judge perceived to give lenient sentences.

While the judge ultimately sets the sentence, the prosecutor has at least two ways of influencing it. First, he may recommend a sentence. The judge of a busy court runs a risk in ignoring the prosecutor's recommendation, since it probably arises out of plea negotiations. If the judge does not follow the recommendation, other defendants may hesitate to bargain with the prosecutor and the negotiation process may break down. Second, by designating the charge to which the defendant pleads, the prosecutor can control the maximum sentence.

**Prosecutors and Defense Attorneys.** A District Attorney or Assistant District Attorney prosecutes the cases in the Superior Court, as well as presenting cases to the Grand Jury. The District Attorney of each county is an elected official who appoints his assistants. As used here, the term prosecutor or District Attorney means the District Attorney or an Assistant District Attorney.

**Two small groups of attorneys represent the majority of criminal defendants in the Superior Court,** although other attorneys may handle a few criminal cases as an offshoot of their civil practice. First, the Massachusetts Defenders Committee (MDC), a state agency, handles most of the defendants unable to pay for private counsel. In 1974, 124 MDC lawyers handled 27,179 new cases, indicating their heavy
Figure 3-5: Judge, Backlog, and Workload in the Superior Court, 1959-1974

Figure 3-6: Trial-Days and Judicial Utilization Factor in the Superior Court, 1959-1974
workload. Second, a small number of lawyers in each county handle the bulk of private defendants. These lawyers specialize in criminal law and tend to carry heavy caseloads.

3.3 Acquisition of Superior Court Judges

The case processing structure of the criminal courts provides the skeleton for the workload adjustment mechanisms. These mechanisms are negative feedback loops intended to keep the workload from growing too large and are made up of informal or unwritten policies and traditions that have developed around the formal court structure.

As the backlog increases in the Superior Court, the most obvious response is to increase the Superior Court judges. Powers notes:

The Chief Justice of the Court (the Superior Court), both past and present, the Massachusetts Bar Association, the Committee on Law Enforcement and Administration of Justice, the Massachusetts Judicial Conference..., the Judicial Council and many others, aware of the current crowded calendar..., have persistently advocated an increase in the number of Associate Justices (in the Superior Court).

Figure 3-5 depicts the trend in the number of Superior Court judges and the Superior Court judicial workload from 1959 through 1974. As mentioned before, the Superior Court judicial workload is the Superior Court backlog divided by the Superior Court judges. During the period from 1959 through 1974, the workload rose over 600 percent and Superior Court judges have increased 24 percent. Judges were added as the workload grew, but slowly.
Figure 3-7: Causal Loop Diagram of Acquisition of Judges
Figure 3-8: Relation Between the Relative Workload for Superior Court Judges and the Percent Increase in Judges per Month.
Figure 3-7 depicts the causal loop diagram of the acquisition of Superior Court judges as represented in the model. At the top of the diagram, the rectangle represents the backlog of cases in the Superior Court. Grand Jury indictments and appeals from the District Court feed this backlog, while total cases processed in the Superior Court deplete it. Trials, guilty pleas, and dismissals make up the total cases processed. The formulation for the acquisition of judges is analogous to the capacity acquisition structure in the Basic Criminal Justice Model.

Loops 1 and 2 in Figure 3-7 relate backlog, the Superior Court judicial workload, and total cases processed. A growing backlog produces a growing Superior Court judicial workload, causing the relative workload for Superior Court judges to rise. The relative workload is the ratio of the actual Superior Court judicial workload to the workload standard for judges.

A high relative workload creates pressures for more judges. Figure 3-8 depicts the relation between the relative workload for Superior Court judges and the percent increase in judges per month. The solid line depicts the base relation, intended to reflect the current policy in Massachusetts. The dashed line depicts a revised policy of faster acquisition of judges, one of the policies tested in Chapter 5. In the base relation, the change in judges is zero when the relative workload is less than or equal to one, representing the fact that judges remain on the bench even though the workload is lower than the standard. As the relative workload rises above one, the
percent increase in judges rises, although the values remain small reflecting the slow increases in the number of Superior Court judges.

In Loop 2, the increase in judges reduces the Superior Court judicial workload directly, since the number of judges occurs in the denominator of that ratio. In Loop 1 the increase in judges increases trials, dismissals, and guilty pleas, since additional judges can process more cases. The increase in total cases processed tends to reduce the backlog and workload.

In Loop 3 (Figure 3-7) the relative workload affects the workload standard. As the relative workload increases, the Superior Court judicial workload standard increases to match the actual workload. The adjustment of standards is an intangible process not openly reported, but some idea of the adjustment can be seen in remarks in some of the court reports. For example, in 1974 the Executive Secretary of the Supreme Judicial Court suggested that 6000 criminal cases formed a reasonable criminal backlog for the Superior Court. With 46 Superior Court judges, this backlog represents a workload of approximately 130 cases per judge. In 1963 the workload was about 120 cases per judge and was reported then as excessive.

3.4 Utilization of Judges in Superior Court Trials

The second response to an increasing workload is to increase the utilization of judges in trials. In the Superior Court, two mechanisms
Figure 3-9: Causal Loop Diagram of Judicial Utilization
Figure 3-10: Relation between the Superior Court Judicial Workload and the Judicial Utilization Factor

Figure 3-11: Relation between the Superior Court Workload and the Pressure on Dismissals from Workload
operate to increase the utilization of judges. First, the Superior Court maintains a policy of giving criminal cases a priority over civil cases. As the workload has increased, judges have been moved from civil sessions to criminal sessions to provide more time for criminal trials. Second, the higher workload has resulted in more utilization of District Court judges to try misdemeanors in the Superior Court.

Figure 3-6 depicts the workload, trial-days for Superior Court judges and District Court judges in the Superior Court, and the judicial utilization factor. This last quantity is the average number of days of criminal trials per month for each Superior Court judge. During the period from 1959 to 1974, as the workload increased, the number of trial-days for both Superior Court judges and District Court judges also increased. The judicial utilization factor rose from 4.1 days per month in 1959 to 9.2 days per month in 1974.

Figure 3-9 depicts the causal loop diagram of the utilization of judges in the model. The top of the diagram shows the Superior Court backlog once again and below it is the Superior Court judicial workload. Loop 4 in Figure 3-9 connects the workload with the judicial utilization factor, the Superior Court session, and Superior Court trials.

Figure 3-10 depicts the relation in the model between the Superior Court judicial workload and judicial utilization factor. An increase in the workload causes an increase in judicial utilization. In the other direction, as workload drops to zero, utilization also
drops to zero, since if there are no cases to try, judges would devote all their time to civil cases.

The product of the judicial utilization factor and the number of Superior Court judges yields the indicated Superior Court session. This is the number of judge-days per month for Superior Court trials, provided the availability of attorneys remains the same. Judge-days from using District Court judges in the Superior Court are incorporated into the judicial utilization factor, so that no separate calculation is used to account for this time.

The judicial efficiency program also affects the indicated Superior Court session. This variable represents an increase in efficiency in conducting trials from improved scheduling and other management techniques. As a policy variable, it can be switched on at a time specified by the modeler. This is one of the policies tested in Chapter 5.

The actual Superior Court session differs from the indicated due to prosecutor and defense attorney availability. To have a trial, a prosecutor and a defense attorney must be brought together with a judge. If the Superior Court tries to expand the trial session too much, it encounters scheduling conflicts from attorneys.

The measure of the prosecutor availability is the prosecutor trial ratio or the number of District Attorneys divided by the indicated Superior Court session. Similarly, the measure of the defense attorney availability is the defense attorney trial ratio or defense attorneys divided by the indicated Superior Court session. As these
ratios decline, the actual Superior Court session is reduced.

Although there is almost no data to measure the impact of attorney availability on trials, some indication of the scheduling problems was seen in a study by MITRE Corporation of the assignment session of the Suffolk County Superior Court. The assignment session hears pre-trial motions and schedules cases for trial. When a case comes before the assignment session, it is either scheduled for trial or it is continued until a later time. The MITRE study\textsuperscript{17} reported that during the period from November 8 to December 23, 1970, approximately twenty percent of felony cases called in the assignment session were continued either because the defense attorney had a schedule conflict or because he was otherwise unavailable. In some instances, cases have to be continued merely because there are no trial sessions available to handle the trial. Nevertheless, the percentage of continuances for attorney conflicts suggests that the limited number of defense attorneys constrains the expansion of criminal trial sessions. Similarly, insufficient prosecutors could provide a constraint also, but apparently district attorney staffs have increased sufficiently so that this limitation does not occur.

The Superior Court trials complete Loop 4. Increases in the Superior Court session increase the flow of trials, thereby tending to reduce the backlog and workload.
Figure 3-12: Dismissals, Guilty Pleas, and Trials per Judge in Superior Court, 1959-1971

Figure 3-13: Fraction of Convictions Imprisoned, Superior Court, 1950-1971
3.5 Superior Court Dismissals

Superior Court dismissals form the third mechanism for regulating workload. In *Justice Denied*, Downie describes dismissals in the nation's criminal courts:

Under pressure to keep the judge's case calendar as light as possible, the prosecutor drops charges against defendants wholesale before cases can reach the judge. These decisions, made by a young assistant prosecutor, usually over-worked and inexperienced, are most often based on a quick glance at police reports of arrests. Summarily, he tosses out cases that seem too "weak"; cases involving charges, such as a husband's beating his wife, that seem too tawdry for the court to consider; those involving, as defendants, neat-looking, middle-class people who seem "respectable" and not likely to get into trouble again, ...Some judges, in their turn, throw out still more cases in large lots. The judges, too, base their decisions on no more than a look at a court paper or a remark from a prosecutor or defense lawyer.¹⁸

The increase in dismissals in Massachusetts is shown in Figure 3-12 which depicts the number of dismissals, guilty pleas, and trials per Superior Court judge during each year from 1959 to 1971. The data cover crimes against persons and property, but not against public order. The graph shows that dismissals per judge have risen faster than trials or guilty pleas. During the period shown, dismissals per judge rose 180 percent while guilty pleas rose 17 percent and trials rose 99 percent.

Figure 3-14 depicts the dismissal mechanism in the model. This mechanism involves two other workloads, the prosecutor workload and Superior Court workload. As noted earlier, the prosecutor workload is the Superior Court backlog divided by the number of district attorneys. The Superior Court workload is the weighted average of
Figure 3-14: Causal Loop Diagram of Dismissals
the prosecutor workload and the Superior Court judicial workload. Discussions with court officials suggest that the pressure on both prosecutors and judges from the backlog influence dismissals.

Loop 5 in Figure 3-14 relates the Superior Court workload, pressure on dismissals from workload, and Superior Court cases dismissed. An increase in the Superior Court workload increases the pressure on dismissals from workload. The latter variable represents the changes in cases dismissed per judge from workload. Figure 3-11 depicts the relation used in the model. When the normalized Superior Court workload is one, the pressure on dismissals from workload is one, indicating that each judge dismisses a normal number of cases per month. As workload increases, the number of dismissals per judge increases, so that when workload is five, dismissals per judge are four times the normal value. The increasing slope of the relation reflects the assumption that dismissals are a last resort. As long as the workload is about one, other means like plea bargaining and increasing trials can be used to control workload. But when workload is high, dismissals must compensate for the limitations of plea bargaining and utilization of judges.

An increase in the pressure on dismissals from workload causes an increase in Superior Court cases dismissed, which tends to decrease the backlog and the Superior Court workload.

The left side of Figure 3-14 depicts the acquisition of District Attorneys. The mechanism is analogous to the acquisition of Superior Court judges. The decision to acquire additional Assistant District
Attorneys is based on the relative workload for prosecutors, that is, the ratio of the prosecutor workload to the prosecutor workload standard. In Loop 6, the higher the relative workload, the larger the fraction of prosecutor staff added each month. The prosecutor workload standard adjusts also to equal the prosecutor workload (Loop 7).

3.6 Superior Court Guilty Pleas

Plea negotiations form the fourth mechanism for regulating workload. As described previously, to relieve a heavy workload, the prosecutor may offer to reduce the recommended sentence or otherwise affect the severity of punishment, if a defendant foregoes his right to trial. Although there is little doubt that plea bargaining is extensive in the Superior Court and that its purpose is to speed the flow of cases, how much sentence severity is reduced is difficult to document from the published data.

Figure 3-12 depicts the trend in guilty pleas per judge. In 1971 the value is higher than in 1959, but for much of the period the trend was down. During the same period, the fraction of convictions imprisoned has declined. (See Figure 3-13.) Hence, while the severity of penalties has declined, the effect on guilty pleas is not as obvious as might be expected. One reason may be that by 1959 plea bargaining was sufficiently extensive that, despite lowered penalties, it could not expand the flow of cases much. Second, the impact of increased
Figure 3-15: Causal Loop Diagram of Guilty Pleas
availability of public defenders may have slowed the plea negotiation process. This aspect is discussed in Section 3.8.

Figure 3-15 depicts the mechanism in the model controlling guilty pleas. Loop 8 relates the Superior Court workload to sentencing, the plea bargaining sentence ratio, and Superior Court guilty pleas. As the Superior Court workload rises, prosecutors are assumed to offer defendants increasingly attractive terms for pleading guilty, resulting in a smaller fraction of defendants receiving prison terms and in lighter sentences for those who are imprisoned. The plea bargaining sentence ratio measures the severity of punishment for those who plead guilty, compared to those who go to trial. As the sentence ratio declines, defendants become more likely to plead guilty, thereby increasing the flow of guilty pleas.

Figure 3-16 depicts the relation between the Superior Court workload and the guilty plea imprisonment ratio. This variable is the ratio of the fraction imprisoned after pleading guilty to the fraction imprisoned after trial. The solid line is the base policy, the dashed line is a revised policy tested in Chapter 5. The downward slope reflects the assumption that judges give those defendants pleading guilty an increased number of probation and suspended sentences as the workload rises.

Figure 3-17 depicts the relation between the Superior Court workload and the guilty pleas sentence ratio. This variable is the ratio of the average length of sentence imposed on those pleading guilty who are imprisoned. Again the solid line is the base policy; the dashed
Figure 3-16: Relation between the Superior Court Workload and the Guilty Plea Imprisonment Ratio

Figure 3-17: Relation between the Superior Court Workload and the Guilty Plea Sentence Ratio
line is a revised policy tested in Chapter 5. The relation reflects the assumption that a high workload results in sentence lengths being reduced to encourage defendants to plead guilty.

3.7 District Court Regulation of Cases

The District Court provides the fifth means of controlling the workload of the Superior Court. Since cases in the Superior Court must first pass through the District Court, the lower court judge has the opportunity to limit the flow of cases to the higher court. Sensitive to the conditions in the Superior Court, the District Court judge may use a form of plea bargaining to restrict appeals. The inability of the lower court to give cases adequate consideration partially counteracts the effects to the plea bargaining. Unable to present his case adequately in the busy District Court, the defense attorney is more likely to appeal to the Superior Court than if the cases were handled more carefully. The interplay of the plea negotiations and the case consideration influences the flow of appeals to the Superior Court. These factors are shown in Figure 3-18.

Case Consideration. In 1971 the District Courts handled close to 50,000 cases for crimes against persons and property, compared to fewer than 9000 in the Superior Court. In further contrast to the Superior Court, the backlog of cases in the District Court is small compared to the flow through the court. The delay in processing cases
is also small. The District Courts do not devote the attention to
criminal cases that the Superior Court does.

In some cases it need not devote as much attention as the higher
court does. Much of the District Court's business consists of minor
misdemeanors, like drunkenness and traffic violations. By their
nature, the District Court trials require less time than Superior
court trials. No jury needs to be empanelled. The police prosecutor
usually presents a perfunctory case with little attempt to develop a
careful prosecution.20

As the number of cases flowing through the District Court has in-
creased, some judges have had to further limit the time for each case.
One approach is to limit motions in cases. As noted in the next sec-
tion, pre-trial motions have become an important, but time consuming,
part of criminal defense in the Superior Court. This situation is not
present in the District Court, because judges often frown on defense
attorneys who present motions. Bing and Rosenfeld found:

Few motions are made by defense counsel in district court
trials, further shortening the time for trial. Defense counsel
in the urban courts do not take pains to develop questions of law
that might take up much of the court's time. They recognize that
the judge may become irritated by this departure from custom.

The few motions presented are usually motions to suppress
illegally obtained evidence and motions to dismiss to [sic]
charge. In the 2,000 cases we studied in detail, however, only
ten motions were noted on the record. Five of ten motions were
successful.21

The ability of the District Court judge to limit the defense attorney's
right to bring motions arises from the trial de novo system of appeal.
Since there is no record of the trial and since the defendant gets a
Figure 3-18: Causal Loop Diagram of the District Court Regulation of Cases
new trial in the Superior Court but no review of the first trial, the conduct of the District Court judge is seldom ever reviewed by a higher court. Hence, the District Court judge is able to conduct his court as he sees fit with little review.

Discouraged from presenting a well-prepared defense, the defense attorney is either forced to appeal to the Superior Court or strike a bargain with the District Court judge.

The ennui caused by the trial de novo system influences private and assigned lawyers alike. Both are generally reluctant to employ the legal tools developed to protect the defendant in the adversary process—the filing of motions, vigorous cross-examination, arguments in summation after the case has been presented on both sides, and a carefully prepared presentation on the defendant's behalf at sentencing. In one case, we observed defendant's private attorney request a continuance to prepare a brief. The court ordered that the motion be argued orally, denied the motion immediately after oral argument, found the defendant guilty and sentenced him immediately to six months in the house of correction. The defendant's lawyer then claimed a new trial on his client's behalf. Sufficient repetition of this process, which takes no more than ten minutes, impresses even the most aggressive defense counsel with its futility, and the practical advisability of saving his energies for the Superior Court.22

In Figure 3-16 the average amount of time devoted to each case is measured by the District Court judicial caseload, which is the ratio of arrests to District Court judges. This ratio has units of cases per person-month. As the District Court judicial caseload increases, the pressure to appeal from case consideration also increases, since defense attorneys are increasingly hindered from presenting full defenses.

The pressure to appeal from case consideration is one of the factors influencing the pressure to appeal. This latter variable represents the pressures from several aspects of court operation which influence
the decision to appeal. As the pressure to appeal increases, the
fraction of convictions imprisoned appealing also rises.

**Plea Bargaining in the District Court.** The District Court judge
can utilize a form of plea bargaining to counteract the pressures for
appeal. Bing and Rosenfeld found:

Through the years, certain courts and judges have developed
pernicious practices specifically designed to discourage the
defendants from asserting their right to a new trial. The two
practices regularly employed are:

(1) Offering probation or a suspended sentence if the defen-
dant foregoes his new trial. Here the judge makes an express
bargain with the defendant.

(2) Setting a new bail requirement, often at a higher amount
than was originally set at arraignment, forcing the defendant to
pay a new premium to remain out of jail pending his new trial in
Superior Court.23

What prompts judicial manipulation is not the nature of the
individual case. The case itself only suggests which tool of
persuasion will be employed. The cause is external to the defen-
dant. It grows from a desire to shield the Superior Court from
a large number of jury trials and to preserve the stature of the
district courts by disposing of as many cases as possible.24

Figure 3-18 depicts the District Court plea bargaining mechanism
in the model. As the Superior Court judicial workload increases,
the District Court judges attempt to limit appeals. The District
Court judge has three paths open to him:

1. He can reduce the fraction of defendants convicted.
2. He can reduce the fraction of convictions imprisoned.
3. He can reduce the length of sentence for those who are
   sentenced to prison.

The third path is suggested by Bing and Rosenfeld. The first two are
suggested by the structure of the court system and data from the
District Court.
Figure 3-19: Relation between the Superior Court Judicial Workload and the Fraction of Cases Convicted

Figure 3-20: Relation Between the Superior Court Judicial Workload and the Fraction of Convictions Imprisoned

Figure 3-21: Relation Between the Superior Court Judicial Workload and the Ratio of District Court Sentence to Superior Court Sentence
Figure 3-19 depicts the relation in the model between the Superior Court judicial workload and the fraction of cases convicted. As the workload increases, the fraction of cases convicted declines. By dismissing cases, the judge screens them out of the court system, thereby preventing them from being appealed to the Superior Court.

Figure 3-20 depicts the relation in the model between the Superior Court judicial workload and the fraction of convictions imprisoned. The solid line reflects the base policy, the dashed line is a revised policy tested in Chapter 5. The larger the workload, the smaller is the fraction imprisoned. By giving probation or a suspended sentence instead of imprisonment, the District Court judge can reduce the likelihood of an appeal, since defendants who are not imprisoned are less likely to appeal than those who are.

Figure 3-21 depicts the relation between the Superior Court judicial workload and the ratio of the District Court sentence to the Superior Court sentence. This latter variable is the ratio of the average length of sentence in the District Court to the average length of sentence given those defendants who are found guilty in trials and sentenced to prison. Again the figure shows both a base policy and a revised policy. As the workload increases, this ratio declines, reflecting the assumption that District Court judges reduce sentences to make appeals less attractive when the workload is high.

The ratio of the District Court sentence to the Superior Court sentence forms an input to the District Court sentence ratio. This variable is the ratio of the District Court sentence to the sentence
Figure 3-22: Fraction of Cases Convicted, Fraction of Convictions Imprisoned, and Fraction of Imprisonments Appealed in District Court, 1950-1971

Figure 3-23: Fraction of Arrests Appealed and Fraction of Arrests Referred to Grand Jury in District Court, 1950-1971
for pleading guilty in Superior Court. This variable incorporates the assumption that the defendant and his attorney base the appeal decision, in part, on the average sentence received after guilty pleas, since the defendant will, following appeal, have his opportunity to plea bargain in higher court.

Figure 3-22 depicts the trends from 1950 through 1971 of the various dispositions of cases. During this period, when the Superior Court judicial workload was rising, the fraction of cases convicted (in District Court) has dropped from almost seventy percent to less than sixty percent. The fraction of convictions imprisoned has dropped slightly from around twenty-one percent to eighteen percent. The data suggest that probation and suspended sentences may not be used as much to limit appeals as outright dismissals. The fraction of imprisonments appealing declines in general until 1963, at which time it reverses direction. The rise is consistent with the effects of case consideration. The next section discusses another possible cause, the availability of defense lawyers.

Referrals to the Grand Jury. The plea bargaining process may also occur in determining referrals to the Grand Jury. Bing and Rosenfeld state:

It is likely that these statistics on disposition of probable cause hearings reflect a plea bargaining process. Many defendants are charged with two or more crimes, some within the jurisdiction of the district courts and other -- high felonies -- within the exclusive jurisdiction of the Superior Court. In exchange for a guilty plea on the crimes within the jurisdiction of the district court, the judge often finds no probable cause on the high felony charge. The defendant is assured a sentence which does not exceed the two and a half year district court maximum and the state is able
to avoid the time consuming process of indictment and trial in the Superior Court. Thus, the district courts play a central role not only in cases tried, but in almost every criminal case brought to court in Massachusetts.25

Figure 3-23 depicts the trend in the fraction of arrests referred to the Grand Jury. Although there is a slight downward trend in the fraction, the mechanism responds very little to changes in the Superior Court judicial workload. Hence, in the model, cases bound over to the Grand Jury are approximately a constant eighteen percent of arrests.

3.8 Impact of Defense Attorneys

The defense attorney holds an important position in criminal proceedings along with the District Attorney and the judge. Consequently, the workload on defense attorneys might be expected to influence the flow of cases, just as the workload on the other officials does. The Impact of Defense Attorney Subsector deals with these influences.

The importance of defense attorneys on the overall behavior of the Court Sector has been particularly evident since 1963. Responding to the U.S. Supreme Court's decision requiring the states to provide indigent defendants with defense counsel in felonies cases, Massachusetts has increased the availability of defense counsel through the Massachusetts Defenders Committee. The increased availability has affected trials, guilty pleas, and appeals.

Importance of Supreme Court Decisions. In the last fifteen years, the U.S. Supreme Court has made it possible for defendants to increas-
ingly exert their rights to appeal, to trials, and to more careful trials. The Honorable Edward F. Hennessey, Chief Justice of the Massachusetts Supreme Judicial Court, notes that in that period "nearly every provision of the Bill of Rights has been held applicable to the States through the Due Process Clause of the Fourteenth Amendment of the Constitution." Defendants, for example, are able as part of their defense to challenge the constitutionality of such matters as the way evidence and confessions have been obtained.

Perhaps the most important ruling was **Gideon v. Wainwright** in 1963, in which the U.S. Supreme Court ruled that in a felony case states must provide free legal counsel for defendants unable to afford private counsel. The Supreme Court extended the requirement to any felony or misdemeanor for which the penalty includes imprisonment. The availability of counsel was held to be crucial to the defendant's exercising his rights in criminal proceedings. Without trained legal assistance, the defendant is unlikely to understand how to challenge the admissibility of evidence, make other pretrial motions, defend himself in trial, or make an appeal.

After 1963, Massachusetts increased its provision of public defenders several fold. Prior to 1963, Massachusetts had been providing free legal counsel to indigent defendants on a limited basis. The Massachusetts Defenders Committee, founded in 1960 with state support, had only seven full-time lawyers in 1963. Various charitable organizations also provided free defense counsel. Since 1963, the Massachusetts Defenders Committee (MDC) has increased to 124 lawyers.
Figure 3-24: Days per Trial in the Superior Court, 1959-1974
Although there are no statistical data verifying the number of lawyers actively engaged in criminal law, the Gideon ruling probably caused an increase in the total number and availability of defense counsel, despite the enormous workload the MDC now carries. The expansion of the Massachusetts Defenders Committee was accompanied by some private organizations dropping criminal defense for the poor. However, the MDC currently handles about forty percent of criminal defenses in the Superior Court. It is doubtful that many of these defendants would have counsel without the Gideon ruling and the Massachusetts Defenders Committee.

The increase in defense attorneys has affected several aspects of the operation of the courts. One aspect is the amount of time required to try a case in the Superior Court. Discussions with court officials indicate that far more pretrial motions are heard in criminal cases now than fifteen years ago. Hearing these motions takes time, in some instances more time than the main portion of the trial.

Commenting on the federal courts, Chief Justice Warren Burger said:

Experienced district judges note that the actual trial of a criminal case now takes twice as long as it did 10 years ago because of the closer scrutiny we now demand as to such things as confessions, identification, witnesses, and evidence seized by the police before depriving any person of his freedom.31

Figure 3-24 depicts the days per trial in the Superior Court from 1959 through 1974. The data on trials are those reported by the Executive Secretary of the Supreme Judicial Court. These data cover trials for all crimes, not just those against persons and property. During the period shown, the number of days per trial has increased.
from slightly more than half a day per trial to slightly more than a
day and a half per trial. Without additional defense counsel, defend-
dants would generally be unable to present as many pre-trial motions
and trials would occur more rapidly.

The increase in public defenders is also likely to affect guilty
pleas. First, the defendant without a lawyer may be reluctant to go
to trial. Providing more defendants with legal counsel may decrease
the number of defendants willing to plead guilty.

In the opposite direction, an increase in cases relative to the
number of defense counsel is likely to result in more plea bargaining.

Bing and Rosenfeld cite the instance of the MDC:

The pressure of their caseload also forces the Massachusetts
Defenders to make some very practical decisions in representing
their clients. These decisions are partially reflected in the
way the Massachusetts Defenders Committee compiles its annual
statistics, evaluating its defense work during the year. According
to these statistics any disposition in the district court short of
a jail term is viewed as a "favorable result." The MDC definition
of a "favorable result" thus includes findings of guilty and pleas
of guilty as well as dismissals and findings of not guilty. This
grouping accurately suggests that the MDC uses plea bargaining
freely, to obtain the defendant's freedom while avoiding the time
necessary to provide a full dress defense at trial. The MDC
considers the results of that bargaining as satisfactory. Plea
bargaining is used by all attorneys to obtain freedom for a client
where the defense appears weak. For the Massachusetts Defenders
Committee, plea bargaining becomes a necessary technique to deal
with an overwhelming caseload. 32

Increased availability of defense counsel has also affected appeals
in the District Court. The unrepresented defendant is less likely to
appeal than the one with a lawyer, because without counsel the
defendant is unlikely to understand the appeal procedures or the trial
in the Superior Court. The impact of increased availability of
Figure 3-25: Causal Loop Diagram of Impact of Defense Attorneys
defense counsel is suggested by the fraction of convictions imprisoned appealing, shown in Figure 3-22. The timing of the increase in this fraction - the upturn starts in 1963 - suggests that the provision of free defense counsel resulted in a higher percentage of defendants receiving lawyers and consequently a higher fraction of appeals.

Impact of Defense Attorneys in the Model. Figure 3-25 depicts the causal loop diagram of the impact of defense attorneys on the court operations. Like the previous causal loop diagrams in this chapter, Figure 3-25 contains the Superior Court backlog and the cases entering the Superior Court and the cases leaving the court. The central variable is the defense attorney workload. Analogous to the Superior Court judicial workload and the prosecutor workload, this variable is the ratio of the Superior Court backlog to the number of defense attorneys. The model groups both private attorneys and public defenders together. The defense attorney workload has two interpretations. First, it measures availability of defense counsel. When the workload is high, that is, there are many cases compared to the number of attorneys, then some defendants will not be able to obtain attorneys. In 1970, one out of three defendants charged with "real crimes" in the District Court voluntarily did not have defense counsel. 33 Despite the guarantee of counsel for indigent defendants, the Massachusetts Defenders Committee cannot presently provide counsel for all those in the District Court who might qualify. 34 As the defense workload decreases, a higher fraction of defendants will have counsel. The second interpretation of workload is that it measures the burden on individual lawyers. A high
Figure 3-26: Relation between the Defense Attorney Workload and the Effect of Defense Attorneys on Trials

Figure 3-27: Relation Between the Defense Attorney Workload and the Effect of Defense Attorneys on Guilty Pleas

Figure 3-28: Relation Between the Defense Attorney Workload and the Effect of Defense Attorneys on Appeals
workload indicates that defense lawyers are handling a lot of cases and cannot devote the attention to each case that they might if the workload were low. As seen in Figure 3-25, the defense workload influences trials, guilty pleas, and appeals to the Superior Court, as well as the increase in defense attorneys.

Loop 10 relates the defense workload to the effect of defense attorney workload on trials. Figure 3-26 depicts the relation between the defense attorney workload and the effect of workload on trials. The latter variable is the change in trials due to workload. When the workload is one, the effect on trials is also one, so that when it is multiplied by the other variables in the equation for the Superior Court trials, it produces no change. As the workload increases, the effect on trials rises, causing an increase in trials. The relation reflects the assumption that an increase in the workload results in a decrease in attorney availability and the amount of time attorneys can devote to individual cases. Consequently, attorneys are less able to make pretrial motions, and trials proceed faster. The increase in the flow of trials tends to reduce the backlog, thereby reducing the defense attorney workload.

Loop 11 relates the defense attorney workload to guilty pleas. Figure 3-27 depicts the relation between the defense attorney workload and the effect of defense attorney workload on guilty pleas. The latter variable is the change in guilty pleas due to workload. When the workload is one, the effect on guilty pleas is also one, so that the variable has no effect on guilty pleas. As the workload rises,
the effect on guilty pleas also rises, causing an increase in guilty pleas. The relation reflects the assumption that an increasing workload causes more guilty pleas, since defense lawyers will be unable to handle the volume of cases and will have to resort to increased plea bargaining to handle the caseload. Similarly, a workload less than one will cause a drop in guilty pleas.

Loop 12 relates the defense attorney workload to appeals. Figure 3-28 depicts the relation between the defense attorney workload and the pressure to appeal from defense attorneys. This pressure is one of the components in the pressure to appeal, discussed earlier in the section on the District Court. As the defense attorney workload increases, the pressure to appeal from defense attorneys decreases, causing a reduction in appeals. The relation reflects the assumption that an increased workload results in less availability of defense counsel. With fewer defendants with counsel, appeals will decline, thereby retarding the rise in backlog and in the defense workload. Similarly, declines in the workload will cause appeals to increase.

Loops 13 and 14 represent the acquisition of defense counsel. The mechanism is analogous to the mechanism for the acquisition of judges and prosecutors. The addition of defense counsel depends on the relative workload, which is the ratio of the actual defense attorney workload to the defense attorney workload standard. As the relative workload rises, more defense attorneys are added. The standard also adjusts, so that it tends to equal the actual workload. In the case of public defenders, the mechanism reflects the governmental budgeting
process. The high relative workload is a justification for seeking more staffing from the legislature. In the case of private attorneys, the high workload represents a demand for criminal lawyers which would influence new lawyers to enter criminal practice. This mechanism is a greatly simplified representation of the market for lawyers, but should be adequate for the purposes of this model.

Exogenous and Endogenous Factors. The Impact of Defense Attorneys Subsector represents the effects of attorney availability on the flow of cases. However, it omits the role of the Supreme Court decisions on the increase in attorneys. This omission may seem strange at first, particularly since I have commented before on the Supreme Court decisions. This omission needs some clarification.

The effect of Gideon v. Wainright on the increase in public offenders is an exogenous input from the point of view of the Court Management Model. In other words, the timing of Supreme Court decisions are largely independent of conditions in the Massachusetts criminal justice system.

Since one exogenous input is used to touch off the growth in crime, other exogenous inputs are excluded to avoid confusing the dynamics resulting from various inputs. Chapter 2 briefly discusses the use of exogenous test inputs in the model. Forrester discusses their use in more detail.

This chapter has discussed the Supreme Court decision, because it produced changes which displayed the endogenous relations between defense attorney availability and the flow of cases in the court.
Figure 3-29: Causal Loop Diagram of Sentencing
These relations are endogenous because they exist within feedback loops inside the system boundary.

An implication of omitting the effect of the Supreme Court decision is that the model will not track historical data as well as it could with them. Chapter 5 shows how the behavior of appeals in the model does not exhibit as much increase as it does in actual data.

This deviation from the data does not mean that the model cannot be used for policy testing. As Chapter 5 discusses, policy recommendations are most affected by the primary structure of the model which causes the exponential growth in crime. The exogenous effect of Supreme Court decisions are unlikely to affect the policy conclusions, because they do not substantially affect the primary structure of the model. This issue could be tested more thoroughly by representing the effects as exogenous inputs in the model, but it is not pursued here.

3.9 Sentencing

The Sentencing Subsector computes the total offenders imprisoned and the sentences in the two courts. The calculations are the direct outcome of the variables discussed in the preceding sections. Therefore, their explanation is left for Appendix A. Of interest in this section is the relation between prison crowding and sentencing.

Figure 3-29 depicts the causal relation in the model between prison overcrowding and sentencing. As prisons and houses of correction
become overcrowded, judges are assumed to reduce the fraction of defendants imprisoned and the length of sentence (not shown) in both the Superior Court and the District Court. Hence, the relations form a negative feedback loop which tends to keep prison population equal to capacity.

The evidence supporting this assumption is somewhat spotty, perhaps because the prisons have not been allowed to become very overcrowded. As described in Chapter 2, parole also serves to regulate the prison population. An active parole policy can maintain the population at capacity without the intervention of judges.

However, some descriptive evidence does point to the role of overcrowding in sentencing. Discussions with officials suggest that at the county level, particularly in small counties, sheriffs may influence judges not to send offenders to county houses of correction when they become overcrowded. Since the sheriff has responsibilities in the courts as well as in the houses of correction, the judges and sheriffs are likely to see each other regularly and may reach an understanding that the judge will help prevent overcrowding.

At the state level, recent events suggest that judges try to prevent overcrowding in state institutions. For example, a District Court judge refused to sentence offenders to MCI Concord until the overcrowding was alleviated there. The Chief Justice of the Superior Courts recently had to declare a moratorium on sentencing to MCI Concord.36

The existence of unexercised feedback loops like the one relating
prison overcrowding to sentencing points out a feature of feedback systems. Hidden feedback loops exist which may not have much effect under present policies but which may come into play when new policies are introduced. Chapter 5 discusses mandatory sentencing, which might inhibit the ability of parole boards to control prison population. This change might well result in judges playing a much more important role in controlling prison population than they do currently.

3.10 The Courts as a Multi-Loop Subsystem

The preceding discussion has described several negative feedback loops in the criminal courts of Massachusetts. Focused mostly on the control of workloads in the Superior Court, these loops regulate the acquisition of manpower and the flow of cases through the courts.

Systems with several negative feedback loops, called multi-loop systems, behave in ways with which policy makers may be unfamiliar. Forrester points out that most of our knowledge about feedback systems arises from experience with single-loop systems, that is, simple systems consisting of only one feedback loop. Multi-loop systems behave differently. One quality of multi-loop systems is that they are likely to hinder the effectiveness of many policies. For example, those who advocate additional judges in the Superior Court to counteract the problem of workload are likely to find that the effects are not as pronounced as expected. Faster acquisition of
judges will be partially compensated for by reduced utilization of judges. As more judges cause the workload to drop, the reduced pressure on judges is likely to cause a shifting of judges' time away from criminal business. Thus the increase in judges will not create a proportional increase in the flow of cases from the Superior Court.

Policies which are likely to improve the functioning of the courts can be developed from an understanding of the various feedback loops. Chapter 5 discusses policies, some of which are effective, some of which are not. The effective ones are not necessarily indicated by considering the operation of each loop in isolation. The loops must be considered as a system.

This viewpoint falls in the realm of strategic planning in the criminal justice system. A system's viewpoint which considers the feedback nature of the courts should be part of the top management planning of the courts and the other agencies of the criminal justice system. Left to operate without an overall plan, the individual decision makers, each operating in the context of his own control mechanisms, will cause the court system to perform in a particular way. It is doubtful that that way will be satisfactory.
FOOTNOTES


5Other courts exist. Most, like the land court, handle civil matters. The four Juvenile Courts have been excluded from the model. The Boston Municipal Court is treated as a District Court.


7In 1974 the Appeals Court and the Supreme Judicial Court handed down a combined total of 447 written opinions compared with 34,938 cases disposed of in the Superior Court in the same year. Source: Massachusetts, Supreme Judicial Court, Executive Secretary, Eighteenth Annual Report to the Justices of the Supreme Judicial Court, Massachusetts Public Document No. 166, Boston, 1974.


9Ibid., pp. 10-11.

10A court diversion program is tested in Chapter 5, hence it is depicted in the diagram.

Executive Secretary, Supreme Judicial Court, *op. cit.*, p. 36

Edwin Powers, *op. cit.*, p. 57

Executive Secretary, Supreme Judicial Court, *op. cit.*, p. 6

Massachusetts, Supreme Judicial Court, Executive Secretary, *Seventh Annual Report to the Justices of the Supreme Judicial Court*, Public Document No. 166, (Boston, June 30, 1963) p. 10

Massachusetts, Supreme Judicial Court, Executive Secretary, *Sixteenth Annual Report to the Justices of the Supreme Judicial Court*, Public Document No. 166, June 30, 1972, p. 7


Massachusetts, Department of Corrections, *Statistical Reports of the Commissioner of Correction*, Public Document No. 115 (Boston, 1971)

Bing and Rosenfeld, *op. cit.*, p. 81

Ibid., pp. 78-79

Ibid., p. 80

Ibid., p. 90

Ibid., p. 37

Ibid., p. 13


372 U.S. 335 (1963)


Powers, *op. cit.*, p. 86
30 Massachusetts, Supreme Judicial Court, Executive Secretary, *op. cit.*, 1974, p. 36


32 Bing and Rosenfeld, *op. cit.*, p. 32

33 *Ibid.*, p. 30. The term "real crimes" is used by Bing and Rosenfeld to designate crimes other than drunkenness, traffic violations, and other minor misdemeanors.

34 Powers, *op. cit.*, p. 87


36 WCVB-TV Editorial, Mar. 14, 1975

CHAPTER IV

THE POLICE AND CORRECTIONS SECTORS

4.1 Introduction

The Police and Corrections Sectors round out the Court Management Model. Since the model focuses primarily on court policies, these other sectors play a supporting role and, therefore, contain less detail than the Court Sector.

Although the police in Massachusetts are under the control of town and city governments as well as several state agencies, in the Police Sector, all these different jurisdictions are grouped together to form one level of police capacity. Both the Massachusetts Department of Corrections and the individual counties maintain correctional facilities. The county Sheriff, an elected official, directs the operation of the county House of Correction. Generally, the Houses of Correction receive the relatively minor offenders. The State Department of Corrections maintains five major institutions as well as forestry camps and half-way houses.
In the Corrections Sector, the House of Corrections and the state institutions are aggregated, so that there is one level of prisoners.

4.2 The Police Sector

The Police Sector deals with two police activities: patrolling and investigation. The President's Commission on Criminal Justice states:

The heart of the police effort against crime is patrol—moving on foot or by vehicle around an assigned area, stopping to check buildings, to survey possible incidents, to question suspicious persons, or simply to converse with residents who may provide intelligence as to occurrences in the neighborhood.

The object of patrol is to disperse policemen in a way that will eliminate or reduce the opportunity for misconduct and to increase the likelihood that a criminal will be apprehended while he is committing a crime or immediately thereafter....

When patrol fails to prevent a crime or apprehend a criminal, the police must resort to investigation. Some investigation is carried out by patrolmen, but the principal responsibility rests with detectives. Investigation aims at identifying offenders through questioning victims, suspects, witnesses, and others, through confronting arrested suspects with victims or witnesses, through photographs or, less frequently, through fingerprints or other laboratory analysis of evidence found at crime scenes.1

Crimes generated in the Crime Sector form the input into the police sector. The police will intercept a fraction of those crimes through patrol activities. The remainder form potential
Figure 4-1: Causal Loop Diagram of the Police Investigations
cases for investigation.

**Police Investigations.** Figure 4-1 depicts the causal loop diagram of the factors affecting police investigations. The structure is similar to the case processing and capacity acquisition sections of the Basic Criminal Justice Model. At the top of the diagram is the police case backlog, which is the backlog of cases awaiting investigation and disposition by the police. Crimes reported feed the backlog, while police cases closed deplete it. The central variable in the causal structure is the police workload. Similar in form to workloads in the Court Sector, the police workload is the police backlog divided by police investigation manpower. This variable is the police manpower devoted to investigating crimes.

Loop 1 relates the police workload to crimes reported. Crimes reported are those crimes, not already intercepted by police patrols, which are reported to the police for investigation. The fraction of crimes reported is assumed to depend on the police workload. Figure 4-2 depicts the relation between the police workload and the fraction of crimes reported. As the police workload increases, the fraction of crimes reported declines. This relation reflects the assumption that a high workload indicates an overburdened police force. The police then become unresponsive to reports of crimes, giving the citizenry the impression that the police can do little about crime. As the backlog rises, the police workload increases, producing a
Figure 4-2: Relation Between Police Workload and the Fraction of Crimes Reported

Figure 4-3: Relation Between Police Workload and the Police Capacity Utilization Factor
decreased fraction of crimes reported. The resulting reduction in the flow of crimes reported tends to limit the increase in backlog.

Victimization surveys have shown that lack of confidence in the ability of the police to counteract crime or recover property is one reason for victims not to report crimes. Unfortunately, these surveys have not been conducted in the same location over a period of time to see how reporting rates change with the effectiveness of the police. However, it seems reasonable that declines in the backlog of cases, resulting in the police being able to give cases more attention, would improve the public's impression of police effectiveness and increase the fraction of cases reported.

Loop 2 relates the police workload with the police capacity utilization factor and police cases closed. Police cases closed are those cases either solved and sent to the District Court or those cases which are unsolved, but are no longer receiving active attention. The police capacity utilization factor represents changes in the flow of cases closed due to the police workload. Figure 4-3 depicts the relation between the police workload and the police capacity utilization factor. The relation reflects the assumption that as the workload grows, the police take steps to move cases faster. They may spend less time on each case or may close out cases more readily. To move cases faster, the police are assumed to investigate less carefully
Figure 4-4: Relation Between the Police Workload and the Fraction of Cases Resulting in Arrest

Figure 4-5: Relation Between the Relative Workload for Police and the Percent Increase in Police Capacity per Month
and make arrests in a smaller fraction of cases. Figure 4-4 depicts the relation in the model between the police workload and the fraction of cases resulting in arrests. Investigations resulting in arrests and crimes intercepted (described below) form the flow of arrests to the District Court.

The lower portion of Figure 4-1 depicts the acquisition of police capacity. The formulation is analogous to the one used for judges, prosecutors, and defense attorneys in the Court Sector. An increase in the police workload causes the relative workload for police to rise. The relative workload is the ratio of the actual police workload to the police workload standard. A high relative workload creates pressures for more police. Figure 4-5 depicts the relation in the model between the relative workload for police and the percent change in police capacity per month. The solid line depicts the case relation, intended to reflect the current policy in Massachusetts. The dashed line depicts a revised policy of faster acquisition of police, one of the policies tested in Chapter 5. In the case relation, the change in police is negative when the relative workload is less than one, representing the assumption that police manpower will be reduced if the case backlog is less than normal. As the relative workload rises above one, the percent increase in police rises.

In Loop 3, the increase in police reduces the police workload, since the police capacity occurs in the denominator of that ratio.
Figure 4-6: Causal Loop Diagram of Crimes Intercepted by Police
In Loop 4 the increase in police causes an increase in police cases closed, and, consequently, tends to reduce the backlog and the police workload.

In Loop 5 the relative workload affects the workload standard. As the relative workload increases, the police workload standard increases to match the actual workload.

**Crimes Intercepted.** Crimes intercepted by police are those crimes which are detected in progress by police patrol and which result in an immediate arrest. Figure 4-6 depicts the factors affecting crimes intercepted. In this figure, Loop 6 relates the police workload to the fraction of capacity on patrol and crimes intercepted. In this figure, Loop 6 relates the police workload to the fraction of capacity on patrol and crimes intercepted.

Two factors directly affect the fraction of crimes intercepted, the police patrol ratio and the change in the police patrol ratio. Figure 4-7 depicts the assumed relation between the police patrol ratio and the effect of police patrol on crimes. The relation is derived as follows: Consider the number of crimes intercepted as determined by the equation

\[
\text{CRIP} = (\text{NFCRIP})(\text{CRIME})^{1-b}(\text{PPM})^b
\]

where

- CRIP is crimes intercepted by police
- NFCRIP is the normal fraction of crimes intercepted by police
- CRIME is the number of crimes per month
- PPM is the police patrol manpower

The formulation has several desirable features. First, there will be no crimes intercepted if either (a) there are no crimes
Figure 4-7: Relation Between the Police Patrol Ratio and the Effect of Police Patrol on Crimes Intercepted

Figure 4-8: Relation Between the Fraction of Ex-Offenders Committing Crimes and the Fraction of Ex-Offenders Imprisoned
or (b) there is no police patrol. The multiplicative formulation captures that feature. Second, the equation exhibits constant returns to scale in both crimes and police patrol manpower; if crimes and police manpower double, the number of crimes intercepted doubles. Third, it also shows diminishing returns to police manpower alone. As long as \( b \) remains less than one, doubling police manpower produces somewhat less than twice the crimes intercepted. Because of these features, this type of formulation has been used in econometric studies of the effectiveness of police.\(^3\)

The equation above can be restated as:

\[
\text{CRIP} = (\text{NFCRIP})(\text{CRIME}) \exp (b \logn(\text{PPM/CRIME}))
\]

where \( \exp \) is the exponential function \( \exp(y) = e^y \) and \( \logn \) is the natural logarithm function. Letting

\[
\text{EPPCI} = \exp(b \logn(\text{PPM/CRIME}))
\]

and substituting it in the previous equation produces:

\[
\text{CRIP} = (\text{NFCRIP})(\text{CRIME})(\text{EPPCI})
\]

where \( \text{EPPCI} \) is a function of the police patrol ratio \( \text{PPM/CRIME} \).

This function is depicted in Figure 4-7, using a normalized value of the police patrol ratio. The relation is depicted on logarithmic scales so that the graph forms a straight line with a slope equal to \( b \).

The value of \( b \) reflects the effectiveness of police patrol. If \( b \) were zero, that is, if the line in Figure 4-7 were level, then increasing police would have no effect on crimes intercepted. If the
slope were one, crimes intercepted would be exactly proportional to
police manpower and unaffected by the volume of crimes. A reason-
able assumption is that the slope is somewhere in between, as shown
in Figure 4-7.

Returning to Figure 4-6, the second factor affecting crimes
intercepted is the change in the police patrol ratio. When police
patrols are increasing quickly relative to crime, more crimes will be
intercepted than if the increase is slow. The justification is that
rapid changes in patrols catch criminals unaware before they move on
to locations where there is less police activity.

In Loop 6, the police patrol manpower is the product of total
police capacity and the fraction of capacity on patrol. Police poli-
cies determine this fraction. These policies in turn are assumed to
respond to pressures within the police departments and from the commu-
nity. One of these pressures is due to community apprehension over
crime. As crime rises above what people have come to expect, there
is increased pressure for more police on the street. Another factor
is the police workload. As the backlog of cases builds up, there is
pressure to take police off of patrol to use them in investigation.
This relation completes Loop 6.

4.3 The Corrections Sector

The Corrections Sector of the Court Management Model is
almost identical to the Corrections section of the Basic Criminal Justice Model in Chapter 2. Therefore, this section only briefly summarizes the structure of the sector and indicates the differences between the structure in this sector and the structure in the Basic Criminal Justice Model.

Like the Police Sector, the Corrections Sector is not intended to be as comprehensive and detailed as the Court Sector. Rather, it provides enough supporting structure representing corrections to complete the model. Two concepts are central to the sector: the role of prisons in increasing the propensity of ex-offenders to commit crimes, and the influence of limited prison capacity on the length of the average effective sentence.

Chapter 2 discussed the impact of imprisonment on inmates, suggesting that some evidence exists supporting the hypothesis that ex-offenders have a higher propensity toward crime than potential new offenders. The Corrections Sector incorporates this assumption by disaggregating ex-offenders and potential new offenders. The flow diagram (Figure 2-21) from the Basic Criminal Justice Model shows how this disaggregation is accomplished. Based on the total offenders imprisoned, new and ex-offenders imprisoned enter the pool of prisoners. After serving their sentence, they enter the pool of ex-offenders. In the Crime Sector, ex-offenders are assumed to commit on the average a substantially higher number of crimes per person than potential new offenders.
Figure 4-9: Prison Population in Massachusetts, 1950 – 1971
Chapter 2 also discussed the determination of the average effective sentence. Like the Basic Criminal Justice Model, the Corrections Sector uses the PROUT macro to compute the level of prisoners, the average effective sentence, and the fraction of prison overcrowding. Figure 2-22 depicts the flow diagram of the macro. As the population of prisoners grows and exceeds the prison capacity, the average effective sentence, or the sentence which the average prisoner actually serves, is reduced to increase the flow of released prisoners. Evidence for this control mechanism is contained in the data on the Massachusetts prison population. Figure 4-9 depicts the total number of prisoners in both state and county facilities (excluding Bridgewater) and the flow of total offenders imprisoned. Although total offenders have not risen nearly as much as crimes since 1950, they have increased by over eighty percent. In contrast, the prison population has remained essentially level except for fluctuations around the average population for the period. The behavior of prison population suggests the role of the adjustment mechanism in controlling population by reducing the average effective sentence.

Two differences exist between the Corrections Sector and the Basic Criminal Justice Model. The more extensive one is the addition of equations for the court diversion program. These equations are discussed in Chapter 5. The second difference is a revised formulation of the fraction of offenders imprisoned. Figure 4-8
depicts the relation between the fraction of ex-offenders committing crimes and the fraction of ex-offenders imprisoned. When the fraction committing crimes is zero, the relation indicates that no ex-offenders will be imprisoned. Similarly, when the fraction committing crimes is one, all those imprisoned are ex-offenders. For values in between, the curve lies above a straight line connecting the zero/one points. This curvature reflects the assumption that ex-offenders are more likely to be imprisoned for their crimes than new offenders.

The Corrections Sector completes the Court Management Model. Chapter 5 discusses how the model behaves.


CHAPTER V
DYNAMICS OF THE COURT MANAGEMENT MODEL

5.1 Introduction

Previous chapters have outlined the structure of the criminal justice system as represented in the Court Management Model. Chapter 2 outlined the basic feedback loops in the overall system. Chapter 3 discussed the adjustment mechanism in the courts. Chapter 4 explained the assumptions in the Corrections and Police Sectors.

Chapter 5 investigates the implications of the assumptions in the Court Management Model. The chapter addresses several questions:

1. What is the dynamic behavior of the model? As Chapter 2 did for the Basic Criminal Justice Model, this chapter discusses the Base Run of the Court Management Model, emphasizing how the feedback loops create its behavior.

2. Is the model valid? This chapter discusses the validation of the model and compares the model behavior with data from the Massachusetts criminal justice system.

3. How do a variety of policies affect crime and the operation of the courts, police, and corrections? A number of policies, parti-
circularly those relating to the courts, are tried out on the model.

4. How might changes in assumptions affect the results from
the model? The chapter describes sensitivity tests that partially
answer this question.

5.2 The Base Run: Crimes

Figures 5-1 through 5-7 present the Base Run. Figure 5-1
depicts the four major feedback loops in the Court Management Model.
Figure 5-2 depicts crimes, crimes known to the police, arrests, and
total offenders imprisoned. Variables are depicted as percentage
changes over their initial values. This scaling permits comparing the
changes in different variables. Figure 5-3 presents some sensitivity
tests used in explaining the behavior of the Base Run. Figure 5-4
through 5-6 depict variables from the Court Sector of the model and
Figure 5-7 depicts variables from the Corrections Sector.

During the forty years of the simulation, crimes increase 397
percent. Initially growing exponentially, crimes begin to level off
after month 180, reaching an equilibrium at a high volume of crime.
Crimes known to the police, the sum of crimes reported and crimes
intercepted, increase by 292 percent. Arrests increase 192 percent,
indicating a declining clearance fraction for the police. Total offen-
ders imprisoned increase 105 percent, indicating that the perceived
imprisonment ratio drops and remains below its original value. The
Figure 5-1: Causal Loop Diagram of the Principal Feedback Loops in the Court Management Model
Figure 5-2: Simulation of the Court Management Model: Base Run—Crimes, Crimes Known to Police, Arrests, and Total Offenders Imprisoned

Figure 5-3: Simulation of the Court Management Model: Comparison of Crimes for Runs S1, S2, S3, and Base
system as a whole does not regain its original deterrent effectiveness.

The Base Run raises several questions about the behavior:

1. Why do crimes grow exponentially for a period of time?
2. Why do crimes level off?
3. Why do crimes not return to their original value?

**Exponential Growth.** As with all exponential growth, the growth in crimes results from the positive feedback loops in the model. Figure 5-1 depicts a causal loop diagram of the principal feedback loops in the model. Loop 1 is a positive loop relating crimes, the perceived imprisonment ratio, and the effect of deterrence on crimes. An increase in crimes tends to reduce the perceived imprisonment ratio, stimulating further increases in crimes. Chapter 2 showed how Loop 1 produces an exponential increase in crimes. Loops 3 and 4 reinforce the increase. In Loop 3, an increase in crime produces an increase in the flow of total offenders imprisoned. This increase results in overcrowding in the prisons. Therefore, prisoners are paroled earlier than before, causing the average effective sentence to decrease and further stimulating the increase in crimes. In Loop 4, an increase in crime and the resulting increase in total offenders imprisoned increases the flow of offenders through the prisons and into the pool of ex-offenders. Since ex-offenders are assumed to have a higher propensity toward crime than others, the increased pool of ex-offenders results in more crime.

**Leveling Off.** The leveling off in crimes results from two factors. First, when the perceived imprisonment ratio drops below 0.5,
Loop 1 operates in a flatter portion of the EIC curve. (See Figure 2-3.) A decrease in the perceived imprisonment ratio causes less of a change in crimes there than when the loop operates in a steeper portion. This behavior is shown in the simulation in Figure 2-6. Second, by month 180 the total offenders imprisoned are rising fast enough that the perceived imprisonment ratio slows its decline. This adjustment is the result of Loop 2 in Figure 5-1. Loop 2 is a negative loop relating crimes, total offenders imprisoned, the perceived imprisonment ratio, and the effect of deterrence on crimes. This loop incorporates the criminal justice system's attempt to control crime through increasing the number of criminals sentenced to prison. An increase in crime produces an increase in total offenders imprisoned, thereby partially restoring the perceived imprisonment ratio to its original value.

**Failure to Decline.** Unlike in the Basic Criminal Justice Model, in the Court Management Model crimes do not decline after reaching their peak. Extending the Base Run past month 480 confirms that crimes are in equilibrium by month 480. The reason for not returning to the original value can be seen in a comparison of four runs shown in Figure 5-3.

The graph in Figure 5-3 depicts the behavior of crimes for four simulations. All were created with a fifty percent step increase in the test input. The curve labeled Base Run results from a simulation using the Base parameters in the model. Since the test input here is larger than in the Base Run shown in Figure 5-2, crimes rise to a
higher level. The other curves result from simulations using combinations of variable or fixed workload standards and the presence or absence of the effect of sentence on crime. In Run S1, workload standards for police, Superior Court judges, District Attorneys, and defense attorneys are held constant and the effect of sentence on crime is eliminated. In Run S2, workload standards are allowed to vary as in the Base Run, but the effect of sentence on crime is eliminated. In Run S3, the effect of sentence on crime is retained, but standards are fixed. The simulations show that only in the Base curve do crimes remain at a high value. In other words, the combination of variable standards and the effect of sentence operate together to keep crimes from falling.

Chapter 2 discussed why crimes might return to their original value. The relationship between the perceived imprisonment ratio and crimes works both ways. Just as an increase in crime results in further increases, a decrease produces further decreases. The simulation in Figure 2-20 depicts how the process can occur.

When variable standards and the effect of sentence length on crime are combined, two influences prevent crimes from declining. First, increasing the total offenders imprisoned produces a tradeoff. As total offenders imprisoned increase, the average effective sentence decreases, partially offsetting the improvement in deterrence. When the effect of sentence is eliminated, the factor does not prevent the increase in the perceived imprisonment ratio from improving deterrence. Second, variable standards alleviate pressures for in-
creasing manpower. When standards are fixed, manpower must be built up until the workload returns to its initial value. In the process, case processing capabilities build up, so that the total offenders imprisoned increase to restore the deterrent value of the system. When standards are variable, they adjust partially in lieu of the manpower. The total offenders imprisoned do not increase enough to restore the system to its original deterrent value.

5.3 The Base Run: Superior Court

Figure 5-4 depicts the total cases processed in Superior Court, broken down by trials, guilty pleas and dismissals. Each of the three categories is further divided between the increase resulting from more judges and the increase resulting from expanding the number of cases processed per judge. Figure 5-5 depicts appeals and indictments entering the Superior Court. Figure 5-6 depicts other variables from the Court Sector.

In response to the increase in crime, total cases processed in the Superior Court increase 186 percent. The influx of cases into the court drives up the workloads, bringing into play the adjustment mechanisms discussed in Chapter 3. As shown in Figure 5-6, Superior Court judges rise rather slowly, hence the rise accounts for only fifty-nine percentage points of the 186 percent increase (see Table 5-1). Since Superior Court cases dismissed increase faster than other
Figure 5-4: Simulation of the Court Management Model: Base Run--Disposition of Cases in Superior Court

Figure 5-5: Simulation of Court Management Model: Base Run--Cases Entering Superior Court
Table 5-1

THE INCREASE IN CASES DUE TO THE INCREASE IN SUPERIOR COURT JUDGES - SIMULATION OF THE COURT MANAGEMENT MODEL - BASE RUN

<table>
<thead>
<tr>
<th></th>
<th>Trials</th>
<th>Dismissals</th>
<th>Guilty Pleas</th>
<th>Total Cases Processed in Superior Court</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases per Month in Month 0</td>
<td>45</td>
<td>22</td>
<td>212</td>
<td>279</td>
</tr>
<tr>
<td>Cases per Month in Month 480</td>
<td>163</td>
<td>119</td>
<td>516</td>
<td>798</td>
</tr>
<tr>
<td>Percent Increase from Month 0 to Month 480</td>
<td>262%</td>
<td>441%</td>
<td>143%</td>
<td>186%</td>
</tr>
<tr>
<td>Increase in Cases due to Increased Judges</td>
<td>27</td>
<td>13</td>
<td>126</td>
<td>166</td>
</tr>
<tr>
<td>Percent Increase in Cases due to Increased Judges</td>
<td>59%</td>
<td>59%</td>
<td>59%</td>
<td>59%</td>
</tr>
</tbody>
</table>
Figure 5-6: Simulation of the Court Management Model: Base Run--
Selected Court Variables

Figure 5-7: Simulation of the Court Management Model: Base Run--
Corrections Sector
categories, the fraction of cases dismissed increases, while the fraction of cases resolved through guilty pleas declines.

A notable feature of the Court Sector is the substantial rise in the court delay, from three months to nine and a half months. The adjustment mechanisms are too weak to prevent it from increasing.

5.4 The Base Run: Corrections

Figure 5-7 depicts the population of prisoners, the average effective sentence, and the population of ex-offenders, as well as the perceived imprisonment ratio. Due to limited prison capacity, as the flow of offenders imprisoned (Figure 5-2) increases, the prison population cannot rise without causing overcrowding. The average effective sentence declines to control overcrowding. The increase in offenders imprisoned results in an increase in prisoners released (not shown) which raises the population of ex-offenders.

The Base Run shows how the interaction of the criminal justice system with crime can result in the exponential growth of crime. The model, of course, does not prove that this interaction is the cause; but by showing how these interactions can produce the problem, the model provides a framework for further investigating whether or not it is a cause. Later on, this chapter discusses under what circumstances the model will not produce exponential growth in crime.

The Base Run also highlights two problems facing the criminal jus-
tice system. First, the system amplifies changes in crime from outside factors. Amplification is probably not a property that people attribute to organizations, perhaps because they feel that organizations are self-correcting and stabilizing. They believe that as a problem occurs, an organization takes steps to correct the problem and the situation is brought back to normal. The structure of the criminal justice system results in amplification of changes, which causes instability in the system. The second problem is that the system tends to stagnate at a low level of performance. Rather than gradually returning to its original deterrence capability, the system remains at a low value of deterrence. Both these problems should be the concern of officials in the criminal justice system. Later sections discuss policies which appear to help solve these problems.

5.5 Model Validity

Having determined the behavior of the model, it is now appropriate to look at the validity of the model. Model validity is a widely debated topic, often with little agreement on what constitutes a valid model. Forrester has commented on this debate and on the subject in general.2 Without discussing this debate in detail, the next sections compare the model with data from the Massachusetts criminal justice system and discuss the significance of the comparison.
Forrester\(^3\) points out that a dynamic model should be evaluated at two levels:

1. Model structure, including the system boundary, the interaction of variables, and the values of parameters
2. The behavior of the whole model.

Evaluating the model structure means seeing if the individual assumptions in the model correspond to one's understanding of the causal links in the system. This requirement does not rule out the simplification, but the assumptions should match the important causal relations in the actual system.

In one sense, the validation of the model structure has proceeded throughout the previous chapters. Chapters 2, 3, and 4 compared individual assumptions with descriptions of the criminal justice system written by individuals with either direct experience in the system or experience in studying it. The assumptions have also been checked through interviews with officials in the Massachusetts criminal justice system.

These comments are not intended to suggest that everyone agrees with the assumptions. In particular, the effects of criminal sanctions on crime and of prison on ex-offenders are controversial. Moreover, assumptions in the model might require modification to reflect different uses for the model. For example, the police sector would most likely need to be expanded, if a thorough analysis of police policies were desired. Finally, various people might differ over the interpretation of the information used in building the model.
Thus, in another sense, evaluation of the model structure is never complete. An individual user of the model might well wish to change assumptions. The model aids in this process by permitting flexibility in changing parameters and structure.

The second level of model evaluation is judging the behavior of the whole model. The output from the simulation is compared with data from the actual system. The principal criterion is whether the model, from within its own internal dynamics, produces behavior like that observed in the real system. In particular, the model should generate the symptoms of the problem under study. This evaluation is sometimes called whole model testing.

Sometimes in the social sciences, whole model tests are considered the test of model validity. Models are judged by their ability to reproduce past data as closely as possible and to forecast future events accurately. Models which accomplish this feat are considered valid regardless of the model structure.

Practitioners of system dynamics do not generally hold this view. Whole model tests are seen as one of several tests of validity. The model user or evaluator should neither expect too much from a whole model test or place too much confidence in it, for several reasons.

First, a system dynamics model should produce the general characteristics of the system's behavior, but it need not exactly reproduce past behavior. As noted in Chapter 2, dynamic behavior arises from three sources, the structure of the system, external inputs, and initial values. A model is expected to produce the important symptoms
within its dynamic structure without the influence of extensive external inputs. Since complex external influences do in fact have some effect on system variables, the model cannot be expected to reproduce past values precisely. The Court Sector provides an example of this situation. As described in Chapter 3, recent U.S. Supreme Court decisions have resulted in an increase in pre-trial motions in criminal cases. This increased burden on the courts has added to the court delay. From the point of view of the Court Management Model, this change results from external factors. Hence, the actual delay observed in the Massachusetts Superior Court may well be longer than that produced by the model. However, the principal cause of delay is the growth in criminal cases. The external factor neither invalidates the underlying assumptions about the causes of the growth in crime, nor is it likely to affect the policy conclusions substantially.

Second, by adjusting parameters, the modeler can improve the fit between data and model output without improving the validity of the model. By the time the modeler is ready to subject the model to a serious comparison with the data, the model generally produces behavior similar to that observed in the system. Otherwise he would have rejected the structure and reformulated the model. Once a model shows the fundamental behavior of the system, adjustments in parameters can improve the fit. If this process is done intelligently and honestly, it can be useful. A discrepancy between the data and the model output may indicate a factor overlooked or faulty structure in the model.
However, correcting the structure should only be done if it can be justified on other grounds besides the improvement of fit. The modeler should be able to support the change with descriptive material about the system. As the discrepancies between data and model output become smaller, they become less important, since they arise less from system structure and more from noise in the system or minor external factors. The modeler can continue to improve the fit, but with little benefit. A system dynamics model usually has several parameters so that numerous adjustments can be made. Small adjustments usually have little impact on the final behavior modes and policy conclusions, so that they add little to the understanding of the system. In fact, they may be misleading because the modeler attempts to adjust an internal parameter to compensate for an external influence. Hence, the modeler should not try to fine tune his model to fit the data as closely as possible.

Third, some behavior modes in systems do not permit discrimination among different model structures. One such mode is exponential growth. When a system is experiencing exponential growth, most variables are moving in one direction, either up or down. The behavior indicates that one or more positive feedback loops are present, but may not indicate which ones are responsible for the growth. The behavior of the criminal justice system in Massachusetts has been in this type of growth mode since the 1950's. Consequently, any model which is dominated by positive feedback is likely to produce at least some variables which will match the data well. A close fit between data and model output can result from an incorrect system structure which hap-
pens to have a behavior mode like that of the system under study.

Despite the limitation of whole model testing, it does provide a useful check on whether the model behaves reasonably. Reasonable behavior is the first criterion which a model must pass. Some models never get past this point.

The next section presents several whole model tests. In considering these tests, the reader should keep in mind the following:

1. Whole model tests are only one kind of test for establishing confidence in the model.

2. The internal structure of the model should produce behavior, problems, and symptoms generally like those observed in the actual system.

3. The model should not be expected to reproduce the values of system variables precisely.

4. Because the general behavior mode of the actual system is exponential growth, the data comparisons do not provide a particularly discerning test of the model.

5. Whole model tests are most useful as tests to show that at least the model behaves in a reasonable manner.

5.6 Whole Model Tests of the Court Management Model

Figure 5–8 through 5–13 present a series of comparisons between data from the Massachusetts criminal justice system and the output
from the Base Run of the Court Management Model. For convenience, the Massachusetts data are called "state data" and output from the Base Run "model output". Each figure consists of two graphs, the top presenting the state data and the bottom presenting model output. Corresponding variables are always plotted on the same scales.

Much of the state data cover only crimes against persons and crimes against property. The Massachusetts Department of Corrections reports much of its data by three major categories of crime: crimes against property, crimes against persons, and crimes against public order. Crimes against property include breaking and entering, larceny, and auto theft. Crimes against persons include murder, rape, robbery and assault. Crimes against property and crimes against persons include most of the crimes which can be thought of as "serious crimes."

Crimes against public order include drunkenness and motor vehicle violations, as well as such victimless crimes as prostitution and gambling. Since the number of motor vehicle and drunkenness cases far exceeds the number of serious crimes, any study of serious crimes must exclude these minor violations from the data. Otherwise they obscure the factors affecting the serious crimes. Using only crimes against property and crimes against persons is a convenient way to exclude the effect of minor offenses. In some instances, however, the data are reported only on a basis of all crimes, so that minor violations are not excluded.

For comparison, month zero in the model corresponds to the start of 1955 in the state data. This correspondence is used for two reasons.
Figure 5-8: Comparison of the Court Management Model and State Data: Crimes Known to Police, Arrests, and Clearance Fraction
First, data from 1955 were used to initialize the model. Second, 1955 is roughly the start of the growth in crime. In the early 1950's, arrests, trials, imprisonments, and other variables were relatively constant. The dramatic increase in crime commenced during the last half of the 1950's.

**Crimes and Police.** Figure 5-8 compares the behavior of crimes known to the police, arrests, and the police clearance fraction. In the state data, crimes known to the police are from the FBI crime index for Massachusetts. Since this index does not include all of the crimes considered in the model, the absolute values of the index and the crimes known to police in the model are not comparable. Therefore, the two graphs show the changes in the index relative to their initial values. The model output exhibits the same exponential growth as the index of crimes, but the rate of growth is slower than in the state data. By 1971, the actual data show an increase of over 400 percent, while the model output shows an increase of almost 200 percent.

The slower growth of crimes in the model could result for at least two reasons. First, the true relations between deterrence and crime could be stronger than those used in the model. Second, outside factors could account for the additional rise. For example, the model uses a constant population, while the Massachusetts population has increased by approximately seventeen percent. The population in the age group from fifteen to thirty-five has increased even more. Other external factors could well add to the rise in crime.

The discrepancy between crimes in the model and in the state data
Figure 5-9: Comparison of the Court Management Model and State Data: District Court Variables
will affect the fit of other variables in the system. As other comparisons will show, since crimes in the model do not increase as fast as in the state data, variables dependent on crime will also not increase as much.

In 1966, the Massachusetts Department of Corrections began reporting arrests for categories of crime matching the categories of the FBI crime index, presumably to permit the computation of the police clearance fraction. This fraction, also referred to as the clearance rate, is the fraction of crimes known to the police cleared by an arrest. Figure 5-8 depicts the police clearance fraction for the model output and the state data. Unfortunately, the state data series is short. However, during the period shown, both the state data and the model output show a similar decline.

Arrests in Figure 5-8 are defined as cases brought before the District Court. The state series is for crimes against persons and property. Both the state data and the model output exhibit exponential growth resulting from the growth of crimes. Since crimes in the model do not grow as fast as in the state data, arrests also show a lower rate of growth in the model.

**District Court.** Figure 5-9 compares the state data with model output for selected variables in the District Court. The variables shown are appeals to the Superior Court, District Court defendants imprisoned (and not appealing), the fraction of cases appealing, and the fraction of defendants imprisoned in District Court. Again, the state data cover crimes against persons and property.
Figure 5-10: Comparison of the Court Management Model and State Data: Trials, Dismissals, Guilty Pleas, and Defendants Imprisoned in Superior Court
The model produces a general upward trend in appeals, but not as strong as shown in the state data. The difference is emphasized by the fraction of cases appealed, which is the ratio of appeals to arrests. While the model shows the ratio declining slightly, the state data move sharply upward after 1963. This trend was already noted in Chapter 3 in the discussion of the impact of defense attorneys. There it was hypothesized that the increase in public defenders caused the increase in the fraction of cases appealed. Since the model generates the number of public defenders within its own internal structure and does not take into account the impact of U.S. Supreme Court decisions on the increase in public defenders, the number of appeals could well be lower in the model than in the state data. While the increase in appeals will affect the system as a whole, the difference is not critical to its functioning.

District Court defendants imprisoned are those cases in which the defendant is sentenced to prison and does not appeal. The fraction of defendants imprisoned in the District Court is the ratio of district court defendants imprisoned to arrests. The model exhibits both the downward trend in the fraction of defendants imprisoned in District Court and the slow rise in District Court defendants imprisoned seen in the state data.

**Superior Court.** Figure 5-10 depicts the first of three sets of graphs comparing data from the Superior Court to model output. Figure 5-10 compares the Superior Court trials, Superior Court cases dismissed, Superior Court guilty pleas, and Superior Court defendants
Figure 5-11: Comparison of the Court Management Model and State Data: Fraction of Cases Pleading Guilty, Tried, and Dismissed in Superior Court
Figure 5-12: Comparison of the Court Management Model and State Data: Superior Court Delay, Superior Court Judges, and the Indicated Superior Court Session
imprisoned. The model produces the general upward trend seen in the state data, except that the flows in the model do not increase as much.

Figure 5-11 compares the fraction of cases processed as trials, guilty pleas, and dismissals. The model generally corresponds with the state data. In particular, the model shows guilty pleas dropping as a fraction of defendants imprisoned also drops in the model as well as in the state data.

Figure 5-12 depicts the comparison of the Superior Court delay, Superior Court judges, and the indicated Superior Court session. These data are drawn from the Annual Report of the Executive Secretary of the Massachusetts Supreme Judicial Court and cover all cases brought before the Superior Court. The model exhibits a growth in the delay similar to that shown in the state data, but not as great. Again, the discrepancy arises out of the slower growth of crime in the model. The indicated Superior Court session corresponds to the total trial days per month in the state data. Like the delay, the indicated session grows like the state data but not as much. The third variable is the number of judges. The state data move in steps, since, of course, the state does not increase the number of judges in fractional parts and the increases usually occur three or more at a time. The model uses a continuous process, which can be considered an approximation of the discrete increments. The model displays a similar increase in judges as the state data, although most of the increase occurs later than in the state data.

**Corrections.** Figure 5-13 compares the prison population, total
Figure 5-13: Comparison of the Court Management Model and State Data: Corrections Sector
offenders imprisoned, the average effective sentence, and the fraction of arrests resulting in imprisonment. The prison population is the average daily population in both state and county institutions excluding Bridgewater. The population data show that the number of prisoners has varied within a fairly small range despite the increase in total offenders imprisoned. The state data exhibit a slight downward trend and a dip around 1967. The model exhibits the general levelness of the population, but does not reproduce the dip.

Total offenders imprisoned are defendants sentenced from both District and Superior Courts to state and county institutions. Both the model and the state data exhibit similar growth in total offenders imprisoned. The fraction of arrests imprisoned is the ratio of total offenders imprisoned to arrests. The model shows a decline similar to the state data, but it is not as great a decline.

The average effective sentence is the number of months the average prisoner spends in prison. Appendix B explains the way this figure was calculated using state data. The model and the state data exhibit similar declines.

Summary. The purpose of the previous tests has been to show the reasonableness of the behavior of the Court Management Model. The tests show that the assumptions of the Court Management Model generate some of the major symptoms of problems in the criminal justice system: exponential growth in crime, a decline in the police clearance fraction, an increase in the Superior Court delay, a decline in the fraction of arrests resulting in imprisonment, and a decline in the average
effective sentence. The tests also show some discrepancies between the state data and the model output. However, they do not cast doubt on any of the major assumptions in the model, although in some instances the discrepancies might suggest further revision of the model as part of a continuing investigation of its structure.

5.7 Overview of Policy Tests

Policy testing is one of the payoffs from a model. Having looked at the causes of the current behavior of a system, the modeler then turns to considering what can be done to improve system performance. The next six sections discuss several policies, including some which are the subject of current debate. The policies are:

1. Increased police
2. Increased judges
3. Increased plea bargaining in the Superior Court
4. Increased plea bargaining in the District Court
5. Increased trial efficiencies
6. Court diversion program
7. Increased prison capacity

Unlike most of the policies tested in Chapter 2, the policies discussed in this chapter are, with a few exceptions, implemented in month 192 in the simulation. During the first 192 months, the policy tests proceed as in the base simulation. Then in month 192, the new policy is insti-
tuted. Month 192 was chosen because it is a point when crime is growing rapidly. In addition to the policy simulations, there are several test simulations which examine the response of pieces of the model.

5.8 Increased Police and Judges

Wilson⁷ notes that often the average citizen sees an increase in police as the answer to the crime problem. Since the police are the most visible part of the criminal justice system, they are the natural recipients of public support and funding (but also criticism). Historically, police personnel have increased faster than judges. In Massachusetts, the equivalent full-time police personnel (uniformed and civilian) increased from 12,943 in 1969 to 15,873 in 1973, an increase of twenty-three percent.⁸ During the same period, the number of Superior Court judges has remained constant. As criminal cases swell court backlogs, pressure builds to acquire more judges. The impact of more police or more judges on crime is, therefore, an important policy issue.

Previous discussion of the model already suggests problems with increasing police and judges. More police will produce more arrests, which will further overload the courts. Increasing judges may more cases through the courts, but the increase places a greater load on the prisons, causing the average sentence to decline. The simulations below show how these interconnections among police, courts, and corrections limit the effectiveness of additional police and judges.
Simulations. Figure 5-14 depicts the behavior of crimes for six simulations:

1. Base Run (some growth in police and judges),
2. Run P1, increased police (more growth in police than in Base Run),
3. Run P2, increased Superior Court judges (more growth in judges than in Base Run),
4. Run P3, increased police and Superior Court judges (combination of P1 and P2),
5. Run P4, no increase in police (no growth in police after month 192),
6. Run P5, no increase in judges (no growth in judges after month 192).

The scales in Figure 5-14 are set to show the relatively small differences between simulations. Consequently, the first part of each simulation, equivalent to the Base Run, is cut off. Table 5-2 compares manpower and crimes in month 480 for each of the simulations.

Increased Police. In Simulation P1, the policy governing the acquisition of police capacity is changed in month 192. Figure 4-5 in Chapter 4 compares this revised policy with the original, base policy. As seen in this figure, for each value of the relative workload above one, the revised policy calls for twice the percentage increase in police capacity as does the base policy. When instituted in month 192, the revised policy results in a fourteen percent increase in police capacity by month 480 over the Base Run. The impact of this increase is only a one percent decline in crimes.

Why does the increase in police have such little effect? The answer can be shown in a test of the model structure. Figure 5-15 depicts a set of simulations in which Loops 1, 3, and 4 (Figure 5-1)
Figure 5-14: Simulation of the Court Management Model: Comparison of Crimes for Runs P1, P2, P3, P4, P5, and Base
<table>
<thead>
<tr>
<th>Simulation</th>
<th>Police Capacity (Persons)</th>
<th>Superior Court Judges (Persons)</th>
<th>Crimes (Cases/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>16,999</td>
<td>59</td>
<td>49,784</td>
</tr>
<tr>
<td></td>
<td>( 0)</td>
<td>( 0)</td>
<td>( 0)</td>
</tr>
<tr>
<td>P1</td>
<td>19,351</td>
<td>62</td>
<td>49,169</td>
</tr>
<tr>
<td></td>
<td>(14)</td>
<td>( 5)</td>
<td>(-1)</td>
</tr>
<tr>
<td>P2</td>
<td>16,828</td>
<td>66</td>
<td>48,545</td>
</tr>
<tr>
<td></td>
<td>(-1)</td>
<td>(12)</td>
<td>(-2)</td>
</tr>
<tr>
<td>P3</td>
<td>19,135</td>
<td>69</td>
<td>47,763</td>
</tr>
<tr>
<td></td>
<td>(13)</td>
<td>(17)</td>
<td>(-4)</td>
</tr>
<tr>
<td>P4</td>
<td>12,891</td>
<td>54</td>
<td>50,440</td>
</tr>
<tr>
<td></td>
<td>(-24)</td>
<td>(-8)</td>
<td>( 1)</td>
</tr>
<tr>
<td>P5</td>
<td>17,021</td>
<td>44</td>
<td>50,164</td>
</tr>
<tr>
<td></td>
<td>(0.1)</td>
<td>(-25)</td>
<td>( 1)</td>
</tr>
</tbody>
</table>

Percent Change from P4 to P1: **49%**  **15%**  **-3%**

Percent Change from P5 to P2: **-1%**  **50%**  **-3%**
have been cut. Consequently, crimes are forced to remain constant regardless of the effect of imprisonment on crime, the effect of sentence on crime, and the population of ex-offenders. In each simulation either police or judges are increased with the model in equilibrium. These tests permit examination of the factors affecting crime without getting the subsequent changes due to the feedback of crime on the rest of the system. Scales are set so that percent changes in variables are comparable. Values for total offenders imprisoned and arrests are expressed as ratios over their initial values. Panel A in Figure 5-15 shows the results of a step increase of fifty percent in police capacity.

Test of Increased Police. The fifty percent step increase in police causes an increase in arrests which is initially about thirty-five percent and then declines to twenty-eight percent. Arrests fail to rise as much as police for at least two reasons. First, the assumed relation between police and crimes intercepted (Figure 4-7) causes an increase in police to produce a less than equal increase in crimes intercepted. Second, the increase in police reduces the police workload and, consequently, the police capacity utilization factor (see Figure 4-3), so that police investigation manpower is used less efficiently than before.

The increase in arrests creates a rise in total offenders imprisoned of only sixteen percent. The total offenders imprisoned fail to increase as much as arrests because of the overloading in the
Figure 5-15: Simulation of the Court Management Model: Tests for Increased Police and Increased Superior Court Judges (T1 and T2)
courts. The arrests raise the backlog and workloads (not shown) in the courts. Plea bargaining and dismissals reduce the fraction of offenders imprisoned (also not shown). The increased flow of offenders to prison creates two effects. First, it causes the perceived imprisonment ratio (not shown) to increase; and, second, it causes the average effective sentence (also not shown) to decrease, since the sentence is reduced to avoid overcrowding. Panel A shows the changes in the effect of imprisonment on crime, the effect of sentence on crime, and the combination of the two factors, the effect of deterrence on crime. The improvement in the perceived imprisonment ratio causes the effect of imprisonment on crime to decline, but the reduced sentence causes the effect of sentence to increase. The net result is a slight decline in the effect of deterrence on crime. Since this last variable measures the change in crime that would result from the impact of the criminal justice system, it shows that the large increase in police produces a small impact on crime.

**Increased Judges.** Run P2 resembles Run P1, except that Superior Court judges are increased instead of police. Figure 3-8 in Chapter 3 depicts the revised policy used in P2. For each value of the relative workload above one, the revised policy calls for twice the percentage increase in Superior Court judges as does the base policy. When initiated in month 192, the revised policy results in a twelve percent increase in judges in month 480. The impact on crime is only a two percent reduction.
The test simulation in Panel B of Figure 5-15 indicates why the policy has such little effect. As in the simulation in Panel A, crimes are held constant while one of the variables is given a step increase, in this case the number of Superior Court judges. The change does not affect arrests, but does produce an increase in total offenders imprisoned. Again, the increase in the perceived imprisonment ratio (not shown) and the resulting decline in the effect of imprisonment are partially offset by the decline in the average effective sentence and resulting increase in the effect of sentence on crime. The net result is only a slight change in the effect of deterrence on crime.

**Increased Police and Judges.** Run P3 combines the revised policies in P1 and P2. By increasing both police and judges faster, the criminal justice system hopefully may be able to avoid overloading the courts, thereby producing a greater improvement in deterrence than can be achieved by increasing the police alone. The revised policy produces a thirteen percent increase in police and a seventeen percent increase in judges in month 480 compared to the Base Run, but crimes are reduced only four percent from the Base Run decline. Although increasing police and judges has more impact than merely increasing one or the other, the combined policy still produces little benefit because of the opposing effects of sentence and the imprisonment ratio.

**Larger Increases in Police and Judges.** It might be argued that the small change in crime is due to a relatively small change in
police or judges. To measure the impact of larger changes, Simulations P4 and P5 were performed using a policy of no increase in police and no increase in Superior Court judges respectively. As in the previous simulations, the new policies were instituted in month 192. As shown in Table 5-2, in month 480 police capacity is forty-nine percent higher in Run P1 than in Run P4; yet crimes are only three percent lower in P1. Similarly, the number of Superior Court judges in Simulation P2 is fifty percent higher than in Simulation P5; yet the number of crimes is only three percent lower in P2. The simulations suggest that the behavior of crimes is insensitive to changes in police and judges.

5.9 Plea Bargaining

Officials in the criminal justice system have shown varying reactions to plea bargaining. While many probably tolerate it as a necessary mechanism for handling cases in the courts, some have suggested that it be eliminated\(^9\), while others have encouraged it. This section considers the impact of plea bargaining policies on the dynamics of the criminal justice system.

Recently, the Superior Court has encouraged the plea bargaining process through pre-trial conferences. In these conferences, the defense counsel meets with the prosecutor and judge to review the case. One purpose of the conference is to reduce continuances by encouraging both defense counsel and the prosecutor to deal with the
Figure 5-16: Simulation of the Court Management Model: Comparison of Crimes for Runs P6, P7, P8, and Base
case before it is called in assignment session. But apparently
the conference also encourages the negotiation of pleas. Kreindel et al.\textsuperscript{10} note that formalized plea conferences may account for the
seventy-three percent of defendants pleading guilty in Worcester
County in 1970 compared to fifty-nine percent in Massachusetts
generally.

Another policy which may foster more plea bargaining is the
District Prosecutor program. While principally designed to provide
trained lawyers as prosecutors in the District Court, the program
can also encourage plea bargaining, since many police prosecutors,
who do not have formal legal training, are more reluctant to plea
bargain than the lawyers in the District Prosecutor Program.\textsuperscript{11}

Simulations. Figure 5-16 compares the behavior of crimes from
four simulations:

1. The Base Run,
2. Run P6, increased plea bargaining in the Superior Court,
3. Run P7, increased plea bargaining in the District Court,
4. Run P8, increased plea bargaining in the Superior Court
introduced in month 30 instead of month 192 as in Run P6.

Figures 3-16 and 3-17 depict the revised plea bargaining poli-
cies in the Superior Court. In the first of those figures, the re-
vised policy calls for imprisoning a smaller fraction of those pleading
guilty than in the base policy. Similarly, in the second figure, the revised policy calls for shorter sentences than in the base policy. The reduced penalties for pleading guilty produce an in-
Figure 5-17: Simulation of the Court Management Model: Tests for Increased Plea Bargaining in Superior and District Courts (T3 and T4)
crease in guilty pleas relative to trials and dismissals.

Increased plea bargaining causes a slight reduction in crimes compared to the Base Run. However, different timing of the policy can produce different results. In Simulation P8, the revised plea bargaining policy is instituted at month 30. Crimes initially grow faster than in the Base Run and then taper off to a value slightly lower than in the Base Run. These simulations raise two questions:

1. Why does more plea bargaining cause crimes to grow faster initially in Simulation P8?

2. Why does the policy prove beneficial during the last part of the simulation?

The first question can best be answered by looking at the test simulations in Figure 5-17. These tests are similar to those shown in Figure 2-32. The Police and Court Sectors are subjected to a fifty percent increase in crimes. Also, the effect of sentence on crimes and the effect of imprisonment on crimes are eliminated so that there is no feedback from the criminal justice system to crimes. Again, scales on the graph are set so that percentage changes are comparable. Panel A in Figure 5-17 depicts a simulation using the base policies. Panel B depicts a simulation using the revised plea bargaining policies in the Superior Court. In both simulations, the step increase in crimes produces the same increase in arrests. The percentage increase in total offenders imprisoned differs. The revised plea bargaining policy retards the increase in total offenders imprisoned, so that the perceived imprisonment ratio
<table>
<thead>
<tr>
<th>Simulation</th>
<th>Perceived Imprisonment Ratio (Dimensionless)</th>
<th>Average Effective Sentence (Months)</th>
<th>Effect of Imprisonment on Crime (Dimensionless)</th>
<th>Effect of Sentence on Crime (Dimensionless)</th>
<th>Effect of Deterrence on Crime (Dimensionless)</th>
<th>Superior Court Judges (Persons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Run</td>
<td>0.39</td>
<td>9.0</td>
<td>2.86</td>
<td>1.56</td>
<td>4.47</td>
<td>59</td>
</tr>
<tr>
<td>Run P6</td>
<td>0.32</td>
<td>10.7</td>
<td>3.04</td>
<td>1.45</td>
<td>4.44</td>
<td>57</td>
</tr>
<tr>
<td>Run P7</td>
<td>0.35</td>
<td>9.5</td>
<td>2.99</td>
<td>1.52</td>
<td>4.57</td>
<td>56</td>
</tr>
<tr>
<td>Run P8</td>
<td>0.33</td>
<td>10.6</td>
<td>3.05</td>
<td>1.46</td>
<td>4.45</td>
<td>57</td>
</tr>
</tbody>
</table>
(not shown) drops more than in the base case. However, the perceived average effective sentence ratio drops slightly less in Panel B than in Panel A, since the reduced flow of imprisoned offenders produces less reduction in the sentence. The revised plea bargaining policy produces a tradeoff, in which the average effective sentence is reduced less than in the base run, but the perceived imprisonment ratio is reduced more.

In Simulation P8, this tradeoff produces adverse results during the early part of the simulation. Crimes are initially more sensitive to changes in the perceived imprisonment ratio than to changes in the average effective sentence. However, in Simulation P6, the situation is reversed. By month 192 the perceived imprisonment ratio has dropped below 0.5, so that Loop 1 (Figure 5-1) operates in a flat portion of the EIC relation (Figure 2-3). In that portion, a decrease in perceived imprisonment ratio has relatively little effect in increasing crime. Meanwhile, the average effective sentence (not shown) in P6 declines less than in the Base Run. The resulting improvement in deterrence more than offsets the decline in the perceived imprisonment ratio. Table 5-3 lists the magnitudes of the various effects.

The benefits of increased plea bargaining in the Superior Court instituted in month 192 depend on where the non-linearity in the EIC relation occurs. If the relation did not level off until lower values of the perceived imprisonment ratio, the benefits would not occur. Therefore, the policy maker should not count on the benefi-
cial effects of plea bargaining, since the EIC relation probably cannot be estimated accurately. Moreover, the benefits in Simulation P6 are slight in any case. Plea bargaining appears attractive to prosecutors and judges because they do not see how they can otherwise cope with the flood of cases. But as discussed in Chapter 3, other adjustment mechanisms exist, in particular the increase of judges. Plea bargaining shifts pressures, so that the number of judges is not increased as much as it might. For example, Table 5-3 shows that the number of Superior Court judges in month 480 is less in P6 than in the Base Run.

Plea Bargaining in the District Court. Figure 5-16 depicts the behavior of crimes for Simulation P7. In this simulation, plea bargaining is increased in the District Court to reduce the appeals to the Superior Court. Figure 3-20 and 3-21 depict the revised policies. In Figure 3-20, the revised policy calls for a smaller fraction of District Court defendants imprisoned when the Superior Court judicial workload is above one than in the base policy. In Figure 3-21 the revised policy calls for a shorter sentence for those imprisoned by the District Court. The result of the revised policy instituted in month 192 is a slight increase in crime.

Panel C in Figure 5-17 indicates that the revised plea bargaining policy in the District Court has an impact similar to the revised policy in the Superior Court. As shown in this test of the Court Sector, in response to a fifty percent increase in crime, total offenders increase less than with the base policy (Panel A). In the
policy simulation P7, the effects of the policy are small, so that little change from the Base Run occurs.

5.10 Mandatory Sentencing

In a recent report, the National League of Cities cited mandatory sentencing as one of five critical areas of criminal justice policy currently receiving attention. Mandatory sentencing seeks to improve the certainty of punishment by restraining the discretion of judges, prosecutors, and parole officials. This section discusses how a mandatory sentence policy can be implemented in the model and what effects it has on the system. The discussion here concerns mandatory sentencing directed toward a broad range of crimes, rather than one or two specific offenses.

Rather than a single policy, mandatory sentencing, as often discussed, is a mix of three policies:

1. An increase in the fraction of convicted defendants who are imprisoned.

2. A reduction in the discretion of judges and prosecutors to negotiate pleas.

3. A reduction in the discretion of parole boards to release offenders before their sentence is finished.

Figure 5-18 depicts how the first component of mandatory sentencing is implemented in the model. For each value of the fraction of prison overcrowding, the fraction of defendants tried, convicted,
Figure 5-18: Relation Between the Fraction of Prison Overcrowding and the Fraction of Defendants Tried Imprisoned: Base Relation and Revised Policy for Mandatory Sentencing

Figure 5-19: Relation Between the Superior Court Workload and the Guilty Plea Imprisonment Ratio: Base Relation and Revised Policy for Mandatory Sentencing
and imprisoned is increased. Since the fraction of those defendants pleading guilty who are imprisoned depends on this variable, the effect of the revised policy is to cause an increase in total offenders imprisoned. Figure 5-21 depicts a test simulation of the impact of this revised policy. The figure shows two tests; the one in Panel A pertains to this component of mandatory sentencing. At month 3, the revised policy is switched on, while crimes are held constant at their initial value. Similar to the tests for increasing police and judges (Figure 5-15), this simulation shows the direct effects of the revised policy without showing the secondary effects of crimes feeding back on the police and courts. Total offenders imprisoned is expressed as a ratio over its initial value. The revised policy does create an increase in total offenders imprisoned, but it is less than a ten percent increase. The impact on deterrence is similar to the impact seen with increases in police and judges. The increase in total offenders imprisoned causes an increase in the perceived imprisonment ratio (not shown) and, consequently, a decline in the effect of imprisonment on crime; but it also causes a decrease in the average effective sentence and, hence, an increase in the effect of sentence on crime. The net effect, as shown by the effect of deterrence on crime, is slight.

Figure 5-19 depicts the policy for the second component of mandatory sentences. In this change, the guilty plea imprisonment ratio is raised for all values of the Superior Court workload greater than zero. This revised policy, therefore, calls for imprisoning a
Figure 5-20: Relation Between the Normal Reduction in Sentence Through Parole and the Sentence Restriction on Parole
larger fraction of defendants who plead guilty than in the base policy. This change makes the negotiated plea less attractive, thereby reducing guilty pleas. Panel B in Figure 5-21 depicts the direct impact of the revised policy when crimes are held constant. As in the previous simulation, total offenders increase, but the change has little impact on deterrence for the same reasons cited before.

Figure 5-20 depicts the third component of mandatory sentences, restricting parole. For values below 0.6 of the normal reduction in sentence through parole, the sentence restriction on parole is higher than base policy. Therefore, the average effective sentence declines less than with the base policy. These effects are shown in the test simulations in Figure 5-22. In these runs, crimes increase fifty percent, but the effect of other variables on crimes is eliminated so that only the direct effects of the change are seen. Panel A depicts the resulting behavior using the original or base policies. In this simulation, the fifty percent increase in crimes produces a twenty-two percent increase in total offenders imprisoned. However, after a small, brief rise, prison population declines to near its original value. In Panel B, the revised policy for the sentence restriction on parole is used. Here, the fifty percent increase in crimes produces a nineteen percent increase in total offenders imprisoned and seven percent increase in prisoners. Panel A and Panel B show a tradeoff. In the second simulation, the average effective sentence (not shown) and the perceived average effective sen-
Figure 5-21: Simulation of the Court Management Model: Tests for Mandatory Sentencing (T5 and T6)
Figure 5-22: Simulation of the Court Management Model: Test of Restriction on Parole (T7)


TABLE 5-4

IMPACT OF MANDATORY SENTENCING, INCREASED TRIAL EFFICIENCY, AND A COURT DIVERSION PROGRAM ON CRIMES, PRISONERS, AND THE SUPERIOR COURT DELAY

(Figures are for month 480. Figures in parentheses are percentage changes over the base run.)

<table>
<thead>
<tr>
<th>Simulation</th>
<th>Crime (Cases/month)</th>
<th>Prisoners (Persons)</th>
<th>Superior Court Delay (Months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>49,784</td>
<td>4,137</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>( 0)</td>
<td>( 0)</td>
<td>( 0)</td>
</tr>
<tr>
<td>Run P9</td>
<td>38,361</td>
<td>5,455</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>(-23)</td>
<td>( 32)</td>
<td>(-11)</td>
</tr>
<tr>
<td>Run P10</td>
<td>46,522</td>
<td>4,331</td>
<td>9.4</td>
</tr>
<tr>
<td></td>
<td>(- 7)</td>
<td>( 5)</td>
<td>(- 1)</td>
</tr>
<tr>
<td>Run P11</td>
<td>49,024</td>
<td>4,220</td>
<td>8.4</td>
</tr>
<tr>
<td></td>
<td>(-2)</td>
<td>( 2)</td>
<td>(-12)</td>
</tr>
<tr>
<td>Run P12</td>
<td>41,337</td>
<td>4,006</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>(-17)</td>
<td>(-3)</td>
<td>(-25)</td>
</tr>
<tr>
<td>Run P13</td>
<td>45,378</td>
<td>4,007</td>
<td>7.4</td>
</tr>
<tr>
<td></td>
<td>(-9)</td>
<td>(-3)</td>
<td>(-22)</td>
</tr>
<tr>
<td>Run P14</td>
<td>41,230</td>
<td>4,007</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>(-17)</td>
<td>(-3)</td>
<td>(-25)</td>
</tr>
</tbody>
</table>
tence ratio decline less than in Panel A. However, the perceived imprisonment drops slightly more in Panel B than Panel A. The reason for this difference, as well as the difference in the increase in total offenders imprisoned, is the role of the courts in limiting overcrowding in the prisons. While in the Base Run, this adjustment mechanism plays only a slight role, when the parole adjustments are inhibited, the role of the courts comes into play. Overcrowding in the prisons causes judges to limit the flow of offenders to prison, thereby reducing the perceived imprisonment ratio.

Policy Simulations. Figure 5-23 compares the behavior of crimes for three simulations:

1. The Base Run
2. Run P9, all three components of mandatory sentencing
3. Run P10, mandatory sentencing without the restriction on parole.

The full mandatory sentence policy does have an impact on crimes. However, the impact arises mostly from the restriction on probation rather from the restrictions on plea bargaining. When the restriction on parole is removed, as in Run P10, the reduction of crimes is only seven percent (see Table 5-4). However, when prison population is allowed to rise, an increase in total offenders imprisoned no longer causes a compensating decline in the average effective sentence. This uncoupling of sentence length and the flow of offenders creates the lowering of crimes.
Figure 5-23: Simulation of the Court Management Model: Comparison of Crimes and Prisoners for Runs P9, P10, and Base

Figure 5-24: Simulation of the Court Management Model: Comparison of Crimes for Runs P11 and Base
Problems with Limiting Parole. Limiting the parole mechanism raises serious administrative and legal problems. Overcrowding in prisons can cause difficulties in maintaining correctional programs. It impairs security, while increasing tensions among inmates, thereby increasing the likelihood of riots.

Overcrowding produces unsanitary and inhumane conditions. The quest for deterrence in the criminal justice system need not mean that the prisons are unfit for prisoners to live in safely.

Overcrowding also raises serious legal issues. Recently, a U.S. District Court ordered Alabama to renovate its prison system on the grounds that the current prisons constituted cruel and unusual punishment. A severely overcrowded prison system brought about by mandatory sentencing might result in the federal courts intervening, either to order the state to build new facilities, or to release offenders to reduce prison crowding.

The trouble with mandatory sentencing is that it is directed toward the wrong decision points within the criminal justice system. Conceivably, plea bargaining could be so extensive that the courts would be the major limiting factor in sentence length. The results would be prisons with excess capacity and most offenders would be released at the expiration of their full sentence. This situation does not presently occur in Massachusetts. The prisons are full, and most offenders are released on parole before the expiration of their sentence.

Some critics of mandatory sentencing fear that it will cause ex-
cessive delay in the courts. The model does not support this fear. In general, the delays are shorter partially due to the reduction in crime and partially due to the compensating adjustments in the Court Sector.

5.11 Increased Trial Efficiency

Methods for improving the efficiency of the courts are currently receiving attention. The courts are beginning to apply computer technology and operations research techniques to their operations. One purpose of these applications is to improve the efficiency of the trial process. Better scheduling and better control over the movement of cases would hopefully permit more trials per trial day. Would such a program have substantial benefits in controlling crime and the Superior Court delay?

Figure 2-24 compares the behavior of crimes in the Base Run and in Run P11. In P11, the judicial utilization factor is increased fifty percent, representing an improved utilization of judges. The size of this increase is probably more than could be hoped for, but it provides a good test of the program. The policy has little effect on crimes.

The test simulation in Figure 5-25 indicates why. The simulation is performed by holding crimes constant, while increasing the judicial utilization factor fifty percent. The change causes the indicated Superior Court session to increase initially fifty percent
Figure 5-25: Simulation of the Court Management Model: Test of Increased Trial Efficiency (T8)

Figure 5-26: Simulation of the Court Management Model: Comparison of Crimes for Runs P12, P13, P14, and Base
also. However, the actual Superior Court session increases less than fifty percent because of defense attorney and prosecutor restrictions on trials. While the efficiency of judges has been improved, prosecutors and defense counsel do not keep up with these improvements. Therefore, the shortage of attorneys partially limits the improvement in processing trials. Despite the substantial increase in trials, the total cases processed in Superior Court increases very little, since trials form only about fifteen percent of all cases processed. Consequently, the increase in total offenders imprisoned is small and has little effect on deterrence.

The comments here are not intended to suggest that applying modern management techniques to the courts is not a good idea. As in industry, these techniques, when properly applied, can save many times their cost of development. However, the simulation does suggest that while these techniques may have several benefits, a substantial reduction in crime is not one of them. In Simulation P11, the policy does produce a twelve percent reduction in the Superior Court delay, compared to the Base Run.

5.12 Court Diversion Program

The large delays in courts have sparked interest in court diversion programs. Rather than attempt to move cases faster through the courts, court diversion seeks to limit the flow of cases into the courts. In a court diversion program, defendants, mostly first
offenders, are offered the opportunity to enter some rehabilitation program in lieu of facing prosecution in court. The program appears to have several advantages for the criminal justice system. First, the courts need not adjudicate the diverted cases, and can, therefore, concentrate on more serious cases. Second, the correctional facilities do not have to handle those individuals who would have been sentenced to prisons. Therefore, some pressure is taken off the parole boards. Third, the defendant is not subjected to whatever adverse effects prisons have on his criminal tendencies. He is not labeled a criminal or handicapped with a prison record.

The program does have the drawback that, by diverting defendants from the courts, it reduces the perceived imprisonment ratio.

The program is implemented in the model as follows: At a specified time, the program is initiated so that approximately thirty percent of all arrests are diverted into the program. Mostly new offenders are selected. These offenders are assumed to spend five years in the program, during which time they are assumed to either commit no crimes (Option 1) or commit crimes at the same rate as potential new offenders (Option 2). At the end of five years, they return as potential new offenders. In one respect, these conditions are idealized: there is probably no way that a program of this type can keep participants from committing no crimes, or, perhaps, even from committing them at the rate for potential new offenders.

Figure 2-26 depicts the effects of the court diversion program on crimes compared to the Base Run. In Simulation P12, the program
with Option 1 is implemented in month 192. The simulation shows that the policy has some effect in reducing crime. Why?

Part of the answer lies in the program's ability to keep participants from committing crimes. In Simulation P13, the program is implemented in month 192 with Option 2. As shown, the program loses about half its effectiveness in reducing crimes over the Base Run (see Table 5-4). The reason for the remaining improvement is the same as the reason for the improvement from plea bargaining in the Superior Court. The values of the perceived imprisonment ratio and the average effective sentence are such that during the last part of the simulation, decreasing the perceived imprisonment ratio, and thereby permitting the average effective sentence to rise, produces an improvement in the effect of deterrence on crime.

Simulation P14 depicts another problem with the policy. In this simulation, the policy is instituted during month 30 with Option 1. With this timing, the policy initially creates a rapid growth in crime, since the perceived imprisonment ratio is greatly lowered. Following the rapid growth in crime, the process of leveling out is greatly extended. Eventually, crimes rise to nearly the same value as in Run P12.

The court diversion program appears to be somewhat useful. Implemented late in the growth cycle of a crime wave, it may have some benefit depending on how effective the program is in preventing participants from committing other crimes. Implemented during the early stages of growth, it can degrade deterrence considerably, re-
sulting in a faster rate of growth for crimes. The program does not produce a desirable reversal in the trend in crime. It does produce a twenty-five percent reduction in the Superior Court delay, which is not as much as might be expected from diverting thirty percent of arrests. Again, the court mechanisms partially compensate for the change in policy.

5.13 Increased Prison Capacity

The discussion so far, as well as the simulations in Chapter 2, have suggested the importance of prison capacity in controlling crime. Figures 5-28, 5-29, and 5-30 depict a simulation in which prison capacity is increased fifty percent in month 192. The policy exerts a pronounced effect on crime and the rest of the criminal justice system.

Figure 5-27 depicts a test simulation similar to those in Figure 5-15. Crimes are held constant while the prison capacity is increased. The increase in prison capacity permits the average effective sentence (not shown) to rise, thereby causing the effect of sentence on crime to decline. Unlike in the tests of increased police and Superior Court judges, there is no shift in variables to counteract the increased deterrence from longer sentences. Indeed, there is some increase in total offenders imprisoned which produces a rise in the perceived imprisonment ratio (not shown) and a decline in the effect of imprisonment on crime. This change further improves de-
Figure 5-27: Simulation of the Court Management Model: Test of Increased Prison Capacity (T9)

Figure 5-28: Simulation of the Court Management Model: Run P15—Increase in Prison Capacity
Figure 5-29: Simulation of the Court Management Model: Run P15—Selected Court Variables

Figure 5-30: Simulation of the Court Management Model: Run P15—Correction Sector
terrence. The increase in total offenders imprisoned results from the excess prison capacity, which reduces the pressures on judges to limit sending offenders imprisoned. As prisons become less crowded, judges are assumed to send a larger fraction of defendants to prison. This effect provides an added stimulus to deterrence, but is not essential to the policy working. Returning to Figures 5-28 through 5-30, the increase in prison capacity permits the average effective sentence to rise. At the same time, judges and police are increasing fast enough that the drop in the perceived imprisonment ratio is slowed. Increasing sentences, therefore, produces a net increase in deterrence. As described in Chapter 2, the relations between sentence length and crime and the perceived imprisonment ratio and crime work in reverse. A decrease in crime promotes a higher imprisonment ratio, longer sentences, and, thus, lower crimes. As crimes decline further, the criminal justice system becomes less and less overcrowded. Crimes continue to decline to a relatively low value.

The policy achieves its effect by using the reinforcing feedback loops in the system. By month 480, the average effective sentence has risen to twenty-one months. Afterwards, it continues to rise to about 30 months (not shown), three times longer than the lowest value achieved during the growth in crime. The policy works because once crimes are slowed through longer sentences, the rest of the system is able to catch up. As deterrence increases, crimes reverse,
Figure 5-31: Simulation of the Court Management Model: Comparison of Crimes for Runs P15, P16, P17, P18, P19, and Base

Figure 5-32: Simulation of the Court Management Model: Comparison of Crimes for Runs S4, S5, S6, and S7
relieving overloading and further improving deterrence.

**How Much Prison Capacity is Enough?** A fifty percent increase in prison capacity, or additional space for 2000 prisoners, requires a substantial investment in correctional facilities. Unfortunately, increases of a much smaller magnitude, while producing some reduction in crime, are not large enough to cause the reversal in the trend of crime.

Figure 5-31 depicts five simulations in which the prison capacity in month 192 is increased by amounts varying from ten percent to fifty percent. Each increase produces a reduction in crime compared to the Base Run (also shown); increases of forty or fifty percent produce the reversal in crimes. Enough prison capacity must be built so that new capacity is not filled before the average effective sentence can rise enough to cause an increase in overall deterrence.

### 5.14 Sensitivity Tests

Sensitivity testing, like policy testing, involves changing parameters in the model to see how the changes affect behavior. Unlike policy testing, the purpose is not to see how the performance of the actual system can be improved, but how inaccuracies in parameters can affect the results. Here is one strength of a simulation model compared to mental models. The policy maker can see precisely how different specifications of relations affect the results of policies.
The limitation on sensitivity testing is that, with a model the size of the Court Management Model, it is impossible to test all combinations of parameters. Thus, the modeler may miss a combination of parameters which will have a dramatic effect on conclusions. This danger is one disadvantage of simulation models compared to analytic models. Because of this limitation, the modeler must select those parameters for testing which his understanding of the system suggests are important, rather than try to test numerous changes in the hopes of finding one which will produce an important effect.

The simulations performed so far indicate a number of things about the parameters in the model.

First, the tables describing the effect of imprisonment on crime (EIC) and the effect of sentence (ESC) on crime play an important role in determining behavior. Chapter 2 described how an EIC table that is not steep enough will not produce exponential growth. Without the effect of sentence on crime, the EIC table must have a slope of greater absolute value than one. With the ESC relation reinforcing it, the EIC relation can be somewhat less, and exponential growth will still occur. The adjustment in police and courts (Loop 2 in Figure 5-1) will dampen the growth in crime, so that the slope of EIC which will produce growth depends on the responsiveness of the Police and Court Sectors. Therefore, without being able to specify precisely what the minimum slope is which causes exponential growth, the simulations in this chapter and in Chapter 2 indicate that the slope, for at least part of the curve,
must be near or above one in absolute value.

The levelling off in the EIC relation as the perceived imprisonment ratio drops below 0.5 plays an important part in behavior. If this non-linearity is omitted and the slope of the EIC relation is steep enough, crimes grow faster than the police and courts can cope with. Crimes increase without bounds. If the slope is somewhat less, crimes peak and then decline.

The simulations S1 through S3 in Figure 5-3 indicate the importance of variable standards for workload and the effect of sentence on crimes. As already discussed, these factors can keep the volume of crime high.

The policy simulations indicate that the model is insensitive to specification of many of the relations in the Police and Court Sectors. Just as changes in the policies cause small variations in crimes, misspecification of these relations within a fairly broad range will have little effect on behavior.

Factors Affecting the Impact of Increased Prison Capacity. An area of particular interest which has not been discussed so far is the relation between the effect of sentence on crime and the impact of the increase in prison capacity. The rest of this section deals with two sets of sensitivity tests. The first set tests the effect of a reduction in or the elimination of the effect of sentence on crime, other relations in the model remaining the same. The purpose of this test is to see if reducing the effect of sentence on crime eliminates the benefits of increased prison capacity. This test is
important, since the relation between length of sentence and crime is an aspect of deterrence in some doubt, more so than the relation between the probability of imprisonment and crime. The second set of tests consider the effect of the criminal justice system, prison capacity in particular, when an exogeneous factor causes the exponential increase in crime.

Figure 5-32 compares four sensitivity tests:

1. Run S4 using a flatter ESC relation (with a slope of 0.15) than originally specified in the model.

2. Run S5 using the same ESC relation as used in S4 and a fifty percent increase in prison capacity in month 192.

3. Run S6 using a completely flat ESC relation (in essence the relation between length of sentence and crimes is eliminated).

4. Run S7 using a completely flat ESC relation and a fifty percent increase in prison capacity in month 192.

The comparison indicates that increasing prison capacity does still have a beneficial effect, although in some instances, the effect is not as pronounced as in the Simulation P15. In each simulation, the step increase in the test input is forty percent; a five percent step does not produce much growth in crimes. In Run S4 crimes still rise and maintain a relatively high value. When prison capacity is increased, the change causes a decline in crimes. Even with the lower sensitivity of crimes to sentence length, the policy has a marked effect on behavior.

When the effect of sentence on crime is eliminated, increased
Figure 5-33: Simulation of the Court Management Model: Comparison of Crimes for Runs S8, S9, and S10
prison capacity has much less effect, although it does have some. As seen previously in Run S2 (Figure 5-3), eliminating ESC permits crime to decline after reaching a peak. An increase in prison capacity speeds that decline, but does not change the mode of behavior. Without any impact of sentence length on crime, the observed effect arises from two sources. First, reducing prison overcrowding alleviates the pressures on judges to avoid sentencing offenders to prison. Thus, the increase in prison capacity produces in increase in the fraction of defendants imprisoned. Second, increasing the number of prisoners reduces the population of ex-offenders from what it would be otherwise. Since ex-offenders are assumed to have a higher propensity for committing crimes than others, any reduction in ex-offenders will, other factors equal, cause a reduction in crimes. These two effects are much less important to the impact of prison capacity than the effect of sentence, when this effect is in the model. When it is eliminated, the others provide some benefit, although it is not substantial.

Figure 5-33 compares three more simulations:

1. Run S8, in which the model is subjected to a test input increasing at 0.5 percent a month. All effects of the criminal justice system on crime are eliminated. This simulation provides a base for comparing the other simulations.

2. Run S9, in which the EIC and ESC tables are replaced with much flatter relations. The EIC relation is a straight line with a slope of -0.3, and the ESC relation is a straight line with a slope
-0.15 (same as in Run S4).

3. Run S10, which uses the same relations for EIC and ESC as above, but also uses a fifty percent step increase in prison capacity in month 192.

The gap between crimes for Runs S8 and S9 indicates how the decline in deterrence in the criminal justice system increases crime. In this instance, the behavior is dominated by the exogenous input, but the criminal justice system produces an amplification of the input through its inability to maintain deterrence.

In Run S10, the increase in prison capacity results in a reduction in crime too small to show up on the graph. This result is not surprising, since crimes are dominated by the exogenous input. The increase in crimes and total offenders imprisoned overwhelms even a fifty percent increase in prison capacity. The average effective sentence (not shown) is not permitted to increase much. In any case, the impact of deterrence is assumed to be small compared to the influence of the exogenous input. The simulation does indicate that, if the impact of deterrence is relatively small, increases in prison capacity are not going to have much effect.
Footnotes

1Appendix C lists the DYNAMO specifications of the simulations reported in this chapter.


3Ibid., p. 117

4Drunkenness is no longer a crime in Massachusetts, although it was for most of the years for which data were collected.

5Census data reported in Massachusetts, Department of Corrections, *Statistical Reports of the Commissioner of Corrections*, Public Document No. 115 (Boston, 1955-1971)

6Massachusetts, Supreme Judicial Court, Executive Secretary, *Annual Report to the Justices of the Supreme Judicial Court*, Public Document No. 166 (Boston, 1959-1974)


12. "Crime: Have We Lost Control? A Reassessment" *Nation's Cities* (December, 1975) 14-32

13. *Pugh v. Locke*, 18 Cr. L. 2370 (U.S. District Court for Middle Alabama, 1976)
CHAPTER VI

CONCLUSIONS

6.1 Introduction

The preceding chapters have dealt with the dynamics of the Massachusetts criminal justice system. The discussion has focused on how policies and interactions among the components of the system can exacerbate the crime problem. Several policy alternatives have been presented. This chapter summarizes the policy conclusions.

In one sense, the specific recommendations presented here are tentative. They are based on models whose assumptions cannot now, or possibly ever, be fully substantiated. Different assumptions may lead to different, perhaps conflicting, recommendations. Anyone using a model like the ones presented here should do enough of his own analysis of the model to satisfy himself that the assumptions are sound.

In another sense, the analysis here is no less tentative than much of criminal justice planning. Of necessity, planning recommendations arise from models, usually mental models whose uncertainties are at least as great as the formal models presented here. I have drawn my assumptions from both the literature and discussions with officials.
in the Massachusetts criminal justice system. In many respects, there is little disagreement about how the state's criminal justice system functions. The tool of computer simulation insures that the results are mathematically derived from the assumptions. This feature is at least one advantage of the approach taken in this study.

6.2 Specific Recommendations

**Dynamics.** The models discussed in this study provide a theory of how the criminal justice system influences the dynamics of crime. The simulations show that the structure of the criminal justice system may lead to exponential growth in crime. Specifically, if the system becomes overloaded, both the probability of imprisonment and the length of sentences decline. The reduction in deterrence may encourage further crime. This reinforcement or positive feedback can produce exponential growth in crime.

**Important Assumptions.** Whether the mechanisms just described account for the exponential growth in crime depends on the strength of two relations. The first is the relation between the perceived imprisonment ratio and the effect of imprisonment on crime. The second is the relation between the average effective sentence and the effect of sentence on crime. Whether these relations exist or not is not so much in question here, as whether they are steep enough to create growing crime. There is mounting evidence, discussed in Chapter 2,
that they do exist, but the strength of these effects needs to be probed more than has been done so far. Experimentation with dynamic models like the ones in this study provides insights into what the effects must be if they are to influence significantly the dynamics of crime.

**Prison Capacity.** The simulations in this study suggest that, of the policies tested, the single most effective policy which the Massachusetts criminal justice system can implement is an increase in the capacity of prisons in Massachusetts. Prison capacity has not increased with other components of the system. Inadequate capacity is causing offenders to serve shorter and shorter sentences. Also, it may lead judges to place defendants on probation rather than sentence them to overcrowded prisons. An adequate increase in prison capacity will permit the average effective sentence to increase, despite more incarcerations. With extra space, prison officials will not have to release offenders as soon. An increase in sentences, coupled with the normal improvements in the rest of the system, can improve deterrence, thereby reversing the trend of the past twenty years.

The effectiveness of this policy does not result from incarcerating offenders for long periods. While a reading of the statutes may give the impression that offenders serve long sentences for crimes, this impression is not borne out by observing the actual sentences served in Massachusetts. Data on prison populations and offenders imprisoned indicate that the average sentence served in both state and county institutions in Massachusetts for crimes against persons and
property has dropped from slightly more than twenty months in 1955 to slightly more than ten months in 1971. Based on their more detailed records, the Department of Corrections may have more accurate values. Nevertheless, the average sentence is short. It has dropped substantially in the last twenty years. It will continue to drop as crimes increase, if prison capacity remains constant. By increasing prison capacity, the average sentence rises to about thirty months.

Increasing prison capacity does not preclude reforms of other kinds. For example, adding capacity could be part of a much-needed program of prison modernization. Enlarging prison capacity does not mean that other correctional programs should be abandoned.

Prisons as Schools for Crime. Some people have argued that prisons reinforce the criminal tendencies of the offender; that prisons are schools for crime, and that the released offender is more likely to commit crimes because of his prison experience. Although studies of this question have not provided adequate substantiation, this assumption was tested in the models by assuming that ex-offenders have a much higher propensity toward crime than the potential offender who has never been in prison. The assumption has little impact on the effectiveness of increased prison capacity for the following reasons.

In the long run, increased capacity tends to decrease the flow of offenders through prison, not increase it. In the policy simulations, the increase in capacity initially increases the flow of offenders imprisoned by relieving overcrowding and reducing pressures for more probation. The average effective sentence rises. The increased de-
terrence then reduces the number of crimes committed. After a while, so few crimes are committed that fewer offenders are subject to imprisonment, than at the same time in the Base Run. A criminal justice system with a low deterrent, in which a large number of offenders are rapidly cycled through the prisons, is replaced by a system with high deterrence, in which relatively few offenders are subject to imprisonment, but those who are serve longer sentences.

Excess Prison Capacity. The simulations suggest that increased prison capacity does not produce an increased prison population in the long run. If the criminal justice system can reverse the trend in crime, the reduced flow of offenders results in a decline in prison population.

The excess capacity may, unfortunately, be viewed as overbuilding and a case of poor correctional management. The excess capacity should be viewed as a benefit, since it provides a buffer which uncouples the flow of offenders into prison from the length of sentence served. If crimes and incarcerations begin to rise again, the excess capacity can absorb the increase in prisoners, thereby eliminating the need to reduce the average sentence served. Thus, excess capacity improves the stability of the criminal justice system as a whole. Increases in crime do not lead to as much a decrease in deterrence as before.

Assumptions Affecting the Impact of Imprisonment. The benefits of increased prison capacity arise from several assumptions in the model, so that changes in individual assumptions do not eliminate the
effects of this policy. One important factor is the size of the increase in capacity. Although increases of as little as ten percent have some benefit, substantial changes require twenty percent or more. As might be expected, if crime is assumed to grow due to external factors, if the impact of deterrence is relatively small, and if the growth continues over a long period, even substantial increases in prison capacity are overwhelmed by the increases in crime and offenders imprisoned. The benefits in these circumstances are marginal. However, reducing the effect of sentence on crime, while changing the behavior of the model, does not eliminate the benefits of increased prison capacity.

More Police. Increased police capacity fails to produce the impact which increased prison capacity produces. This failure arises not because the model includes an assumption that the police are ineffective in arresting offenders. On the contrary, more police raise the flow of arrests, further overloading the courts and reducing sentences. Earlier parole, plea bargaining, and dismissals dissipate most of the potential improvements in deterrence from increased arrests.

These comments do not suggest that the police are unimportant. Obviously, the criminal justice system requires police to apprehend offenders. In some circumstances, insufficient police could critically affect the deterrent capability of the entire system. However, the simulations suggest that, under current conditions, the police are not the limiting resource.
The Impact of Courts on Deterrence. The model does not support the hypothesis that the courts serve as a situs of particular leverage in controlling crime. To the contrary, crime appears to be insensitive to changes in court policy. Two factors are responsible for this insensitivity.

First, several interlocking adjustment mechanisms or negative feedback loops regulate the processing of cases through the courts. Policy changes in one mechanism produce counteracting changes in another. Examples were discussed in Chapter 5 and some are summarized below. Second, the position of the courts within the criminal justice system limits their impact. If the courts sentence an increased number of offenders, they improve the probability of imprisonment but the average effective sentence drops. These factors partially cancel each other in terms of the change in deterrence.

Good reasons exist for improving the courts. In Massachusetts the Superior Court is overloaded. Changes in court administration could reduce delay, raise the quality of justice, and reduce costs. However, the policy tests in Chapter 5 suggest that a marked reduction in crimes will not be one of the outcomes.

More Judges in the Superior Court. Suppose the state were to increase substantially the number of judges in the Superior Court. The simulations in Chapter 5 suggest that the following scenario might occur. The backlog of cases relative to the number of judges declines, thereby lessening the pressure on judges to move cases faster. Some judges would be shifted away from hearing criminal trials
to the crowded civil bench. Potential increase in trials would be limited to some extent by the lack of available defense counsel, particularly of public defenders who already carry a heavy caseload and may not be able to represent defendants in a greater number of trials. Thus, an increase in judges does not produce an equal increase in cases processed by the Superior Court, or in incarcerations. Moreover, the increase in incarcerations which did occur would force a reduction in the average effective sentence. The net result is a relatively small change in deterrence.

**Plea Bargaining.** Plea bargaining is the subject of controversy between those who wish to see it eliminated and those who wish to see it extended. Simulations in this study show mixed results for various types of plea bargaining. In the small Basic Criminal Justice Model, increased plea bargaining resulted in increased amounts of crime. In the Court Management Model, additional plea bargaining in the District Court produced a slight increase in crime, while additional plea bargaining in the Superior Court produced a decrease. Even in this case, though, if the policy were implemented during the early part of the growth cycle, it would increase crimes.

Plea bargaining appears attractive to prosecutors and judges because it appears to be the only means of coping with the flood of cases. However, as discussed in Chapter 3, there are other adjustment mechanisms for controlling workload. Increased plea bargaining helps to move cases faster, but it also relieves some of the pressures which might induce the state legislature to approve more judges.
Mandatory Sentencing. Recently, mandatory sentencing is receiving wide attention. The discussion in this study has dealt with mandatory sentencing for a broad range of crimes, rather than for just one or two. Mandatory sentencing is composed of three separate elements. Different laws might combine them differently from the representation in this study. One advantage of testing the policies with a simulation model is that it forces the planner to state explicitly what he means by the term "mandatory sentencing." The components of mandatory sentencing are:

1. An increase in the fraction of convicted defendants who are imprisoned;

2. A reduction in the discretion of judges and prosecutors to negotiate pleas; and

3. A reduction in the discretion of parole boards to release offenders before their sentence is finished.

The simulations in Chapter 5 suggest that mandatory sentencing in general can be a dangerous policy. The policy can produce a reduction in crime, but at the expense of overcrowding in the prisons. The components of the policy which affect plea bargaining produce some improvement; but most of the benefit arises from restricting parole, so that the average effective sentence does not decline as much when the flow of imprisoned offenders is increased.

However, by inhibiting the parole adjustments, the policy can increase overcrowding in the prisons. Overcrowding can impair security, increase tensions among prisoners, and possibly lead to rioting.
Moreover, it leads the courts to intervene to limit prison population. The legislature will have difficulty in completely limiting the discretion of the sentencing judges. As prisons become overcrowded, judges will find ways of not sentencing offenders to prison. The courts will then provide an adjustment process now performed largely by the parole boards.

Mandatory sentencing presupposes that light sentencing and extensive probations and paroles result because judges are too lenient and need to be guided to impose stiffer sentences. True, in many instances, judges do impose light sentences or fail to imprison at all. Although the practices arise from plea bargaining, they do help to prevent further overcrowding in the prisons. There is no point in judges imposing stiffer sentences, if prisons are full and there is no room for new prisoners. However, if judges were the major cause of offenders serving light sentences, then prisons would have empty cells and prisoners would be serving out most of their court-imposed sentences. This situation does not presently occur in Massachusetts. The purposes behind mandatory sentencing could be better achieved by increasing prison capacity.

Increased Efficiency in Trials. Like other changes in the policies of the courts, increasing the flow of trials with improved management techniques is unlikely to reduce crime significantly. One reason for this is that trials constitute only about fifteen percent of all cases processed in the Superior Court. Even a substantial increase in trials will not produce much impact on the overall flow of
cases through the court. Second, attempts to increase the number of trials will meet limitations imposed by prosecutors and especially defense attorneys, where the shortage of private and public defense counsel prevents the number of trials from increasing as much as it might. Defense counsel must be increased to keep pace with the increased flow of trials, if the full benefit of better court management is to be obtained. The third reason is that increasing trials causes a slight increase in total offenders imprisoned, with the resultant decrease in the length of sentence.

Court Diversion Program. In a court diversion program, some offenders are permitted to volunteer for rehabilitation programs in lieu of prosecution in the courts. The program appears to have two benefits. First, the courts need not handle the cases, thereby reducing the court delay. Second, the offender is not exposed to the adverse effects (if any) of conviction and imprisonment. It can be argued that some who are diverted will go "straight" and escape the web of crime forever. The disadvantage is that the program reduces the probability of imprisonment and deterrence.

Simulations of the program suggest that sometimes it is detrimental and sometimes beneficial, but the benefits depend to some extent on how effective the programs are at rehabilitation. When the program is introduced early in the growth cycle of crime, the reduction in deterrence is exacerbated. Crimes grow faster than they would otherwise. When the program is instituted late in the growth cycle, the effect on deterrence is weak. In the model, improvements occur
because offenders end up in the pool of program participants rather than the pool of ex-offenders with significantly higher rates of crime. Unfortunately, there is little evidence to suggest that programs can reduce the propensity of offenders to commit crimes. The simulations suggest that unless such a reduction is possible, the benefits of court diversion in reducing crime are small.

6.3 Summary

The criminal justice agencies in Massachusetts form a system sufficiently complex that intuition may prove unreliable in developing policies. The feedback structure of the system tends to defeat the impact of many policies, which, at first glance, appear to be effective. In other instances, the process of clearly stating cause and effect relations indicates problems with a policy.

As a result of this complexity and the diversified authority and control in the criminal justice system, there may well be an imbalance in resources, particularly a lack of prison capacity. Consequently, increases in police and court personnel may not prove as effective as they otherwise might.

Dynamic modeling provides a means for identifying these imbalances and better understanding the complex criminal justice system. It is an effective tool for permitting the planner to precisely specify his assumptions and to rigorously check their implications. Modeling, of
course, does not guarantee correct results. If assumptions are significantly incorrect, then the conclusions may be incorrect.

No doubt some people may disagree with the specific recommendations and the approach to deterrence and crime presented in this study. They should realize that the techniques here are not confined to a single set of assumptions. Dynamic modeling can be used with a number of points of view concerning crime.

What is most important is that officials and planners, as well as the public, make an effort to understand the impact of policies throughout the criminal justice system, rather than merely in terms of individual programs and agencies.
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APPENDIX A

DESCRIPTION OF THE EQUATIONS IN THE COURT MANAGEMENT MODEL

A.1 Introduction

The purpose of this appendix is to provide a detailed description of the equations in the Court Management Model. The emphasis here is on what the specific equations represent, rather than what evidence supports the assumptions underlying the equations. The reader should refer to Chapters 2 through 4 for a discussion of the evidence supporting the equations.

The Court Management Model is a computer simulation model in DYNAMO of approximately one hundred thirty variables representing important aspects of the Massachusetts criminal justice system. The model is divided into four sectors:

1. Crime Sector
2. Police Sector
3. Court Sector
4. Corrections Sector

Table 3-1 in the main body of this study outlines the sectors and lists the important factors computed in each. Figure 3-1 depicts
the important connections among sectors. The Court Sector in turn is divided into seven subsectors:

1. Acquisition of Superior Court Judges
2. Utilization of Judges in Superior Court Trials
3. Superior Court Dismissals
4. Superior Court Guilty Pleas
5. District Court
6. Impact of Defense Attorneys
7. Sentencing

A.2 The Crime Sector

The Crime Sector contains the assumptions relating conditions in the criminal justice system to the number of crimes committed. The sector is divided into two parts:

1. Crimes Committed
2. Effect of Deterrence on Crime

Crimes Committed. Equation 5 computes the number of crimes per month CRIME.
The equation uses the SWITCH function to choose between two alternative calculations of crimes:

For DTS equal to 0,

\[ \text{CRIME} = \text{CRINO} + \text{CRIXO} + \text{CRINC} + \text{CRIXC} \]

For DTS not equal to 0,

\[ \text{CRIME} = \text{ICRIME} = 10,000 \]

In some test simulations in Chapter 5, DTS is set to one, thereby causing CRIME to remain constant. This testing is useful to see the direct effects of other changes in the model without obtaining the effects from feeding back crime into the rest of the system.

However, for most of the simulation, DTS is set to zero, so that CRIME equals the crimes committed by four categories.
of offenders:

1. New offenders or those without a prison record for the past five years.

2. Ex-offenders or those with a prison record during the past five years.

3. New offenders in the court diversion program or those new offenders who have been placed in the court diversion program. There are no offenders in this category unless the court diversion program (described below) is implemented in a rerun.

4. Ex-offenders in the court diversion program or those ex-offenders who have been placed in the court diversion program. Again, there are no offenders in this category unless the court diversion program is implemented in a rerun.

Initial values in the model are, in the end, based on initial crimes ICRIME. The procedure uses aids in initializing the model in equilibrium without having to solve simultaneous equations. The value of initial crimes ICRIME was estimated from 1955 data on cases flowing into the District Court (arrests). In 1955, 14,378 cases entered the District Court, an average of 1198 cases per month. Assuming an initial clearance fraction (see below) of 0.225, cases known to the police should equal 1198/0.225 or 5324 cases per month. Assuming that about half of all crimes are reported, then the total number of crimes should be 5324/0.5 or 10,648 cases per month. Rounding out this number yields 10,000 cases per month. This estimate is obviously rough but is sufficiently accu-
rate for the purposes of this model.

Crimes by new offenders CRINO (Equation 6) is the product of four factors. The first is the population of potential new offenders PNO. Potential new offenders are defined as those who are not prisoners, ex-offenders, or participants in the court diversion program. PNO is calculated in the Corrections Sector. The second factor is the crime rate normal for potential new offenders CRNNO. CRNNO is the average number of crimes per month committed by new offenders per potential new offender, when the deterrence of the criminal justice system is normal. An initial value equation calculates CRNNO so that, given the population of potential new offenders, ninety percent of the initial number of crimes per month are committed by new offenders. The resulting value of CRNNO is 0.00181 crimes per person per month. The third factor affecting CRINO is the effect of deterrence on crime EDC. The fourth factor is the variable TEST.

\[
\begin{align*}
\text{CRINO}_K &= (\text{PNO}_K)(\text{CRNNO})(\text{EDC}_K)(\text{TEST}_K) \\
\text{CRINO} &= (\text{CRIME})(1-\text{IFXO}) \\
\text{CRNNO} &= \text{CRINO}/\text{PNO} \\
\text{IFXO} &= 0.1
\end{align*}
\]

CRINO  - CRIMES BY NEW OFFENDERS (CASES/MONTH)
PNO    - POTENTIAL NEW OFFENDERS (PERSONS)
CRNNO  - CRIME RATE FOR POTENTIAL NEW OFFENDERS (CASES/PERSON-MONTHS)
EDC    - EFFECT OF DETERRENCE ON CRIME (DIMENSIONLESS)
TEST   - TEST INPUT (DIMENSIONLESS)
CRIME  - CRIMES (CASES/MONTH)
IFXO   - INITIAL FRACTION OF EX-OFFENDERS COMMITTING CRIMES (DIMENSIONLESS)
TEST (Equation 7) provides an exogenous input for checking the behavior of the model. The type of input depends on TINP (Equation 8). By setting various constants in Equation 8, the following types of inputs can be created:

1. A step input with height ACR
2. A random noise input
3. An exponential growth input with a growth rate of GRC.

\[
\text{TEST} = \text{EXP(TINP)} \\
\text{TINP} = \text{STEP(SHGT, CRS)} + \text{NSW} \times \text{SAMPLE(NORMRN(0, ACR), SINT, 0) + GRC \times \text{TIME} \times K} \\
\text{SHGT} = \text{LOGN(1 + ACR)} \\
\text{ACR} = 0.05 \\
\text{CRS} = 12 \\
\text{NSW} = 0 \\
\text{SINT} = 6 \\
\text{GRC} = 0
\]

Crimes by ex-offenders CRIXO (Equation 9) is computed analogously to crimes by new offenders. The crime rate normal for ex-offenders is 0.0741 cases per person per month.
CRIXK.K=(XO.K)(CRNXO)(EDC.K)(TEST.K)  
CRIXO=(CRIME)(IFXO)  
CRNXO=CRIXO/XO

CRIXO - CRIMES BY EX-OFFENDERS (CASES/MONTH)  
XO - EX-OFFENDERS (PERSONS)  
CRNXO - CRIME RATE NORMAL FOR EX-OFFENDERS (CASES/PERSON-MONTH)  
EDC - EFFECT OF DETERRENCE ON CRIME (DIMENSIONLESS)  
TEST - TEST INPUT (DIMENSIONLESS)  
CRIME - CRIMES (CASES/MONTH)  
IFXO - INITIAL FRACTION OF EX-OFFENDERS COMMITTING CRIMES (DIMENSIONLESS)

Crimes by new offenders in court diversion program CRINC (Equation 10) and crimes by ex-offenders in court diversion program CRIXC (Equation 11) are also computed similarly to CRINO. However, TEST is not included and these categories do not have their own crime rate normals. Instead, the equations use the crime rate normal for the respective category of people not in the program; that is, CRNNO for new offenders and CRNXO for ex-offenders. The effect of court diversion programs on crime rates ECDPC permits adjusting the crime rate normals for offenders in the court diversion program.

CRINC.K=(NOCD.K)(CRNNO)(ECDPC)(EDC.K)  
ECDPC=0

CRINC - CRIMES BY NEW OFFENDERS IN COURT DIVERSION PROGRAM (CASES/MONTH)  
NOCD - NEW OFFENDERS IN COURT DIVERSION PROGRAM (PERSONS)  
CRNNO - CRIME RATE FOR POTENTIAL NEW OFFENDERS (CASES/PERSON-MONTHS)  
ECDPC - EFFECT OF COURT DIVERSION PROGRAM ON CRIME RATES (DIMENSIONLESS)  
EDC - EFFECT OF DETERRENCE ON CRIME (DIMENSIONLESS)
\[ CRI\text{X}\text{C}_k = (XOC\text{D}_k)(CR\text{N}\text{X}O)(ECD\text{P}\text{C})(EDC_k) \]

- **CR\text{I}\text{X}\text{C}** - CRIMES BY EX-OFFENDERS IN COURT DIVERSION PROGRAM (CASES/MONTH)
- **XOC\text{D}** - EX-OFFENDERS IN COURT DIVERSION PROGRAM (PERSONS)
- **CR\text{N}\text{X}O** - CRIME RATE NORMAL FOR EX-OFFENDERS (CASES/PERSON-MONTH)
- **ECD\text{P}\text{C}** - EFFECT OF COURT DIVERSION PROGRAM ON CRIME RATES (DIMENSIONLESS)
- **EDC** - EFFECT OF DETERRENCE ON CRIME (DIMENSIONLESS)

**Effect of Deterrence on Crime.** The effect of deterrence on crime (Equation 12) combines the effect of sentence on crime ESC and the effect of imprisonment on crime EIC.

\[ EDC_k = (EIC_k)(ESC_k) \]

- **EDC** - EFFECT OF DETERRENCE ON CRIME (DIMENSIONLESS)
- **EIC** - EFFECT OF IMPRISONMENT ON CRIME (DIMENSIONLESS)
- **ESC** - EFFECT OF SENTENCE ON CRIME (DIMENSIONLESS)

The effect of imprisonment on crime EIC (Equation 13) incorporates the influence of the risk of imprisonment on individuals' decisions to commit crimes. The measure of the risk is the perceived imprisonment ratio PIR (Equation 14). PIR is the normalized
ratio of perceived offenders imprisoned to perceived crime. The effect of imprisonment on crime EIC reflects the assumption that a decline in the perceived imprisonment ratio causes an increase in crime. Near one, the slope of this relation is greater than one, so that a fractional change in PIR generates a larger fractional change in EIC and, therefore, in CRIME. As PIR drops below 0.5, the EIC relation levels off, so that changes in PIR produce relatively little change in CRIME. (See Figure 2-3).

\[
\text{EIC.K} = \text{TABLE(EICT,1.44*LOGN(PIR.K),-2,2,0.5)}
\]

\[
\text{EICT} = 3.20/3.00/2.50/1.60/1.00/0.64/0.40/0.24/0.15
\]

EIC - EFFECT OF IMPRISONMENT ON CRIME (DIMENSIONLESS)
TABLE - TABLE LOOK-UP FUNCTION
EICT - EFFECT OF IMPRISONMENT ON CRIME TABLE
LOGN - NATURAL LOGARITHM FUNCTION
PIR - PERCEIVED IMPRISONMENT RATIO (DIMENSIONLESS)

\[
\text{PIR.K} = (\text{POI.K}/\text{PCRIM.K})/\text{NIF}
\]

\[
\text{NIF} = \text{TOI}/\text{CRIME}
\]

PIR - PERCEIVED IMPRISONMENT RATIO (DIMENSIONLESS)
POI - PERCEIVED OFFENDERS IMPRISONED (PERSONS/MONTH)
PCRIM - PERCEIVED CRIME (CASES/MONTH)
NIF - NORMAL IMPRISONMENT FRACTION (PERSONS/CASE)
TOI - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)
CRIME - CRIMES (CASES/MONTH)

Perceived offenders imprisoned POI (Equation 15) is an average of total offenders imprisoned TOI. TOI is the sum of
defendants convicted and sentenced to prison by the District Court and the Superior Court. Perceived crime PCRIM (Equation 16) is an average of crimes. These equations use an averaging time of thirty months.

POI.K = POI.J + (DT/DPT)(TOI.J - POI.J)  
POI = TOI  
DPT = 30  
POI  - PERCEIVED OFFENDERS IMPRISONED (PERSONS/MONTH)  
DT  - INTEGRATION INTERVAL (MONTHS)  
DPT  - DETERRENCE PERCEPTION TIME (MONTHS)  
TOI  - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)

PCRIM.K = PCRIM.J + (DT/DPT)(CRIME.J - PCRIM.J)  
PCRIM = CRIME  
PCRIM  - PERCEIVED CRIME (CASES/MONTH)  
DT  - INTEGRATION INTERVAL (MONTHS)  
DPT  - DETERRENCE PERCEPTION TIME (MONTHS)  
CRIME  - CRIMES (CASES/MONTH)

The effect of sentence on crime ESC (Equation 17) incorporates the impact on crime of the average effective sentence, or average sentence actually served by those offenders sentenced to prison. The input to the ESC equation is the perceived average effective sentence ratio PAESR (Equation 18). This ratio is the perceived average effective sentence PAES (Equation 19) divided by its initial value. The ESC relation reflects the assumption that decreases in sentence decrease deterrence and increase crime. In the opposite direction, increases in sentence increase deterrence and reduce crime up
to a point, after which increases in sentence have little effect.

(See Figure 2-27).

\[ \text{ESC}_K = \text{TABLE}(\text{ESCT}, 1.44 \times \text{LOGN} (\text{PAESR}_K), -2, 2, 0.5) \]
\[ \text{ESCT} = 1.65 / 1.75 / 1.60 / 1.40 / 1.00 / 0.80 / 0.70 / 0.64 / 0.60 \]

\[ \text{ESC} \quad \text{EFFECT OF SENTENCE ON CRIME (DIMENSIONLESS)} \]
\[ \text{TABLE} \quad \text{TABLE LOOK-UP FUNCTION} \]
\[ \text{ESCT} \quad \text{EFFECT OF SENTENCE ON CRIME TABLE} \]
\[ \text{LOGN} \quad \text{NATURAL LOGARITHM FUNCTION} \]
\[ \text{PAESR} \quad \text{PERCEIVED AVERAGE EFFECTIVE SENTENCE RATIO (DIMENSIONLESS)} \]

\[ \text{PAESR}_K = \text{PAES}_K / \text{NAES} \]
\[ \text{NAES} = \text{AES} \]

\[ \text{PAESR} \quad \text{PERCEIVED AVERAGE EFFECTIVE SENTENCE RATIO (DIMENSIONLESS)} \]
\[ \text{PAES} \quad \text{PERCEIVED AVERAGE EFFECTIVE SENTENCE (MONTHS)} \]
\[ \text{NAES} \quad \text{NORMAL AVERAGE EFFECTIVE SENTENCE (MONTHS)} \]
\[ \text{AES} \quad \text{AVERAGE EFFECTIVE SENTENCE (MONTHS)} \]

\[ \text{PAES}_K = \text{PAES}_J + (\text{DT} / \text{DPT})(\text{AES}_J - \text{PAES}_J) \]
\[ \text{PAES} = \text{AES} \]

\[ \text{PAES} \quad \text{PERCEIVED AVERAGE EFFECTIVE SENTENCE (MONTHS)} \]
\[ \text{DT} \quad \text{INTEGRATION INTERVAL (MONTHS)} \]
\[ \text{DPT} \quad \text{DETERRENCE PERCEPTION TIME (MONTHS)} \]
\[ \text{AES} \quad \text{AVERAGE EFFECTIVE SENTENCE (MONTHS)} \]

A.3 The Police Sector

The Police Sector reflects the role of the police in detecting and solving crimes. The sector consists of four parts:

1. Crimes Investigated
2. Police Capacity
3. Crimes Intercepted by Police
4. Fraction of Police Capacity on Patrol
**Crimes Investigated.** When the police fail to intercept the criminal (see below), then a case may be reported for investigation. The flow of reported crimes forms a backlog of cases which the police must settle either by solving the cases or by dismissing them. For the purposes of this model, cases which the police are not actively investigating are considered dismissed.

The police case backlog PCBL (Equation 21) is the backlog of cases awaiting investigation. Crimes reported CRRPT feeds this level, and police cases closed PCC depletes it.

\[
\begin{align*}
PCBL.K &= PCBL.J + (DT)(CRRPT.JK - PCC.J) \\
PCBL &= (PCPDN)(1 IPCAP)(NCPP)(1 - IFCPC) \\
PCPDN &= 4
\end{align*}
\]

PCBL - POLICE CASE BACKLOG (CASES)
DT - INTEGRATION INTERVAL (MONTHS)
CRRPT - CRIMES REPORTED (CASES/MONTHS)
PCC - POLICE CASES CLOSED (CASES/MONTH)
PCPDN - POLICE CASE PROCESSING DELAY NORMAL (MONTHS)
IPCAP - INITIAL POLICE CAPACITY (PERSONS)
NCPP - NORMAL CASES CLOSED PER POLICE OFFICER (CASES/PERSON-MONTH)
IFPCP - INITIAL FRACTION OF POLICE CAPACITY ON PATROL (DIMENSIONLESS)

**Crimes reported CRRPT** (Equation 22) are the number of crimes not intercepted by police patrol (see below) times the fraction of crimes reported FCR (Equation 23). FCR depends on the police workload PWL (Equation 24). The police workload is the normalized ratio of the police case backlog to police investigation manpower PIM.
As the workload increases, the police are assumed to be increasingly incapable of devoting time to people's complaints. Perceiving the police as overburdened and unresponsive, citizens report a smaller fraction of cases than when the workload is light.

\[ \text{CRRPT} = (\text{CRIME} \times (1 - \text{NFCRIP})) \times (\text{IFCR}) \]
\[ \text{IFCR} = \text{TABLE}((\text{FCRT}, 1, 0, 5, 1)) \]
\[ \text{CRRPT} - \text{CRIMES REPORTED (CASES/MONTHS)} \]
\[ \text{CRIME} - \text{CRIMES (CASES/MONTH)} \]
\[ \text{CRIP} - \text{CRIMES INTERCEPTED BY POLICE (CASES/MONTH)} \]
\[ \text{FCR} - \text{FRACTION OF CRIMES REPORTED (DIMENSIONLESS)} \]
\[ \text{NFCRIP} - \text{NORMAL FRACTION OF CRIMES INTERCEPTED BY POLICE (DIMENSIONLESS)} \]
\[ \text{IFCR} - \text{INITIAL FRACTION OF CRIMES REPORTED (DIMENSIONLESS)} \]
\[ \text{FCRT} - \text{FRACTION OF CRIMES REPORTED TABLE} \]
\[ \text{TABLE} - \text{TABLE LOOK-UP FUNCTION} \]

\[ \text{FCR} = \text{TABLE}((\text{FCRT}, \text{PWL}.K, 0, 5, 1)) \]
\[ \text{FCRT} = 0.70/0.50/0.40/0.32/0.27/0.25 \]
\[ \text{FCR} - \text{FRACTION OF CRIMES REPORTED (DIMENSIONLESS)} \]
\[ \text{TABLE} - \text{TABLE LOOK-UP FUNCTION} \]
\[ \text{FCRT} - \text{FRACTION OF CRIMES REPORTED TABLE} \]
\[ \text{PWL} - \text{POLICE WORKLOAD (DIMENSIONLESS)} \]

\[ \text{PWL} = (\text{PCBL}.K / \text{PIM}.K) / \text{NRBP} \]
\[ \text{PWL} = 1 \]
\[ \text{NRBP} = (\text{PCPDN}) \times (\text{NCPP}) \]
\[ \text{PWL} - \text{POLICE WORKLOAD (DIMENSIONLESS)} \]
\[ \text{PCBL} - \text{POLICE CASE BACKLOG (CASES)} \]
\[ \text{PIM} - \text{POLICE INVESTIGATION MANPOWER (PERSONS)} \]
\[ \text{NRBP} - \text{NORMAL RATIO OF BACKLOG TO POLICE (CASES/PERSO/N)} \]
\[ \text{PCPDN} - \text{POLICE CASE PROCESSING DELAY NORMAL (MONTHS)} \]
\[ \text{NCPP} - \text{NORMAL CASES CLOSED PER POLICE OFFICER (CASES/PERSON-MONTH)} \]
The police investigation manpower PIM (Equation 25) is the number of police devoted to investigation as opposed to patrol. It is the product of police capacity PCAP and one minus the fraction of police capacity on patrol.

\[ PIM_{,K} = (PCAP_{,K})(1-\text{FPCP}_{,K}) \]

\begin{align*}
PIM &\quad - \text{POLICE INVESTIGATION MANPOWER (PERSONS)} \\
PCAP &\quad - \text{POLICE CAPACITY (PERSONS)} \\
\text{FPCP} &\quad - \text{FRACTION OF POLICE CAPACITY ON PATROL (DIMENSIONLESS)}
\end{align*}

Police cases closed PCC (Equation 26) represents those cases no longer receiving active attention, because the cases have been "solved" and sent to the courts or they have been dismissed. PCC is the product of police investigation manpower PIM, the normal cases closed per police officer NCPP, and the police capacity utilization factor PCUF. NCPP is determined by the initial value of police capacity so that police cases closed equal crimes reported at time zero.

\[ \text{PCC}_{,K} = (\text{NCPP})(\text{PIM}_{,K})(\text{PCUF}_{,K}) \]

\[ \text{NCPP} = \text{CRRPT}/(\text{IPCAP}(1-\text{IFPCP})) \]

\begin{align*}
PCC &\quad - \text{POLICE CASES CLOSED (CASES/MONTH)} \\
\text{NCPP} &\quad - \text{NORMAL CASES CLOSED PER POLICE OFFICER (CASES/PERSON-MONTH)} \\
PIM &\quad - \text{POLICE INVESTIGATION MANPOWER (PERSONS)} \\
\text{PCUF} &\quad - \text{POLICE CAPACITY UTILIZATION FACTOR (DIMENSIONLESS)} \\
\text{CRRPT} &\quad - \text{CRIMES REPORTED (CASES/MONTHS)} \\
\text{IPCAP} &\quad - \text{INITIAL POLICE CAPACITY (PERSONS)} \\
\text{IFPCP} &\quad - \text{INITIAL FRACTION OF POLICE CAPACITY ON PATROL (DIMENSIONLESS)}
\end{align*}
The police capacity utilization factor PCUF (Equation 27) represents changes in the number of cases closed per man-month of police effort due to the police workload. As the workload increases, the police are assumed to try to move cases faster by working longer hours, investigating cases less thoroughly, and dismissing a larger fraction of cases. In the other direction, as the workload declines, there are fewer cases to be worked on, so that the police spend more time on each case. (See Figure 4-3).

\[
\text{PCUF.K} = \text{TABLE(PCUFT, PWL.K, 0, 3, 0.5)}
\]

\[
\text{PCUFT} = 0.00/0.60/1.00/1.40/1.80/2.00/2.00
\]

PCUF - POLICE CAPACITY UTILIZATION FACTOR (DIMENSIONLESS)

TABLE - TABLE LOOK-UP FUNCTION

PCUFT - POLICE CAPACITY UTILIZATION FACTOR TABLE

PWL - POLICE WORKLOAD (DIMENSIONLESS)

Arrests ARR (Equation 28) are those cases which the police send to the District Court. Arrests are the sum of investigations resulting in arrests IRA (Equation 29) and crimes intercepted by police CRIP. IRA is the product of police cases closed and the fraction of cases resulting in arrest FARR (Equation 30). As the police workload rises, the police are assumed to solve a smaller fraction of cases as the result of less attention to each case and a greater willingness to drop cases. (See Figure 4-4).
ARR.K = IRA.K + CRIP.K
ARR     - ARRESTS (CASES/MONTH)
IRA     - INVESTIGATIONS RESULTING IN ARREST (CASES/MONTH)
CRIP    - CRIMES INTERCEPTED BY POLICE (CASES/MONTH)

IRA.K = (PCC.K)(FARR.K)
IRA     - INVESTIGATIONS RESULTING IN ARREST (CASES/MONTH)
PCC     - POLICE CASES CLOSED (CASES/MONTH)
FARR    - FRACTION OF CASES RESULTING IN ARREST (DIMENSIONLESS)

FARR.K = TABLE(FARRT, PWL.K, 0.3, 1)
FARRT = 0.25/0.10/0.05/0.025
FARR     - FRACTION OF CASES RESULTING IN ARREST (DIMENSIONLESS)
TABLE    - TABLE LOOK-UP FUNCTION
FARRT    - FRACTION OF CASES RESULTING IN ARREST TABLE
PWL      - POLICE WORKLOAD (DIMENSIONLESS)

Police Capacity. The CAP (Capacity) macro regulates the changes in police capacity. In this macro, which is explained below, police capacity is acquired in response to increases in the police workload. The tables PAT1 and PAT2 govern the speed of acquisition. PAT1 specifies the base policy; PAT2 specifies a revised policy in which police are acquired faster than in the base policy. (See Figure 4-5.)
CAP Macro. Besides regulating police capacity, the CAP macro also regulates Superior Court judges, District Attorneys, Defense Attorneys, District Court judges, and Prison Capacity. Depending on the values of parameters, the macro provides either a closed loop acquisition policy or an open loop acquisition policy. In the closed loop policy, the acquisition of capacity depends on workloads, workload standards, and current capacity. In the open loop policy, capacity can be given a step increase, the size and timing of which is determined by the modeler. In most instances, the closed loop policy is used, but the open loop policy is used for prison capacity and for some test simulations in Chapter 5.

Equation 1 in CAP computes the level of capacity. In the macro, capacity CAP is a general resource, usually manpower.
Capacity acquisition $CPAC$ changes the level. Depending on the value of the macro argument ACAP (addition to capacity), $CPAC$ equals the capacity acquisition under either the closed loop policy or the open loop policy.

ACAP equals 0.0, $CPAC = CPAC1$ (closed loop policy)

ACAP not equal to 0.0, $CPAC = CPAC2$ (open loop policy)

The modeler can set ACAP to select the type of policy he wants.

\[
\begin{align*}
CAP_{K} &= CAP_{J} + (DT)(CPAC_{J}K) \\
CAP &= ICAP \\
CAP &- CAPACITY (MACRO) \\
DT &- INTEGRATION INTERVAL (MONTHS) \\
CPAC &- CAPACITY ACQUISITION (UNITS/MONTH) \\
ICAP &- INITIAL CAPACITY (UNITS) \\
CPAC_{KL} &= SWITCH(CPAC1_{K}, CPAC2_{K}, ACAP) \\
CPAC &- CAPACITY ACQUISITION (UNITS/MONTH) \\
SWITCH &- SWITCH FUNCTION \\
CPAC1 &- CAPACITY ACQUISITION (CLOSED-LOOP POLICY) (UNITS/MONTH) \\
CPAC2 &- CAPACITY ACQUISITION (OPEN-LOOP POLICY) (UNITS/MONTH) \\
ACAP &- ADDITION TO CAPACITY (DIMENSIONLESS) \\
\end{align*}
\]

The structure of the closed loop policy is analogous to the capacity acquisition structure in the Basic Criminal Justice Model (Chapter 2). Capacity acquisition (closed-loop policy) $CAP1$ (Equation 3 in CAP) is the product of current capacity CAP and the pressure to acquire capacity $SPACAP$. $SPACAP$ (Equation 4 in CAP) is the fractional increase in capacity per month as a function of the
relative workload.

\[ $\text{CPAC1}.K = (\text{CAP}.K)(\text{PACAP}.K) \]

3. A

\[ $\text{CPAC1} - \text{CAPACITY ACQUISITION (CLOSED-LOOP POLICY)} \]
\[ (\text{UNITS/MONTH}) \]
\[ \text{CAP} - \text{CAPACITY (MACRO)} \]
\[ \text{PACAP} - \text{PRESSURE TO ACQUIRE CAPACITY (1/MONTH)} \]

\[ $\text{PACAP}.K = \text{STABLE(TAB1, TAB2, $\text{RWL}.K, 0, 3, 0.5, TSW)} \]

4. A

\[ $\text{PACAP} - \text{PRESSURE TO ACQUIRE CAPACITY (1/MONTH)} \]
\[ \text{STABLE} - \text{SWITCH TABLE LOOK-UP FUNCTION} \]
\[ \text{TAB1} - \text{TABLE (BASE)} \]
\[ \text{TAB2} - \text{TABLE (REVISED)} \]
\[ $\text{RWL} - \text{RELATIVE WORKLOAD (DIMENSIONLESS)} \]
\[ \text{TSW} - \text{TABLE SWITCH (MONTHS)} \]

Equation 4 uses the switch table look-up function STABLE. This function, defined in a macro, permits the modeler to change the relation between the relative workload and the pressure to acquire capacity at a specified time according to the following rule:

If time is less than TSW, use table TAB1 (base)

Otherwise, use table TAB2 (revised)

In all other aspects, this function operates like the standard TABLE function. The STABLE equations are listed below.

MACRO STABLE(TAB1, TAB2, X, XLOW, XHIGH, XINCR, TSW)
\[ \text{STABLE} - \text{SWITCH TABLE LOOK-UP FUNCTION} \]
\[ \text{TAB1} - \text{TABLE (BASE)} \]
\[ \text{TAB2} - \text{TABLE (REVISED)} \]
\[ X - \text{TABLE INPUT (DIMENSIONLESS)} \]
\[ XLOW - \text{LOW VALUE OF TABLE INPUT (DIMENSIONLESS)} \]
\[ XHIGH - \text{HIGH VALUE OF TABLE INPUT (DIMENSIONLESS)} \]
\[ XINCR - \text{INCREMENT OF TABLE INPUT (DIMENSIONLESS)} \]
\[ TSW - \text{TABLE SWITCH (MONTHS)} \]
STABLE - SWITCH TABLE LOCK-UP FUNCTION  
$SW - SWITCH FOR STABLE FUNCTION (DIMENSIONLESS)  
$V1 - FIRST VARIABLE (DIMENSIONLESS)  
$V2 - SECOND VARIABLE (DIMENSIONLESS)  

$SW.K=STEP(1, TSW)  
$SW - SWITCH FOR STABLE FUNCTION (DIMENSIONLESS)  
STEP - STEP FUNCTION  
TSW - TABLE SWITCH (MONTHS)  

$V1.K=TABLE(TAB1, X.K, XLOW, XHIGH, XINCR)  
$V1 - FIRST VARIABLE (DIMENSIONLESS)  
TABLE - TABLE LOCK-UP FUNCTION  
TAB1 - TABLE (BASE)  
X - TABLE INPUT (DIMENSIONLESS)  
XLOW - LOW VALUE OF TABLE INPUT (DIMENSIONLESS)  
XHIGH - HIGH VALUE OF TABLE INPUT (DIMENSIONLESS)  
XINCR - INCREMENT OF TABLE INPUT (DIMENSIONLESS)  

$V2.K=TABLE(TAB2, X.K, XLOW, XHIGH, XINCR)  
$V2 - SECOND VARIABLE (DIMENSIONLESS)  
TABLE - TABLE LOCK-UP FUNCTION  
TAB2 - TABLE (REVISED)  
X - TABLE INPUT (DIMENSIONLESS)  
XLOW - LOW VALUE OF TABLE INPUT (DIMENSIONLESS)  
XHIGH - HIGH VALUE OF TABLE INPUT (DIMENSIONLESS)  
XINCR - INCREMENT OF TABLE INPUT (DIMENSIONLESS)  

Returning to the CAP macro, the input to the pressure to acquire capacity is the relative workload $RWL (Equation 5 in CAP), which is the ratio of the workload $WL to the workload standard $WLS. Workload is an input to the CAP macro. Workload standard $WLS (Equation 6 of CAP) is a level affected by the change in workload standard $CWLS (Equation 7). $CWLS adjusts WLS so that $RWL
tends toward one or so that the workload standard equals the work-
load. The standard adjustment time, SAT (an argument of the macro),
determines how fast the adjustment occurs.

$$\$RWL.K = WL.K/WLS.K$$
$$\$RWL \quad - \quad \text{RELATIVE WORKLOAD (DIMENSIONLESS)}$$
$$WL \quad - \quad \text{WORKLOAD (DIMENSIONLESS)}$$
$$WLS \quad - \quad \text{WORKLOAD STANDARD (DIMENSIONLESS)}$$

$$WLS.K = WLS.J + (DT)(\$CWLS.K)$$
$$WLS = WL$$
$$WLS \quad - \quad \text{WORKLOAD STANDARD (DIMENSIONLESS)}$$
$$DT \quad - \quad \text{INTEGRATION INTERVAL (MONTHS)}$$
$$\$CWLS \quad - \quad \text{CHANGE IN WORKLOAD STANDARD (1/MONTH)}$$
$$WL \quad - \quad \text{WORKLOAD (DIMENSIONLESS)}$$

$$\$CWLS,KL = (WLS.K)(\$RWL.K-1)/SAT$$
$$\$CWLS \quad - \quad \text{CHANGE IN WORKLOAD STANDARD (1/MONTH)}$$
$$WLS \quad - \quad \text{WORKLOAD STANDARD (DIMENSIONLESS)}$$
$$\$RWL \quad - \quad \text{RELATIVE WORKLOAD (DIMENSIONLESS)}$$
$$SAT \quad - \quad \text{STANDARD ADJUSTMENT TIME (MONTHS)}$$

In the closed loop policy, as the relative workload rises,
the pressure to acquire capacity increases, resulting in the acquisi-
tion of more capacity.

The open loop policy permits the modeler to specify one or
a series of step increases in capacity. Equation 8 in CAP uses
the pulse function to compute the capacity acquisition (open
loop policy) $\$CPAC2$. The modeler specifies the policy as follows:

1. He specifies the fractional increase or the addition to
capacity ACAP. A non-zero value of ACAP results in the macro
selecting the open-loop policy.
2. He specifies the time at which the first increase will occur TSW.

3. He specifies the interval between successive increases INT. By using a value greater than the length of the simulation (10,000 is used in the model), the modeler permits only one increase to occur.

$\text{CPAC2.K=\text{PULSE}}((\text{ACAP*CAP.K})/\text{DT}, \text{TSW}, \text{INT})$

$\text{CPAC2} - \text{CAPACITY ACQUISITION (OPEN-LOOP POLICY)}$

$\text{ACAP} - \text{ADDITION TO CAPACITY (DIMENSIONLESS)}$

$\text{CAP} - \text{CAPACITY (MACRO)}$

$\text{DT} - \text{INTEGRATION INTERVAL (MONTHS)}$

$\text{TSW} - \text{TABLE SWITCH (MONTHS)}$

$\text{INT} - \text{CAPACITY INTERVAL (MONTHS)}$

**Crimes Intercepted by Police.** Returning to the main portion of the model, crimes intercepted by police are those crimes in which the police patrols apprehend the criminal in the process of, or shortly after, committing a crime, and in which the case is referred to the District Court. Crimes intercepted are, therefore, one component of arrests.

Equation 33 computes the crimes intercepted CRIP. The fraction of crimes intercepted FCRIP (Equation 34) depends on three factors:

1. the normal fraction of crimes intercepted by police $\text{NFCRIP}$
2. the effect of police patrol on crimes intercepted EPPCI,
3. the effect of change in police patrol ECPT.

The normal fraction of crimes intercepted is a constant computed in an initial value equation. The value of NFCRIP is determined in such a way that the ratio of arrests to crimes known to the police (crimes intercepted plus crimes reported) will initially equal the initial clearance fraction ICLNF. The value of ICLNF was selected to be somewhat higher than the clearance fraction indicated by 1966 data, the first year in which the Massachusetts Department of Corrections reported arrests in the same categories as the FBI index of crimes. (See Appendix B.)

$$\text{CRIPT.K} = \text{CRIME.K} \times \text{FCRIP.K}$$
$$\text{CRIP} = \text{CRIME} \times \text{NFCRIP}$$

**CRIP** - CRIMES INTERCEPTED BY POLICE (CASES/MONTH)
**CRIME** - CRIMES (CASES/MONTH)
**FCRIP** - FRACTION OF CRIMES INTERCEPTED (DIMENSIONLESS)
**NFCRIP** - NORMAL FRACTION OF CRIMES INTERCEPTED BY POLICE (DIMENSIONLESS)
FCRIP.K = (NFCRIP)(EPPCI.K)(ECPT.K)  
NFCRIP = (IFCR*(ICLNF-IFARR))/(1-IFCR*IFARR-ICLNF*(1-IFCR))  
IFARR=TABLE(FARRT,1,0,3,1)  
ICLNF=.225

FCRIP - FRACTION OF CRIMES INTERCEPTED (DIMENSIONLESS)
NFCRIP - NORMAL FRACTION OF CRIMES INTERCEPTED BY POLICE (DIMENSIONLESS)
EPPCI - EFFECT OF POLICE PATROL ON CRIMES INTERCEPTED (DIMENSIONLESS)
ECPT - EFFECT OF CHANGE IN POLICE PATROL (DIMENSIONLESS)
IFCR - INITIAL FRACTION OF CRIMES REPORTED (DIMENSIONLESS)
ICLNF - INITIAL POLICE CLEARANCE FACTOR (DIMENSIONLESS)
IFARR - INITIAL FRACTION OF CASES RESULTING IN ARRESTS (DIMENSIONLESS)
TABLE - TABLE LOOK-UP FUNCTION
FARRT - FRACTION OF CASES RESULTING IN ARREST TABLE

The effect of police patrol on crimes intercepted EPPCI (Equation 35) represents the assumed impact of police patrol manpower on the crimes intercepted. (See Figure 4-7.) The input to this relation is the police patrol ratio PATR (Equation 36), which is the normalized ratio of police patrol manpower to the volume of crimes. As this ratio declines, EPPCI declines, causing a reduction in the fraction of crimes intercepted. Chapter 4 discusses the derivation of this relation.
EPPCI.K = TABLE(EPPCIT, 1.44*LOGN(PATR.K), -2, 2, 1)  
EPPCIT = 0.70/0.85/1.00/1.20/1.50

EPPCI - EFFECT OF POLICE PATROL ON CRIMES
INTERCEPTED (DIMENSIONLESS)
TABLE - TABLE LOOK-UP FUNCTION
EPPCIT - EFFECT OF POLICE PATROL ON CRIMES
INTERCEPTED TABLE
LOGN - NATURAL LOGARITHM FUNCTION
PATR - POLICE PATROL RATIO (DIMENSIONLESS)

PATR.K = (PPM.K/CRIME.K)/NPMC
NPMC = (IPCAP*IFPCP)/CRIME

PATR - POLICE PATROL RATIO (DIMENSIONLESS)
PPM - POLICE PATROL MANPOWER (PERSONS)
CRIME - CRIMES (CASES/MONTH)
NPMC - NORMAL RATIO OF POLICE MANPOWER TO CRIME
(PERSON-MONTHS/CASE)
IPCAP - INITIAL POLICE CAPACITY (PERSONS)
IFPCP - INITIAL FRACTION OF POLICE CAPACITY ON
PATROL (DIMENSIONLESS)

Police patrol manpower PPM (Equation 37) is the product of
police capacity PCAP and the fraction of police capacity on patrol
FP.CP.

PPM.K = (PCAP.K)(FPCP.K)

PPM - POLICE PATROL MANPOWER (PERSONS)
PCAP - POLICE CAPACITY (PERSONS)
FPCP - FRACTION OF POLICE CAPACITY ON PATROL
(DIMENSIONLESS)

The effect of change in police patrol ECPT (Equation 38) is
the assumed impact of changing values of police patrol on crimes
intercepted. The input to this relation is the change in police
patrol ratio CPATR (Equation 39), which is the ratio of the police
patrol ratio PATR to the perceived police patrol ratio PPATR (Equa-
tion 40). PPATR is an average or smoothed value of PATR. ECPT
represents the assumed effect of unexpected changes in police patrol on crime interceptions. If \( \text{PATR} \) is increasing, \( \text{ECPT} \) rises above one, thereby increasing the fraction of crimes intercepted.

\[
\begin{align*}
\text{ECPT} & = \text{TABLE} (\text{ECPTT}, \text{CPATR.K}, 0, 0.2, 0.5) \\
\text{ECPTT} & = 0.50/0.75/1.00/1.10/1.15 \\
\text{ECPT} & - \text{EFFECT OF CHANGE IN POLICE PATROL (DIMENSIONLESS)} \\
\text{TABLE} & - \text{TABLE LOOK-UP FUNCTION} \\
\text{ECPTT} & - \text{EFFECT OF CHANGE IN POLICE PATROL TABLE} \\
\text{CPATR} & - \text{CHANGE IN POLICE PATROL RATIO (DIMENSIONLESS)}
\end{align*}
\]

\[
\begin{align*}
\text{CPATR.K} & = \text{PATR.K}/\text{PPATR.K} \\
\text{CPATR} & - \text{CHANGE IN POLICE PATROL RATIO (DIMENSIONLESS)} \\
\text{PATR} & - \text{POLICE PATROL RATIO (DIMENSIONLESS)} \\
\text{PPATR} & - \text{PERCEIVED POLICE PATROL RATIO (DIMENSIONLESS)}
\end{align*}
\]

\[
\begin{align*}
\text{PPATR.K} & = \text{PPATR.J} + (\text{DT}/\text{DPT})(\text{PATR.J}-\text{PPATR.J}) \\
\text{PPATR} & = \text{PATR} \\
\text{PPATR} & - \text{PERCEIVED POLICE PATROL RATIO (DIMENSIONLESS)} \\
\text{DT} & - \text{INTEGRATION INTERVAL (MONTHS)} \\
\text{DPT} & - \text{DETERRENCE PERCEPTION TIME (MONTHS)} \\
\text{PATR} & - \text{POLICE PATROL RATIO (DIMENSIONLESS)}
\end{align*}
\]

The Fraction of Police Capacity on Patrol. The fraction of police capacity on patrol \( \text{FPCP} \) (Equation 41) is a level varied by the change in the fraction of police patrol \( \text{CFPCP} \) (Equation 42). \( \text{CFPCP} \) responds to the pressure on the fraction of police capacity on patrol \( \text{PFPCP} \) (Equation 43). This pressure is assumed to arise
from three sources:

1. maintenance of the normal fraction of capacity on patrol

2. community pressure for more patrolling

3. pressures to allocate more capacity to investigation.

\[ \text{FPCP}_K = \text{FPCP}_J + (\text{DT})(\text{CFPCP}_J) \]

\[ \text{FPCP} = 1 \text{FPCP} \]

\[ \text{IFPCP} = 0.6 \]

\[ \text{FPCP} = \text{FRACTION OF POLICE CAPACITY ON PATROL (DIMENSIONLESS)} \]

\[ \text{DT} = \text{INTEGRATION INTERVAL (MONTHS)} \]

\[ \text{CFPCP} = \text{CHANGE IN FRACTION OF POLICE CAPACITY ON PATROL (1/MONTH)} \]

\[ \text{IFPCP} = \text{INITIAL FRACTION OF POLICE CAPACITY ON PATROL (DIMENSIONLESS)} \]

\[ \text{CFPCP}_K = (\text{FPCP}_K)(\text{PFPCP}_K-1)(\text{PPAF}) \]

\[ \text{PPAF} = 0.1 \]

\[ \text{CFPCP} = \text{CHANGE IN FRACTION OF POLICE CAPACITY ON PATROL (1/MONTH)} \]

\[ \text{FPCP} = \text{FRACTION OF POLICE CAPACITY ON PATROL (DIMENSIONLESS)} \]

\[ \text{PFPCP} = \text{PRESSURE ON FRACTION OF POLICE CAPACITY ON PATROL (DIMENSIONLESS)} \]

\[ \text{PPAF} = \text{POLICE PATROL ADJUSTMENT FRACTION (1/MONTH)} \]

\[ \text{PFPCP}_K = (\text{PSPT}_K)(\text{CPPP}_K)(\text{PPP}_K) \]

\[ \text{PFPCP} = \text{PRESSURE ON FRACTION OF POLICE CAPACITY ON PATROL (DIMENSIONLESS)} \]

\[ \text{PSPT} = \text{PRESSURE FROM STANDARD PATROL (DIMENSIONLESS)} \]

\[ \text{CPPP} = \text{COMMUNITY PRESSURE FOR POLICE PATROL (DIMENSIONLESS)} \]

\[ \text{PPP}_K = \text{PRESSURE ON POLICE PATROL FROM WORKLOAD (DIMENSIONLESS)} \]
The pressure from standard patrol PSPT (Equation 44) represents assumed organizational pressures to maintain the fraction of police capacity at its normal value. The input to this relation is the fraction of police capacity on patrol. As the fraction drops, PSPT increases, thereby tending to prevent further declines in FPCP. Similarly, as FPCP increases, PSPT declines, tending to prevent further increases.

\[
\text{PSPT}, k = \text{TABLE}(\text{PSPTT}, \text{FPCP}, k, 0, 1, 0.2) \\
\text{PSPTT} = 5/3.5/2/1 / .4 / 0 \\
\text{PSPT} - \text{PRESSURE FROM STANDARD PATROL} \\
(\text{DIMENSIONLESS}) \\
\text{TABLE} - \text{TABLE LOOK-UP FUNCTION} \\
\text{PSPTT} - \text{PRESSURE FROM STANDARD PATROL TABLE} \\
\text{FPCP} - \text{FRACTION OF POLICE CAPACITY ON PATROL} \\
(\text{DIMENSIONLESS})
\]

The community pressure for police patrol CPPP (Equation 45) represents citizen pressures for more police on the streets when crime increases. The input to this relation is the community awareness of crime CACR (Equation 46), which is the ratio of perceived crime PCRIM to the standard of crime SCRIM (Equation 47). As explained in the section on the Crime Sector, PCRIM is a smoothed value of CRIME. SCRIM is, in turn, a smoothed value of PCRIM. When crimes are increasing, PCRIM increases above SCRIM, causing CACR to rise above one and CPPP to increase. This structure represents the assumption that if crime is increasing, people become
alarmed and request more police patrol.

CPPP.K = TABLE(CPPT, CACR.K, 0.2, 0.5)
CPPT = 0.50/0.65/1.00/1.50/1.75

CPPP - COMMUNITY PRESSURE FOR POLICE PATROL
        (DIMENSIONLESS)
TABLE - TABLE LOOK-UP FUNCTION
CPPT - COMMUNITY PRESSURE FOR POLICE PATROL TABLE
CACR - COMMUNITY AWARENESS OF CRIME
        (DIMENSIONLESS)

CACR.K = PCRIM.K/SCRIM.K
CACR - COMMUNITY AWARENESS OF CRIME
        (DIMENSIONLESS)
PCRIM - PERCEIVED CRIME (CASES/MONTH)
SCRIM - STANDARD OF CRIME (DIMENSIONLESS)

SCRIM.K = SCRIM.J+(DT/CSAT)(PCRIM.J-SCRIM.J)
SCRIM = CRIME
CSAT = 12
SCRIM - STANDARD OF CRIME (DIMENSIONLESS)
DT - INTEGRATION INTERVAL (MONTHS)
CSAT - CRIME STANDARD ADJUSTMENT TIME (MONTHS)
PCRIM - PERCEIVED CRIME (CASES/MONTH)
CRIME - CRIMES (CASES/MONTH)

The pressure on police patrol from workload PPPW (Equation 48) represents the assumed relation between the police workload and pressures to allocate more police to investigation. As the police workload rises, PPPW increases, tending to cause a reduction in the fraction of police capacity on patrol. A larger fraction of capacity is allocated to investigation in an effort to reduce the backlog of cases awaiting processing.
A.4 Court Sector: Acquisition of Superior Court Judges

The first subsector of the Court Sector deals with the impact of workload on the acquisition of Superior Court judges. As explained in Chapter 3, this is one of several adjustment mechanisms with which the courts can control workload. The reader is referred to Chapter 3 for a discussion of the formal structure of the courts underlying this model.

Superior Court Backlog. The Superior Court backlog SCB (Equation 50) is the backlog of cases awaiting processing in the Superior Court. This backlog is fed by Grand Jury indictments and appeals to the Superior Court from the District Court. The cases are disposed of through Superior Court trials, Superior Court cases dismissed, and Superior Court guilty pleas.
The Superior Court backlog forms the numerator of the Superior Court judicial workload SCJWL (Equation 51), which is one of the workloads affecting decisions in the Court Sector.

**SCJWL.K=(SCB.K/SCJ.K)/NRBJ**  
**NRBJ=SCB/IScj**  
**SCJWL=1**

- **SCJWL** - SUPERIOR COURT JUDICIAL WORKLOAD (DIMENSIONLESS)
- **SCB** - SUPERIOR COURT BACKLOG (CASES)
- **SCJ** - SUPERIOR COURT JUDGES (PERSONS)
- **NRBJ** - NORMAL RATIO OF BACKLOG TO JUDGES (CASES/ PERSON)
- **IScj** - INITIAL SUPERIOR COURT JUDGES (PERSONS)

**Superior Court Judges.** Acquisition of Superior Court judges is one way the Superior Court is assumed to control the Superior Court judicial workload. The number of Superior Court judges SCJ (Equation 52) is computed using the CAP macro explained above. For most of the simulations, the closed-loop policy is in effect. The
tables SCAT1 and SCAT2 (see Figure 3-8) specify the relation between the relative workload for Superior Court judges (embedded in the CAP macro) and the pressure to acquire judges (also embedded in the macro). For values less than one, the pressure to acquire judges is zero, so that there is no change in the number of judges. For values of the relative workload greater than one, the pressure to acquire judges increases slowly, reflecting the reluctance of the legislature to increase Superior Court judges.

| SCJ.K=CAP(SCJWL.K,SCJWLS.K,SCAT1,SCAT2,SCJSAT,ISCJ, 52, A SCJSW,ASCJ,SCJINT) | 52.2, T |
| SCAT1=0.0E-2/0.0E-2/0.0E-2/0.05E-2/0.2E-2/0.4E-2/0.8E-2 | 52.4, T |
| SCAT2=0.0E-2/0.0E-2/0.0E-2/0.1E-2/0.4E-2/0.8E-2 | 52.6, C |
| SCJSAT=180 | 52.7, C |
| ISCJ=37 | 52.8, C |
| SCJSW=10000 | 52.9, C |
| ASCJ=0 | 53.1, C |
| SCJINT=10000 | 53.5, C |

SCJ - SUPERIOR COURT JUDGES (PERSONS)
CAP - CAPACITY (MACRO)
SCJWL - SUPERIOR COURT JUDICIAL WORKLOAD (DIMENSIONLESS)
SCJWLS - SUPERIOR COURT JUDICIAL WORKLOAD STANDARD (DIMENSIONLESS)
SCAT1 - SUPERIOR COURT JUDGE ADJUSTMENT TABLE (BASE)
SCAT2 - SUPERIOR COURT JUDGE ADJUSTMENT TABLE (REVISED)
SCJSAT - SUPERIOR COURT JUDICIAL STANDARD ADJUSTMENT TIME (MONTHS)
ISCJ - INITIAL SUPERIOR COURT JUDGES (PERSONS)
SCJSW - SUPERIOR COURT JUDICIAL SWITCH (MONTHS)
ASCJ - ADDITION TO SUPERIOR COURT JUDGES (DIMENSIONLESS)
SCJINT - SUPERIOR COURT JUDICIAL INTERVAL (MONTHS)
A.5 Court Sector: Utilization of Judges in Superior Court Trials

This subsector determines the flow of trials in the Superior Court and the number of days per month devoted to trials.

**Superior Court Trials.** The Superior Court trials SCT (Equation 54) depends on the Superior Court session SCS and the effect of defense attorneys on trials EDFT. EDFT is described below in the subsector dealing with the impact of defense attorneys.

\[
\text{SCT} = \text{NTJD} \times (\text{SCS} \times \text{EDFT})
\]

\[
\text{NTJD} = \left( \frac{(GJI + APLS) \times \text{IFT}}{\text{ISCS}} \right)
\]

\[
\text{IFT} = 0.16
\]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCT</td>
<td>Superior Court Trials (Cases/Month)</td>
</tr>
<tr>
<td>NTJD</td>
<td>Normal Trials Per Judge-Day (Cases/Person-Day)</td>
</tr>
<tr>
<td>SCS</td>
<td>Superior Court Session (Person-Days/Month)</td>
</tr>
<tr>
<td>EDFT</td>
<td>Effect of Defense Attorneys on Trials (Dimensionless)</td>
</tr>
<tr>
<td>GJI</td>
<td>Grand Jury Indictments (Cases/Month)</td>
</tr>
<tr>
<td>APLS</td>
<td>Appeals to Superior Court (Cases/Month)</td>
</tr>
<tr>
<td>IFT</td>
<td>Initial Fraction of Cases Tried (Dimensionless)</td>
</tr>
<tr>
<td>ISCS</td>
<td>Indicated Superior Court Sessions (Person-Days/Month)</td>
</tr>
</tbody>
</table>

The Superior Court session SCS (Equation 55) is the number of trial-days per month devoted to criminal trials. It is a function of the indicated Superior Court session ISCS and the restrictions on trials from prosecutors and defense attorneys.
SCS.K=(ISCS.K)(PRRT.K)(DFRT.K)

SCS - SUPERIOR COURT SESSION (PERSON-DAYS/MONTH)
ISCS - INDICATED SUPERIOR COURT SESSIONS (PERSON-DAYS/MONTH)
PRRT - PROSECUTOR RESTRICTION ON TRIALS (DIMENSIONLESS)
DFRT - DEFENSE ATTORNEY RESTRICTION ON TRIALS (DIMENSIONLESS)

The indicated Superior Court session ISCS (Equation 56) is the number of trial-days per month for criminal trials that would occur if the restrictions on trials from prosecutors and defense attorneys remained unchanged from their initial values. ISCS is the product of the number of Superior Court judges, the judicial utilization factor, and the judicial efficiency program.

ISCS.K=(SCJ.K)(JUF.K)(JEFP.K)

ISCS - INDICATED SUPERIOR COURT SESSIONS (PERSON-DAYS/MONTH)
SCJ - SUPERIOR COURT JUDGES (PERSONS)
JUF - JUDICIAL UTILIZATION FACTOR (DAYS/MONTH)
JEFP - JUDICIAL EFFICIENCY PROGRAM (DIMENSIONLESS)

The judicial utilization factor JUF (Equation 57) represents the second adjustment mechanism of the courts. As the Superior Court judicial workload increases, the Superior Court is assumed both to allocate a larger fraction of Superior Court judges' time to criminal trials and to increase the amount of time that District Court judges sit in the Superior Court. Consequently, the number of trial-days per month per judge increases.
The judicial efficiency program JEFF (Equation 58) represents the impact of increased efficiency in conducting trials. It is incorporated into the equation for the indicated Superior Court session, so that it acts like an increase in the indicated Superior Court session and, therefore, is subject to prosecutor and defense attorney restrictions. This location for the program is appropriate, since attempting to increase the flow of trials without increasing the prosecutors and defense attorneys is assumed to meet with the same possible limitations as increasing the number of days of trials. The program is depicted as an open-loop policy, which is switched on at a time specified by JEPS.

Restrictions on Trials from Prosecutors and Defense Attorneys.

Since a prosecutor and a defense attorney must usually participate
in a trial, insufficient numbers of these attorneys are assumed to restrict the flow of trials.

The prosecutor restriction on trials PRRT (Equation 59) represents the limitation from prosecutors. The input to this relation is the prosecutor trials ratio PRTR (Equation 60), which is the normalized ratio of District Attorneys to the indicated Superior Court session. As the prosecutor trial ratio declines, PRRT also declines, causing the Superior Court session to decrease relative to the indicated Superior Court session.

\[
\text{PRRT}_k = \text{TABLE}(\text{PRRTT}, 1.44 \times \log(\text{PRTR}_k), -2, 2, 1)
\]
\[
\text{PRRTT} = 0.80/0.90/1.00/1.12/1.25
\]

PRRT - PROSECUTOR RESTRICTION ON TRIALS (DIMENSIONLESS)

TABLE - TABLE LOOK-UP FUNCTION

PRRTT - PROSECUTOR RESTRICTION ON TRIALS TABLE

LOGN - NATURAL LOGARITHM FUNCTION

PRTR - PROSECUTOR TRIAL RATIO (DIMENSIONLESS)

\[
\text{PRTR}_k = (\text{DA}_k/\text{ISCS}_k)/\text{NRPRRT}
\]

NRPRRT = DA/ISCS

PRTR - PROSECUTOR TRIAL RATIO (DIMENSIONLESS)

DA - DISTRICT ATTORNEYS (PERSONS)

ISCS - INDICATED SUPERIOR COURT SESSIONS (PERSON-DAYS/MONTH)

NRPRRT - NORMAL RATIO OF PROSECUTORS TO TRIALS (DAYS/MONTH)

IUA - INITIAL DISTRICT ATTORNEYS (PERSONS)

Equations 61 and 62 depict an analogous structure for defense attorneys.
DFRT.K = TABLE(DFRTT, 1.44*LOGN(DFTR.K), -2, 2, 1) 61, A
DFRTT = 0.80/0.90/1.00/1.12/1.25 61.1, T
DFRT  - DEFENSE ATTORNEY RESTRICTION ON TRIAL (DIMENSIONLESS)
TABLE - TABLE LOOK-UP FUNCTION
DFRTT - DEFENSE ATTORNEY RESTRICTION ON TRIAL TABLE
LOGN  - NATURAL LOGARITHM FUNCTION
DFTR  - DEFENSE ATTORNEY TRIAL RATIO (DIMENSIONLESS)

DFTR.K = (DFAT.K/ISCS.K)/NRDFT 62, A
NRDFT = IDF/ISCS 62.1, N
DFTR  - DEFENSE ATTORNEY TRIAL RATIO (DIMENSIONLESS)
DFAT  - DEFENSE ATTORNEYS (PERSONS)
ISCS  - INDICATED SUPERIOR COURT SESSIONS (PERSON-DAYS/MONTH)
NRDFT - NORMAL RATIO OF DEFENSE ATTORNEYS TO TRIALS (DAYS/MONTH)
IDF   - INITIAL DEFENSE ATTORNEYS (PERSONS)

A.6 Court Sector: Superior Court Dismissals

Some cases before the Superior Court are dismissed without a trial or a guilty plea. The dismissals are assumed to depend, in part, on the workload of the Superior Court. If the workload is large, judges and prosecutors are assumed to be more willing to dismiss cases than when the workload is small. Thus, dismissals form a third adjustment mechanism for controlling workload.

Superior Court Cases Dismissed. Superior Court cases dismissed SCCD (Equation 63) are a function of the number of Superior Court judges SCJ and the pressure on dismissals from workload PDW (Equation 64). In the equation for PDW, the Superior Court workload SCWL (Equation 65) is the input. SCWL is a weighted average
of the prosecutor workload and the Superior Court judicial workload. The use of the average reflects the assumption that pressures from the workload on both judges and prosecutors enter into the decision to dismiss cases. As the Superior Court workload increases, the pressure on dismissals also increases, producing a rise in the cases dismissed. For values of SCWL near five, the slope of the relation is fairly steep. (See Figure 3-11.)

SCCD.KL=(NDJ)(SCJ.K)(PDW.K)  63, R
NDJ=(GJI+APLS)(IFD)/ISCJ  63.1, N
IFD=0.08  63.2, C
SCCD  - SUPERIOR COURT CASES DISMISSED (CASES/MONTH)
NDJ  - NORMAL DISMISSELS PER JUDGE (CASES/PERSON-MONTH)
SCJ  - SUPERIOR COURT JUDGES (PERSONS)
PDW  - PRESSURE ON DISMISSELS FROM WORKLOAD (DIMENSIONLESS)
GJI  - GRAND JURY INDICTMENTS (CASES/MONTH)
APLS  - APPEALS TO SUPERIOR COURT (CASES/MONTH)
IFD  - INITIAL FRACTION OF CASES DISMISSED (DIMENSIONLESS)
ISCJ  - INITIAL SUPERIOR COURT JUDGES (PERSONS)

PDW.K=TABLE(PDWT,SCWL.K,0.5,0.5)  64, A
PDWT=0.00/0.80/1.00/1.20/1.40/1.70/2.00/2.50/3.00/3.50/4.00  64.1, T
PDW  - PRESSURE ON DISMISSELS FROM WORKLOAD (DIMENSIONLESS)
TABLE  - TABLE LOOK-UP FUNCTION
PDWT  - PRESSURE ON DISMISSELS FROM WORKLOAD TABLE
SCWL  - SUPERIOR COURT WORKLOAD (DIMENSIONLESS)

SCWL.K=(PWF)(PRWL.K)+(1-PWF)(SCJWL.K)  65, A
PWF=0.7  65.1, C
SCWL  - SUPERIOR COURT WORKLOAD (DIMENSIONLESS)
PWF  - PROSECUTOR WEIGHTING FACTOR (DIMENSIONLESS)
PRWL  - PROSECUTOR WORKLOAD (DIMENSIONLESS)
SCJWL  - SUPERIOR COURT JUDICIAL WORKLOAD (DIMENSIONLESS)
The prosecutor workload PRWL (Equation 66) is the normalized ratio of the Superior Court backlog to the number of District Attorneys.

\[
\text{PRWL.}K = \frac{\text{SCB.}K/\text{DA.}K}{\text{NRBDA}} \\
\text{NRBDA} = \frac{\text{SCB}}{\text{IDA}} \\
\text{PRWL} = 1
\]

- **PRWL** - PROSECUTOR WORKLOAD (DIMENSIONLESS)
- **SCB** - SUPERIOR COURT BACKLOG (CASES)
- **DA** - DISTRICT ATTORNEYS (PERSONS)
- **NRBDA** - NORMAL RATIO OF BACKLOG TO DISTRICT ATTORNEYS (CASES/PERSON)
- **IDA** - INITIAL DISTRICT ATTORNEYS (PERSONS)

*District Attorneys.* In Equation 67, the CAP macro computes the number of District Attorneys DA. As with police capacity and Superior Court judges, an increase in the appropriate workload, in this case the prosecutor workload, produces an increase in District Attorneys.
A.7 Court Sector: Superior Court Guilty Pleas

Guilty pleas provide the fourth adjustment mechanism. As the Superior Court workload grows, prosecutors and judges are assumed to reduce the severity of sentences for those defendants pleading guilty. The reduction provides an incentive for more defendants to forego trials. Cases, therefore, move faster than before.

**Guilty Pleas.** Superior Court guilty pleas SCGP (Equation 69)
are assumed to depend on three factors:

1. Superior Court judges SCJ

2. the effect of sentence ratio on guilty pleas ESRGP

3. the effect of defense attorneys on guilty pleas EDFGP.

EDFGP is explained later.

\[
SCGP, KL = (NGPJ)(SCJ, K)(ESRGP, K)(EDFGP, K) \\
NGPJ = (GJI + APLS)(1 - IFD - IFT)/ISCJ
\]

SCGP - SUPERIOR COURT GUILTY PLEAS (CASES/MONTHS)
NGPJ - NORMAL GUILTY PLEAS PER JUDGE (CASES/PERSON-MONTH)
SCJ - SUPERIOR COURT JUDGES (PERSONS)
ESRGP - EFFECT OF SENTENCE RATIO ON GUILTY PLEAS (DIMENSIONLESS)
EDFGP - EFFECT OF DEFENSE ATTORNEYS ON GUILTY PLEAS (DIMENSIONLESS)
GJI - GRAND JURY INDICTMENTS (CASES/MONTH)
APLS - APPEALS TO SUPERIOR COURT (CASES/MONTH)
IFD - INITIAL FRACTION OF CASES DISMISSED (DIMENSIONLESS)
IFT - INITIAL FRACTION OF CASES TRIED (DIMENSIONLESS)
ISCJ - INITIAL SUPERIOR COURT JUDGES (PERSONS)

The effect of sentence ratio on guilty pleas ESRGP (Equation 70) represents the assumed impact of reduced sentences on the willingness of defendants to plead guilty. The plea bargaining sentence ratio represents the severity of sentence for those who plead guilty, relative to those who were found guilty in a trial. As the severity of sentence for pleading guilty declines, the plea bargaining sentence ratio PBSR declines and the effect of sentence ratio on guilty pleas increases, resulting in more guilty pleas.
The plea bargaining sentence ratio PBSR (Equation 71) depends on two factors:

1. the guilty plea imprisonment ratio GPIR
2. the guilty plea sentence ratio GPSR.

The guilty plea imprisonment ratio GPIR (Equation 72) is the ratio of the fraction of defendants imprisoned after pleading guilty to the fraction of defendants imprisoned after conviction in a trial. (See Figure 3-16.) When the Superior Court workload is low, judges are assumed to set the two fractions to be nearly equal. As the workload
grows, judges are assumed to grant more suspended sentences and probations to encourage defendants to plead guilty.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPIR.K</td>
<td>Stable (GPIRT1, GPIRT2, SCWL.K, 0, 5, 1, SCPBSW)</td>
<td>72, A</td>
<td>72.1, T</td>
<td>72.3, C</td>
</tr>
<tr>
<td>GPIRT1</td>
<td>Guilty Plea Imprisonment Ratio Table (Base)</td>
<td>0.98/0.75/0.68/0.64/0.60/0.56</td>
<td>0.98/0.75/0.60/0.53/0.45/0.38</td>
<td></td>
</tr>
<tr>
<td>GPIRT2</td>
<td>Guilty Plea Imprisonment Ratio Table (Revised)</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCWL</td>
<td>Superior Court Workload (Dimensionless)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCPBSW</td>
<td>Superior Court Plea Bargaining Switch</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The guilty plea sentence ratio GPRS (Equation 73) is the ratio of the court-imposed sentence given to those pleading guilty over the court-imposed sentence given to those convicted in a trial. As the Superior Court workload increases, this ratio is assumed to drop. (See Figure 3-17.)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPRS.K</td>
<td>Stable (GPSRT1, GPSRT2, SCWL.K, 0, 5, 1, SCPBSW)</td>
<td>73, A</td>
<td>73.1, T</td>
<td>73.2, T</td>
</tr>
<tr>
<td>GPSRT1</td>
<td>Guilty Plea Sentence Ratio Table (Base)</td>
<td>0.72/0.60/0.54/0.48/0.42/0.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPSRT2</td>
<td>Guilty Plea Sentence Ratio Table (Revised)</td>
<td>0.84/0.60/0.42/0.33/0.27/0.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCWL</td>
<td>Superior Court Workload (Dimensionless)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCPBSW</td>
<td>Superior Court Plea Bargaining Switch</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A.7 Court Sector: District Court

The District Court provides the fifth mechanism for controlling workload. The structure of the District Court permits the regulation of appeals to the Superior Court. The District Court also provides a screening of cases into several dispositions. This subsector deals with this screening, as well as the adjustment mechanism. The reader may find Figure 3-3 helpful in following the processing of cases in this subsector.

Cases Referred to Court Diversion Program. A court diversion program is the first means of disposing of cases in the District Court. Massachusetts does not currently have a formal court diversion program, but if one were to be implemented, it could well occur this point in the flow of cases. Cases referred to the court diversion program CRCD (Equation 75) represent the part of arrests that might be diverted. The fraction of cases referred to the court diversion program FRCD (Equation 76) depends on the Superior Court judicial workload. Equation 76 uses the STABLE function to select one of two possible relations between SCJWL and FRCD. In the base policy, FRCD is always zero, meaning that the program has not been implemented. In the revised policy, thirty percent of arrests are diverted when SCJWL is one. For higher values of SCJWL, FRCD increases to sixty percent.
CRCD.K = (ARR.K)(FRCD.K)  
CRCD - CASES REFERRED TO COURT DIVERSION PROGRAM  
       (CASES/MONTH)  
ARR - ARRESTS (CASES/MONTH)  
FRCD - FRACTION REFERRED TO COURT DIVERSION PROGRAM (DIMENSIONLESS)

FRCD.K = STABLE(FRCDT1, FRCDT2, SCJWL.K, 0.5, 0.5, CDSW)  
FRCDT1 = 0.00/0.00/0.00/0.00/0.00/0.00/0.00/0.00/0.00/0.00/0.00/0.00/0.00/  
       0.00/0.00/0.00  
FRCDT2 = 0.15/0.24/0.30/0.36/0.42/0.47/0.51/0.54/0.57/0.59/0.60  
CDSW = 10000

FRCD - FRACTION REFERRED TO COURT DIVERSION PROGRAM (DIMENSIONLESS)  
STABLE - SWITCH TABLE LOOK-UP FUNCTION  
FRCDT1 - FRACTION REFERRED TO COURT DIVERSION PROGRAM TABLE (BASE)  
FRCDT2 - FRACTION REFERRED TO COURT DIVERSION PROGRAM TABLE (REVISED)  
SCJWL - SUPERIOR COURT JUDICIAL WORKLOAD (DIMENSIONLESS)  
CDSW - COURT DIVERSION PROGRAM SWITCH (MONTHS)

Cases Referred to Grand Jury. A fraction of arrests results in the cases being bound over to the Grand Jury and the defendant indi- 
dicted. Grand jury indictments GJI (Equation 77) represents this flow. The fraction of cases bound over and indicted FCBOI (Equation 78) is the product of two factors, the unadjusted fraction of cases bound over and indicted UFCBO (Equation 80) and the fraction of cases not diverted subject to referral to the grand jury FCNDR (Equation 79).

UFCBO represents the fraction that would be indicted if there were no court diversion program. Potentially, UFCBO is a function
of the Superior Court judicial workload. However, the relation used is a constant eighteen percent, except for very low values of SCJWL. These values reflect the fact that cases bound over to the Grand Jury have, over the last decade in Massachusetts, been about eighteen to twenty percent of arrests and have not varied in any perceptible way with the workload of the court.

\[ G_{J1} = (R_{Arr}, K)(F_{CBOI}, K) \]

- **GJ1**: GRAND JURY INDICTMENTS (CASES/MONTH)
- **ARR**: ARRESTS (CASES/MONTH)
- **F_{CBOI}**: FRACTION OF CASES BOUND OVER AND INDICTED (DIMENSIONLESS)

\[ F_{CBOI} = (U_{FCBO}, K)(F_{CNDR}, K) \]

- **F_{CBOI}**: FRACTION OF CASES BOUND OVER AND INDICTED (DIMENSIONLESS)
- **U_{FCBO}**: UNADJUSTED FRACTION OF CASES BOUND OVER AND INDICTED (DIMENSIONLESS)
- **F_{CNDR}**: FRACTION OF CASES NOT DIVERTED SUBJECT TO REFERRAL TO GRAND JURY (DIMENSIONLESS)

\[ F_{CNDR} = \text{CTABLE}(F_{CNDRT}, F_{RCD}, K, U_{FCBO}, K) \]

- **F_{CNDR}**: FRACTION OF CASES NOT DIVERTED SUBJECT TO REFERRAL TO GRAND JURY (DIMENSIONLESS)
- **CTABLE**: CHECK TABLE FUNCTION
- **F_{CNDRT}**: FRACTION OF CASES NOT DIVERTED REFERRED TO GRAND JURY TABLE
- **F_{RCD}**: FRACTION REFERRED TO COURT DIVERSION PROGRAM (DIMENSIONLESS)
- **U_{FCBO}**: UNADJUSTED FRACTION OF CASES BOUND OVER AND INDICTED (DIMENSIONLESS)
CTABLE Macro. Equation 79 uses the CTABLE (Check Table) macro to compute FCNDR. FCNDR is an adjustment to UFCBO resulting from the impact of the court diversion program. CTABLE requires some explanation, which is aided by Figure A-1.

Underlying the calculation of FCNDR is the assumption that diverting a sizeable fraction of arrests can be expected to have some impact on the fraction of arrests bound over. If participants in the court diversion program were selected without regard to the seriousness of their crime, some of those who would have been bound over to the grand jury would end up in the court diversion program. An appropriate adjustment for this circumstance would be:

$$FCBOI = (UFCBO) (1-FRCD)$$

where

- **FCBOI** is the fraction of arrests bound over and indicted
- **UFCBO** is the unadjusted fraction of cases bound over and indicted
- **FRCD** is the fraction of arrests referred to the court diversion program.
Figure A-1: Explanation of CTABLE Macro
The adjustment (1-FRCD) is represented in Figure A-1 by the dotted line running from the (1,0) point to the (0,1) point.

However, this adjustment is not really correct, since the court diversion program is more likely to select those offenders who have committed the least serious crimes. An alternate assumption might be that none of the defendants who would eventually be bound over are allowed in the court diversion program. In this case,

\[ FCBOI = UFCBO \]

The adjustment always equals one and is represented by the dotted line running from the point (1,0) to (1,1).

However, the program might well draw on some of those who might later be bound over, particularly if the program draws out a large percentage of those arrested. Thus, an adjustment like the solid line in Figure A-1 seems appropriate. When relatively few defendants enter the court diversion program, there is almost no impact on the fraction of defendants bound over. When a large fraction of defendants are diverted, the fraction bound over is reduced. At the limit, when FRCD is one, all defendants are diverted and none are bound over.

However, one problem still remains. FRCD and UFCBO are determined independently of one another. If each should take on sufficiently large values, FRCD and FCBOI might add up to more than one. An instance is shown in Figure A-1. Suppose UFCBO equaled 0.4 and FRCD equaled 0.8. According to the relation depicted by the solid
line in A-1,

\[
\text{FCBOI} = (\text{UFCBO})(\text{FCNDR}) = (0.4)(0.6) = 0.24
\]

The sum of FCBOI and RCD adds up to 1.04; more cases are being processed than arrests. However, if FCNDR equaled 0.5,

\[
\text{FCBOI} = (\text{UFCBO})(\text{FCNDR}) = (0.4)(0.5) = 0.2
\]

Then FCBOI and FCNDR equal exactly one, which is permissible. (The equations determining other dispositions of cases would correct for this situation so that cases are only bound over or diverted.) The proper adjustment is represented in Figure A-1 by the dotted line running from the point A to the point (0,1). In no instance should the actual relation between FRCD and FCNDR (the solid line) be higher than this dotted line. The line will vary depending on the value of UFCBO; thus, a simple table function cannot guarantee that the problem will not occur, unless the solid line is simply the diagonal line running from (1,0) to (0,1). To insure that under some change of table values the problem does not arise, the CTABLE macro is used. In essence, it operates like a normal table look-up function, except that it does not allow FCBOI and FRCD to add up to more than one. The equations for CTABLE are as follows:

\[
\text{MACRO CTABLE(TAB,AF,UF)}
\]

CTABLE - CHECK TABLE FUNCTION
TAB - TABLE
AF - ADJUSTABLE FRACTION
UF - UNADJUSTED FACTOR (DIMENSIONLESS)
Fraction of Cases Convicted. The fraction of arrests convicted in District Court FACV (Equation 81) is the product of the fraction of cases convicted (in District Court) FCCV times the fraction of cases not yet disposed of by some other means (bound over or diverted).

\[
\text{FACV}_K = (\text{FCCV}_K)(1-\text{FCBOI}_K \cdot \text{FRCD}_K)
\]

\[
\text{FACV} - \text{FRAC} \text{TION OF ARRESTS CONVICTED IN DISTRICT COURT (DIMENSIONLESS)}
\]

\[
\text{FCCV} - \text{FRAC} \text{TION OF CASES CONVICTED (IN DISTRICT COURT) (DIMENSIONLESS)}
\]

\[
\text{FCBOI} - \text{FRAC} \text{TION OF CASES BOUND OVER AND INDICTED (DIMENSIONLESS)}
\]

\[
\text{FRCD} - \text{FRAC} \text{TION REFERRED TO COURT DIVERSION PROGRAM (DIMENSIONLESS)}
\]
FCCV (Equation 82) depends on the Superior Court judicial workload. The equation incorporates the assumption that as SCJWL increases, a higher fraction of cases is dismissed, thereby reducing convictions. This adjustment, although represented as rather weak, reduces appeals by reducing convictions, thereby assisting in controlling workload. (See Figure 3-19).

\[
\begin{align*}
FCCV, K &= \text{TABLE}(FCCVT, SCJWL, K, 0.5, 1) \\
FCCVT &= 0.67/0.66/0.64/0.63/0.59/0.53 \\
FCCV &= \text{FRACTION OF CASES CONVICTED (IN DISTRICT COURT)} (\text{DIMENSIONLESS}) \\
\text{TABLE} &= \text{TABLE LOOK-UP FUNCTION} \\
FCCVT &= \text{FRACTION OF CASES CONVICTED (IN DISTRICT COURT)} (\text{DIMENSIONLESS}) \\
SCJWL &= \text{SUPERIOR COURT JUDICIAL WORKLOAD} (\text{DIMENSIONLESS})
\end{align*}
\]

Fraction of Convictions Imprisoned. The fraction of convictions imprisoned (by District Court) FCVI (Equation 83) depends on both the Superior Court judicial workload and the fraction of prison overcrowding. The pressure on District Court imprisonment from overcrowding PDCIO represents the latter influence and is explained in the section discussing the Sentencing Subsector. The influence of the Superior Court judicial workload is incorporated in the unadjusted fraction of convictions imprisoned UFCI (Equation 84). As SCJWL increases, UFCI declines, thereby reducing appeals, since relatively few defendants who are not imprisoned appeal. (See Figure 3-20.)
Equation 84 uses the STABLE function to switch between the base policy and the revised policy. The revised policy represents increased plea bargaining in the District Court.

\[ FCVI.K = (UFCI.K)(PDCIO.K) \]

FCVI - FRACTION OF CONVICTIONS IMPRISONED (BY DISTRICT COURT) (DIMENSIONLESS)

UFCI - UNADJUSTED FRACTION OF CONVICTIONS IMPRISONED

PDCIO - PRESSURE ON DISTRICT COURT IMPRISONMENT FROM OVERCROWDING (DIMENSIONLESS)

\[ UFCI.K = STABLE(UFCIT1, UFCIT2, SCJWL.K, 0, 5, 1, DCPBSW) \]

UFCIT1 = 0.25/0.21/0.20/0.19/0.18/0.17 84.1, T

UFCIT2 = 0.27/0.21/0.18/0.16/0.14/0.12 84.2, T

DCPBSW = 10000 84.3, C

UFCI - UNADJUSTED FRACTION OF CONVICTIONS IMPRISONED

STABLE - SWITCH TABLE LOOK-UP FUNCTION

UFCIT1 - UNADJUSTED FRACTION OF CONVICTIONS IMPRISONED TABLE (BASE)

UFCIT2 - UNADJUSTED FRACTION OF CONVICTIONS IMPRISONED TABLE (REVISED)

SCJWL - SUPERIOR COURT JUDICIAL WORKLOAD (DIMENSIONLESS)

DCPBSW - DISTRICT COURT PLEA BARGAINING SWITCH (MONTHS)

Appeals to Superior Court. Appeals to the Superior Court APLS (Equation 85) are those arrest which result in a conviction and then an appeal for a trial de novo in the Superior Court.
APLS, KL=(ARR, K)(FCA, K)  
APLS  - APPEALS TO SUPERIOR COURT (CASES/Month)  
ARR   - ARRESTS (CASES/Month)  
FCA   - FRACTION OF CASES APPEALED (DIMENSIONLESS)  

The fraction of cases appealed FCA (Equation 86) is the fraction of arrests appealed. This fraction is constructed from several variables. First, it is the product of two factors:

1. the fraction of arrests convicted in District Court

2. a combination of variables which form the fraction of convictions appealing. This second factor is the sum of two products.

The first product (FCVI)(FDIA) is the fraction of convictions imprisoned and appealing; and the second product (1-FCVI)(FDNIA) is the fraction of convictions not imprisoned, but appealing.

FCA, K=(FACV, K)(FCVI, K*FDIA, K+(1-FCVI, K)*FDNIA, K)  
FCA   - FRACTION OF CASES APPEALED (DIMENSIONLESS)  
FACV  - FRACTION OF ARRESTS CONVICTED IN DISTRICT COURT (DIMENSIONLESS)  
FCVI  - FRACTION OF CONVICTIONS IMPRISONED (BY DISTRICT COURT) (DIMENSIONLESS)  
FDIA  - FRACTION OF DEFENDANTS IMPRISONED APPEALING (DIMENSIONLESS)  
FDNIA - FRACTION OF DEFENDANTS NOT IMPRISONED APPEALING (DIMENSIONLESS)  

Both the fraction of defendants imprisoned appealing FDIA (Equation 87) and the fraction of defendants not imprisoned appealing FDNIA (Equation 88) depend on the pressure to appeal PA (Equation 89). The larger PA is, the larger FDIA and FDNIA are.
FDIA.K=TABLE(FDIAT,PA.K,0.5,1) 87, A
FDIAT=0.60/0.35/0.65/0.80/0.90/0.95 87.1, T
FDIA - FRACTION OF DEFENDANTS IMPRISONED APPEALING
       (DIMENSIONLESS)
TABLE - TABLE LOOK-UP FUNCTION
FDIAT - FRACTION OF DEFENDANTS IMPRISONED APPEALING
       TABLE
PA - PRESSURE TO APPEAL (DIMENSIONLESS)

FDNIA.K=TABLE(FDNIAT,PA.K,0.5,1) 88, A
FDNIAT=0.000/0.025/0.050/0.075/0.100/0.120 88.1, T
FDNIA - FRACTION OF DEFENDANTS NOT IMPRISONED
        APPEALING (DIMENSIONLESS)
TABLE - TABLE LOOK-UP FUNCTION
FDNIAT - FRACTION OF DEFENDANTS NOT IMPRISONED
         APPEALING TABLE
PA - PRESSURE TO APPEAL (DIMENSIONLESS)

The pressure to appeal PA combines three factors which are
assumed to influence appeals:

1. pressure to appeal from case consideration,
2. pressure to appeal from sentence,
3. effect of defense attorneys on appeals

PA.K=(PACC.K)(PAS.K)(EDFAP.K) 89, A
PA - PRESSURE TO APPEAL (DIMENSIONLESS)
PACC - PRESSURE TO APPEAL FROM CASE CONSIDERATION
       (DIMENSIONLESS)
PAS - PRESSURE TO APPEAL FROM SENTENCE
     (DIMENSIONLESS)
EDFAP - EFFECT OF DEFENSE ATTORNEYS ON APPEALS
       (DIMENSIONLESS)
Pressure to Appeal from Sentence. The pressure to appeal from sentence PAS (Equation 90) represents pressures on appeals resulting from the average length of sentence at the District Court level compared to sentences given those who plead guilty in the Superior Court. The measure of the relative severity of sentences is the District Court sentence ratio DCSR (Equation 91). The larger DCSR, the higher are PAS and the flow of appeals.

\[
PAS.K = \text{TABLE(PAST, DCSR.K, 0.2, 0.5)} \quad 90, A
\]
\[
PAST = 0.40/0.60/1.00/1.35/2.00 \quad 90.1, T
\]
\[
PAS \quad - \text{PRESSURE TO APPEAL FROM SENTENCE (DIMENSIONLESS)}
\]
\[
\text{TABLE} \quad - \text{TABLE LOOK-UP FUNCTION}
\]
\[
PAST \quad - \text{PRESSURE TO APPEAL FROM SENTENCE TABLE}
\]
\[
\text{DCSR} \quad - \text{DISTRICT COURT SENTENCE RATIO (DIMENSIONLESS)}
\]

\[
\text{DCSR.K} = (\text{RDSS.K/GPSR.K})(1/\text{GPIR.K})/\text{NDCSR} \quad 91, A
\]
\[
\text{NDCSR} = (\text{RDSS/GPSR})(1/\text{GPIR}) \quad 91.1, N
\]
\[
\text{DCSR} \quad - \text{DISTRICT COURT SENTENCE RATIO (DIMENSIONLESS)}
\]
\[
\text{RDSS} \quad - \text{RATIO OF DISTRICT COURT SENTENCE TO SUPERIOR COURT SENTENCE (DIMENSIONLESS)}
\]
\[
\text{GPSR} \quad - \text{GUilty PLEA SENTENCE RATIO (DIMENSIONLESS)}
\]
\[
\text{GPIR} \quad - \text{GUilty PLEA IMPRISONMENT RATIO (DIMENSIONLESS)}
\]
\[
\text{NDCSR} \quad - \text{NORMAL DISTRICT COURT SENTENCE RATIO (DIMENSIONLESS)}
\]

In addition to being normalized, DCSR is the product of two factors:

1. the ratio of RDSS to GPSR,
2. the ratio of one to GPIR.

The first factor is a comparison of the length of sentence imposed in the District Court to the length of sentence imposed in the Superior Court for those pleading guilty. The numerator is the ratio of the district court sentence to the Superior Court sentence RDSS. RDSS, explained below, is the ratio of the average District Court sentence to the average Superior Court sentence imposed on those imprisoned after a trial. Dividing RDSS by the guilty plea sentence ratio converts that measure to one relative to the sentence received for pleading guilty.

The second factor reflects the relative risks involved in pleading guilty in the Superior Court relative to the certainty of imprisonment in the District Court. (At this point, the defendant has already been sentenced to prison in the District Court.)

The essence of the pressure to appeal from sentence is that as the severity of sentence in the District Court increases relative to that severity in the Superior Court, the pressure to appeal from sentence increases, resulting in an increase in appeals. The relative severity of sentences can change either because the District Court is changing the length of sentences or because the Superior Court, through plea bargaining, is changing the severity of its sentences. The sentence for pleading guilty is used here, because once the defendant appeals he has the opportunity to plea bargain in the higher court.
The ratio of the District Court sentence to the Superior Court sentence RDSS (Equation 92) depends on the Superior Court judicial workload. (See Figure 3-21.) As the Superior Court judicial workload increases, District Court judges are assumed to reduce the length of sentence in order to reduce appeals to the higher court. Equation 92 uses the STABLE function to switch between policies. The revised policy in this case represents increased plea bargaining in the District Court.

\[
\begin{align*}
RDSS.K &= \text{STABLE}(RDSST1, RDSST2, SCJWL.K, 0.5, 1, DCPBSW) \\
RDSST1 &= 0.21/0.16/0.13/0.11/0.10/0.09 \\
RDSST2 &= 0.24/0.16/0.11/0.09/0.07/0.06 \\
RDSS &= \text{RATIO OF DISTRICT COURT SENTENCE TO SUPERIOR COURT SENTENCE (DIMENSIONLESS)} \\
\text{STABLE} &= \text{SWITCH TABLE LOOK-UP FUNCTION} \\
RDSST1 &= \text{RATIO OF DISTRICT COURT SENTENCE TO SUPERIOR COURT SENTENCE TABLE (BASE)} \\
RDSST2 &= \text{RATIO OF DISTRICT COURT SENTENCE TO SUPERIOR COURT SENTENCE TABLE (REVISED)} \\
SCJWL &= \text{SUPERIOR COURT JUDICIAL WORKLOAD (DIMENSIONLESS)} \\
DCPBSW &= \text{DISTRICT COURT PLEA BARGAINING SWITCH (MONTHS)} \\
\end{align*}
\]

**Pressure to Appeal from Case Consideration.** The pressure to appeal from case consideration FACC (Equation 93) represents the impact of inadequate time in the District Court for dealing with cases on the decision to appeal. PACC is a function of the District Court judicial case ratio DCJCR (Equation 94), which is the normalized
ratio of arrests to District Court judges. DCJCR measures the number of cases per man-month of judicial time. A high value of DCJCR indicates that, on the average, cases are moving quickly through the court. Defense counsel, prevented from putting on a full defense, are assumed to be more likely to appeal a case than if the court could provide more time for each case.

\[
PACC.K = \text{TABE}(PACCT, DCJCR.K, 0, 2, 0.5) \\
PACCT = 0.50/0.75/1.00/1.40/2.00 \\
PACC = \text{PRESSURE TO APPEAL FROM CASE CONSIDERATION} \\
\text{(DIMENSIONLESS)} \\
\text{TABLE} = \text{TABLE LOOK-UP FUNCTION} \\
PACCT = \text{PRESSURE TO APPEAL FROM CASE CONSIDERATION} \\
\text{TABLE} \\
DCJCR = \text{DISTRICT COURT JUDICIAL CASE RATIO} \\
\text{(DIMENSIONLESS)}
\]

\[
DCJCR.K = (ARR.K/DCJ.K)/NCPDCJ \\
DCJCR = 1 \\
NCPDCJ = ARR/1DCJ \\
DCJCR = \text{DISTRICT COURT JUDICIAL CASE RATIO} \\
\text{(DIMENSIONLESS)} \\
ARR = \text{ARRESTS (CASES/MONTH)} \\
DCJ = \text{DISTRICT COURT JUDGES (PERSONS)} \\
NCPDCJ = \text{NORMAL CASES PER DISTRICT COURT JUDGE} \\
\text{(CASES/PERSON-MONTH)} \\
1DCJ = \text{INITIAL DISTRICT COURT JUDGES (PERSONS)}
\]

District Court judges DCJ (Equation 95) are computed using the CAP macro. The District Court judicial case ratio serves in place of a workload. Increases in DCJCR above the standard produce increases in the number of District Court judges.
A.8 Court Sector: Impact of Defense Attorneys

This subsector depicts the influences of the defense attorney workload on trials, guilty pleas, and appeals. Underlying the subsector is the notion that, although defense attorneys are of course motivated in individual cases by the best interests of their clients, at a broader level, the heavy workload many defense attorneys must
carry influences decisions about plea bargaining and trials.

In this subsector, both private defense counsel and public defenders are aggregated. The subsector provides a simplified view of the forces determining the supply of defense counsel and the impact on the flow of cases.

**Effect of Defense Attorneys on Trials.** The effect of defense attorneys on trials EDFT (Equation 97) represents the influence of defense attorney workload on the time necessary to complete a trial. The defense attorney is assumed to be able to influence the length of trial by spending time in filing motions, interrogating jurors, and other means. These activities are a normal part of a defense. However, if the defense attorney carries a heavy workload, as many public defenders do, he may not have the time to prepare as many motions or spend as much time on the trial as he might otherwise. Consequently, the trials will go faster when defense attorneys face a heavy workload than when they face a light workload. Thus, the effect of defense attorneys on trials increases when the defense workload DFWL increases. This change produces an increase in the flow of Superior Court trials. (See Figure 3-26.)

\[
\text{EDFT.K} = \text{TABLE(EDFTT,DFWL,K,0.5,1)}
\]

<table>
<thead>
<tr>
<th>EDFTT</th>
<th>EFFECT OF DEFENSE ATTORNEYS ON TRIALS (DIMENSIONLESS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>T</td>
</tr>
<tr>
<td>1.00</td>
<td>T</td>
</tr>
<tr>
<td>1.15</td>
<td>T</td>
</tr>
<tr>
<td>1.25</td>
<td>T</td>
</tr>
<tr>
<td>1.30</td>
<td>T</td>
</tr>
<tr>
<td>1.32</td>
<td>T</td>
</tr>
</tbody>
</table>

TABLE - TABLE LOOK-UP FUNCTION
EDFTT - EFFECT OF DEFENSE ATTORNEYS ON TRIALS TABLE
DFWL - DEFENSE WORKLOAD (DIMENSIONLESS)
Analogous to other workloads, the defense workload $DFWL$ is the normalized ratio of the Superior Court backlog to the number of defense attorneys.

$$DFWL.K = (SCB.K / DFAT.K) / NRBDF$$

$DFWL = 1$

$NRBDF = SCB / IDF$

$DFWL$ - DEFENSE WORKLOAD (DIMENSIONLESS)

$SCB$ - SUPERIOR COURT BACKLOG (CASES)

$DFAT$ - DEFENSE ATTORNEYS (PERSONS)

$NRBDF$ - NORMAL RATIO OF BACKLOG TO DEFENSE ATTORNEYS (CASES/PERSON)

$IDF$ - INITIAL DEFENSE ATTORNEYS (PERSONS)

Effect of Defense Attorneys on Guilty Pleas. The effect of defense attorneys on guilty pleas $EDFGP$ (Equation 99) incorporates the assumed relation between the defense workload and guilty pleas. As $DFWL$ increases, defense attorneys are assumed to be less able to take cases to trial and more willing to negotiate pleas. Hence, a high workload increases $EDFGP$ and the flow of guilty pleas.

(See Figure 3-27.)

$$EDFGP.K = TABLE(EDFGPT, DFWL.K, 0.5, 0.5)$$

$EDFGPT = 0.00 / 0.70 / 1.00 / 1.07 / 1.15 / 1.20 / 1.25 / 1.27 / 1.30 / 1.31 / 1.32$

$EDFGP$ - EFFECT OF DEFENSE ATTORNEYS ON GUILTY PLEAS (DIMENSIONLESS)

$TABLE$ - TABLE LOOK-UP FUNCTION

$EDFGPT$ - EFFECT OF DEFENSE ATTORNEYS ON GUILTY PLEAS TABLE

$DFWL$ - DEFENSE WORKLOAD (DIMENSIONLESS)
Effect of Defense Attorneys on Appeals. The effect of defense attorneys on appeals EDFAP (Equation 100) reflects the influence of the availability of defense attorneys on appeals. If defense attorneys, public defenders in particular, have a heavy workload in the Superior Court, they are unable to handle as many District Court cases as they might otherwise. Therefore, some defendants are assumed to be unrepresented. The unrepresented defendant is assumed to be less likely to appeal than one with an attorney. Moreover, if defense attorneys already have a heavy workload, they are assumed to be less willing to take on additional appeals. (See Figure 3-28.)

\[
\begin{align*}
&\text{EDFAP} = \text{TABLE(EDFAPT,DFWL.K,0.5,0.5)} \\
&\text{EDFAPT} = 2.00/1.35/1.00/0.90/0.80/0.75/0.70/0.65/0.60/0.57/0.55 \\
&\text{EDFAP} - \text{EFFECT OF DEFENSE ATTORNEYS ON APPEALS (DIMENSIONLESS)} \\
&\text{TABLE} - \text{TABLE LOOK-UP FUNCTION} \\
&\text{EDFAPT} - \text{EFFECT OF DEFENSE ATTORNEYS ON APPEALS TABLE} \\
&\text{DFWL} - \text{DEFENSE WORKLOAD (DIMENSIONLESS)}
\end{align*}
\]

Defense Attorneys. The number of defense attorneys DFAT (Equation 101) is computed using the CAP macro. In the case of public defenders, a workload heavier than the standard creates administrative pressures for increasing the staff. For private attorneys, the heavy workload means more criminal work available for attorneys. Even though criminal work may pay less well than civil practice and it is perceived as more unpleasant, the presence of a substantial
backlog of work may still provide an incentive for lawyers to enter
criminal practice. First, the heavy workload suggests that at
least some clients may be able to pay higher fees. Second, it may
suggest that fees will increase due to the heavy demand for defense
counsel. Third, it may indicate that, at least in this area, there
is work, whereas some attorneys may have difficulty pursuing a civil
practice.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFAT.K</td>
<td>CAP(DFWL.K,DFWLS.K,DFATT1,DFATT2,DFSAT,IDF, A</td>
</tr>
<tr>
<td>DFAT</td>
<td>DEFENSE ATTORNEYS (PERSONS)</td>
</tr>
<tr>
<td>DFAT.K</td>
<td>CAPACITY (MACRO)</td>
</tr>
<tr>
<td>DFAT</td>
<td>DEFENSE WORKLOAD (DIMENSIONLESS)</td>
</tr>
<tr>
<td>DFAT.K</td>
<td>DEFENSE WORKLOAD STANDARD (DIMENSIONLESS)</td>
</tr>
<tr>
<td>DFATT1</td>
<td>DEFENSE ATTORNEY ADJUSTMENT TABLE (BASE)</td>
</tr>
<tr>
<td>DFATT2</td>
<td>DEFENSE ATTORNEY ADJUSTMENT TABLE (REVISED)</td>
</tr>
<tr>
<td>DFSAT</td>
<td>DEFENSE ATTORNEY STANDARD ADJUSTMENT TIME (MONTHS)</td>
</tr>
<tr>
<td>IDF</td>
<td>INITIAL DEFENSE ATTORNEYS (PERSONS)</td>
</tr>
<tr>
<td>DFSW</td>
<td>DEFENSE ATTORNEY SWITCH (MONTHS)</td>
</tr>
<tr>
<td>ADF</td>
<td>ADDITION TO DEFENSE ATTORNEYS (DIMENSIONLESS)</td>
</tr>
<tr>
<td>DFINT</td>
<td>DEFENSE ATTORNEY INTERVAL (MONTHS)</td>
</tr>
</tbody>
</table>
A.9 Court Sector: Sentencing

This subsector serves two functions. First, it incorporates the assumptions relating prison overcrowding and sentencing. Second, it completes the calculations for the flow of offenders to prison and the court-imposed sentence. Since many of these latter calculations are self-explanatory, their description will be brief.

Total Offenders Imprisoned. Total offenders imprisoned TOI (Equation 103) is the sum of District Court defendants imprisoned, defendants imprisoned after pleading guilty (in Superior Court), and defendants imprisoned after trial (in Superior Court).

\[ \text{TOI}_K = \text{DCDI}_K + \text{DIPG}_K + \text{DIT}_K \]

\[ \text{TOI} = \text{TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)} \]
\[ \text{DCDI} = \text{DISTRICT COURT DEFENDANTS IMPRISONED (PERSONS/MONTH)} \]
\[ \text{DIPG} = \text{DEFENDANTS IMPRISONED AFTER PLEADING GUILTY (PERSONS/MONTH)} \]
\[ \text{DIT} = \text{DEFENDANTS IMPRISONED AFTER TRIAL (PERSONS/MONTH)} \]

District Court Defendants Imprisoned. Equation 104 computes the District Court defendants imprisoned DCDI based on the fraction of defendants imprisoned from District Court FDIDC (Equation 105). At this point, it is necessary to change units from cases per month to persons per month. The constant, cases per suspect CPS, serves this purpose. Making CPS a constant represents a simplification.
The pressure on District Court imprisonment from overcrowding

\[ PDCIO.K = \text{TABLE}(PDCIOT, FPOC.K, 0, 2, 0.5) \]
\[ PDCIOT = 1.30/1.20/1.00/0.80/0.50 \]

\[ PDCIO \quad \text{- Pressure on District Court Imprisonment from Overcrowding (Dimensionless)} \]
\[ \text{TABLE} \quad \text{- Table Look-Up Function} \]
\[ \text{PDCIOT} \quad \text{- Pressure on District Court Imprisonment Table} \]
\[ \text{FPOC} \quad \text{- Fraction of Prison Overcapacity (Dimensionless)} \]

PDCIO (Equation 106) represents the assumption relating prison crowding to the fraction of convictions imprisoned (by District Court) FCVI. As the fraction of prison overcrowding FPOC increases, PDCIO decreases, causing FCVI to decrease.
Superior Court Defendants Imprisoned After Trial. Equations 107 and 108 compute the defendants imprisoned after trial DIT and the fraction of defendants imprisoned after trial FDTI. In the equation for DIT, the conviction ratio in the Superior Court CNVR is the fraction of trials resulting in a conviction. CNVR is assumed to be a constant sixty percent.

The fraction of defendants tried imprisoned FDTI is assumed to depend on the fraction of prison overcrowding FPOC. As FPOC increases, FDTI declines.

### Superior Court Defendants Imprisoned After Trial

<table>
<thead>
<tr>
<th>Equation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIT.Κ = (SCT.JK/CPS)(CNVR)(FDTI.Κ)</td>
<td>DIT - Defendants imprisoned after trial (persons/month)</td>
</tr>
<tr>
<td>CNVR = 0.6</td>
<td></td>
</tr>
<tr>
<td>FDTI.Κ = STABLE(FDTI1,FDTI2,FPOC.Κ,0.2,0.5,MSSW)</td>
<td>FDTI - Fraction of defendants tried imprisoned (dimensionless)</td>
</tr>
<tr>
<td>FDTI1 = 0.90/0.65/0.80/0.60/0.30</td>
<td>STABLE - Switch table look-up function</td>
</tr>
<tr>
<td>FDTI2 = 1.00/0.95/0.90/0.70/0.40</td>
<td>FDTI1 - Fraction of defendants tried imprisoned table (base)</td>
</tr>
<tr>
<td>FPOC - Fraction of prison overcapacity (dimensionless)</td>
<td></td>
</tr>
<tr>
<td>MSSW - Mandatory sentence switch (months)</td>
<td>FDTI2 - Fraction of defendants tried imprisoned table (revised)</td>
</tr>
</tbody>
</table>
Superior Court Defendants Imprisoned After Guilty Pleas.

Equation 109 computes the defendants imprisoned after pleading guilty DIPG. DIPG is based on the flow of guilty pleas, the fraction of defendants tried imprisoned, and the guilty plea imprisonment ratio.

\[
\text{DIPG}_k = \left( \frac{\text{SCGP}_k}{\text{CPS}_k} \right) (\text{FDTI}_k)(\text{GPIR}_k)
\]

Equation 109, A

DIPG - DEFENDANTS IMPRISONED AFTER PLEADING GUILTY (PERSONS/MONTH)
SCGP - SUPERIOR COURT GUILTY PLEAS (CASES/MONTHS)
CPS - CASES PER SUSPECT (CASES/PERSON)
FDTI - FRACTION OF DEFENDANTS TRIED IMPRISONED (DIMENSIONLESS)
GPIR - GUILTY PLEA IMPRISONMENT RATIO (DIMENSIONLESS)

Court-imposed Sentences. Equations 110 through 114 compute the average court-imposed sentences in the District Court and the Superior Court. All sentences are based on the Superior Court imposed sentence SCIS (Equation 111), which is the sentence the defendant tried, convicted, and imprisoned by the Superior Court would receive. SCIS is assumed to be affected by the fraction of prison overcrowding, through the variable PSPC (Equation 113). The larger FPOC, the shorter SCIS. Since all other court-imposed sentences are based on SCIS, they too are affected by prison overcrowding.

\[
\text{DCIS}_k = (\text{RDSS}_k)(\text{SCIS}_k)
\]

Equation 110, A

DCIS - DISTRICT COURT IMPOSED SENTENCE (MONTHS)
RDSS - RATIO OF DISTRICT COURT SENTENCE TO SUPERIOR COURT SENTENCE (DIMENSIONLESS)
SCIS - SUPERIOR COURT IMPOSED SENTENCE (MONTHS)
SCIS\_K=(NSCIS\_K)(PSPC\_K)

**SCIS** - SUPERIOR COURT IMPOSED SENTENCE (MONTHS)

**NSCIS** - NORMAL SUPERIOR COURT IMPOSED SENTENCE (MONTHS)

**PSPC** - PRESSURE ON SENTENCE FROM PRISON CROWDING (DIMENSIONLESS)

**NSCIS\_K=ISCIS+STEP(ASCIS,SCSS)**

**ASCIS=9**

**ISCIS=60**

**SCSS=10000**

**NSCIS** - NORMAL SUPERIOR COURT IMPOSED SENTENCE (MONTHS)

**ISCIS** - INITIAL SUPERIOR COURT IMPOSED SENTENCE (MONTHS)

**STEP** - STEP FUNCTION

**ASCIS** - ADDITION TO SUPERIOR COURT IMPOSED SENTENCE (MONTHS)

**SCSS** - SUPERIOR COURT SENTENCE SWITCH (MONTHS)

PSPC\_K=TABLE(PSPCT,FPOC\_K,0,2,0.5)

**PSPCT=1.3/1.1/1.0/0.9/0.8**

**PSPC** - PRESSURE ON SENTENCE FROM PRISON CROWDING (DIMENSIONLESS)

**TABLE** - TABLE LOOK-UP FUNCTION

**PSPCT** - PRESSURE ON SENTENCE FROM PRISON CROWDING TABLE

**FPOC** - FRACTION OF PRISON OVERCAPACITY (DIMENSIONLESS)

SCIS\_GP\_K=(SCIS\_K)(GPSR\_K)

**SCIS\_GP** - SUPERIOR COURT IMPOSED SENTENCE FOR GUILTY PLEA (MONTHS)

**SCIS** - SUPERIOR COURT IMPOSED SENTENCE (MONTHS)

**GPSR** - GUILTY PLEA SENTENCE RATIO (DIMENSIONLESS)

A.10 The Corrections Sector

The Corrections Sector traces the flow of offenders from potential new offenders, to prisoners, to ex-offenders. In addi-
tion, it determines the prison population, prisoners released, and the average effective sentence. It also contains some of the equations for the court diversion program.

Disaggregating the population into prisoners, ex-offenders, and potential new offenders has two purposes. First, prison restrains some potential offenders, thereby preventing some crime. Second, the prison experience is assumed to reinforce the criminal tendencies of offenders. Ex-offenders are assumed to have a much higher crime rate normal than potential new offenders.

Offenders Imprisoned. New offenders imprisoned NOI (Equation 116) and ex-offenders imprisoned XOI (Equation 119) depend on the total offenders imprisoned TOI and the fraction of ex-offenders imprisoned FXOI (Equation 117). FXOI is a function of the fraction of ex-offenders committing crimes FXO (Equation 118), which equals the ratio of crimes by ex-offenders to total crimes. In Equation 117, when FXO is zero, no ex-offenders are imprisoned. When FXO is one, all of the total offenders imprisoned are ex-offenders. As FXO moves from zero to one, the curve for FXOI rises quickly and then levels off as it approaches one. (See Figure 4-8). The assumption behind this curve is that ex-offenders, once convicted, are more likely to be imprisoned for a crime than new offenders. Hence the proportion of ex-offenders among total offenders imprisoned is higher than their proportion among those convicted of crimes.
NOI.KL = (TOI.K)(1-FX01.K)  

NOI  - NEW OFFENDERS IMPRISONED (PERSONS/MONTH)  
TOI  - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)  
FX01  - FRACTION OF EX-OFFENDERS IMPRISONED  
      (DIMENSIONLESS)  

FX01.K = TABLE(FX01T,FX0.K,0,1,0.2)  
FX01T = 0.00/0.45/0.70/0.90/0.95/1.00  
FX01  - FRACTION OF EX-OFFENDERS IMPRISONED  
      (DIMENSIONLESS)  
TABLE  - TABLE LOOK-UP FUNCTION  
FX01T  - FRACTION OF EX-OFFENDERS IMPRISONED TABLE  
FX0  - FRACTION OF EX-OFFENDERS COMMITTING CRIMES  
      (DIMENSIONLESS)  

FX0.K = (CRIX0.K/CRIME.K)  
FX0  - FRACTION OF EX-OFFENDERS COMMITTING CRIMES  
      (DIMENSIONLESS)  
CRIX0  - CRIMES BY EX-OFFENDERS (CASES/MONTH)  
CRIME  - CRIMES (CASES/MONTH)  

X01.KL = (TOI.K)(FX01.K)  
X01  - EX-OFFENDERS IMPRISONED (PERSONS/MONTH)  
TOI  - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)  
FX01  - FRACTION OF EX-OFFENDERS IMPRISONED  
      (DIMENSIONLESS)  

**Prisoners.** Prisoners released, prisoners, the average effective sentence, and the fraction of prison overcrowding are computed in the PROUT macro (Equation 120). Chapter 2 explains each equation in this macro. The reader is referred to that description.
Sentence time in STIN (Equation 121) represents the total man-months which the offenders currently being sentenced must serve, if they are to serve their full court-imposed sentences. STIN is, therefore, the sum of each category of imprisoned defendant times the respective court-imposed sentence.
Ex-Offenders and Potential New Offenders. Prisoners released PRRL add to the pool of ex-offenders XO (Equation 122). Also, ex-offenders terminating the court diversion program XOTCD add to the pool. Ex-offenders are depleted in three ways: ex-offenders imprisoned XOI, ex-offenders referred to court diversion program XORCD, and ex-offenders aging out XOA0 (Equation 123). XOA0 represents the assumption that ex-offenders will age out of ex-offender status in five years (sixty months) unless they are arrested and either imprisoned or placed in a diversion program.

\[
\begin{align*}
XO.K &= XO.J + (DT)(PRRL.JK + XOTCD.JK - XOI.JK - XOA0.JK - XORCD.JK) \\
XO &= (NOI)(XOLT)
\end{align*}
\]

\[
\begin{align*}
XO & - Ex-offenders (Persons) \\
DT & - Integration interval (months) \\
PRRL & - Prisoners released (Persons/month) \\
XOTCD & - Ex-offenders terminating court diversion program (Persons/month) \\
XOI & - Ex-offenders imprisoned (Persons/month) \\
XOA0 & - Ex-offenders aging out (Persons/month) \\
XORCD & - Ex-offenders referred to court diversion program (Persons/month) \\
NOI & - New offenders imprisoned (Persons/month) \\
XOLT & - Ex-offender life time (months)
\end{align*}
\]

\[
\begin{align*}
XOA0.KL &= XO.K / XOLT \\
XOLT &= 60
\end{align*}
\]

Potential new offenders PNO (Equation 124) are those members of the population who are not in one of the other population categories.
The constant LTS permits cancelling the impact of changes in the pool of ex-offenders during the test simulations.

\[ PNO.K \times POP - (LTS)(PRSN.K + NOCD.K + XOCD.K + XO.K) \]

| \( PNO \) | POTENTIAL NEW OFFENDERS (PERSONS) |
| \( POP \) | POPULATION (PERSONS) |
| \( LTS \) | LOOP TEST SWITCH (DIMENSIONLESS) |
| \( PRSN \) | PRISONERS (PERSONS) |
| \( NOCD \) | NEW OFFENDERS IN COURT DIVERSION PROGRAM (PERSONS) |
| \( XOCD \) | EX-OFFENDERS IN COURT DIVERSION PROGRAM (PERSONS) |
| \( XO \) | EX-OFFENDERS (PERSONS) |

**Prison Capacity.** Prison capacity PRCAP (Equation 125) is computed with the CAP macro. Unlike police and judges, PRCAP is computed using the open loop policy. (The addition to prison capacity APRCAP is greater than zero.) In the present form, prison capacity is constant.
PRCAP.K = CAP(FPOC.K, FPOCS.K, PRAT1, PRAT1, PRSAT, 
  IPRCAP, PRSW, APRCAP, PRINT)  
PRAT1 = 0/0/0/0/0/0/0/0  
PRSAT = 120  
IPRCAP = 4000  
PRSW = 10000  
APRCAP = 0.5  
PRINT = 10000  
PRCAP = PRISON CAPACITY (PERSONS)  
CAP = CAPACITY (MACHO)  
FPOC = FRACTION OF PRISON OVERCAPACITY 
  (DIMENSIONLESS)  
FPOCS = FRACTION OF PRISON OVERCAPACITY STANDARD 
  (DIMENSIONLESS)  
PRAT1 = PRISON ADJUSTMENT TABLE  
PRSAT = PRISON STANDARD ADJUSTMENT TIME (MONTHS)  
IPRCAP = INITIAL PRISON CAPACITY (PERSONS)  
PRSW = PRISON SWITCH (MONTHS)  
APRCAP = ADDITION TO PRISON CAPACITY (DIMENSIONLESS)  
PRINT = PRISON INTERVAL (MONTHS)  

Offenders in Court Diversion Program. Equations 127 through 133 account for offenders in the court diversion program based on cases referred to the court diversion program CRCD. New offenders in court diversion program NOCD (Equation 127) are new offenders who have been placed in the program. This level is fed with new offenders referred to court diversion program NORCD (Equation 128) and depleted by new offenders terminating court diversion program NOTCD (Equation 130). The fraction of total referrals consisting of new offenders is one minus the fraction of ex-offenders referred to court diversion program FXOR (Equation 129). FXOR depends on
the fraction of ex-offenders committing crimes FXO. When FXO is small, FXOR is small also, so that few ex-offenders enter the program. The flow of new offenders terminating court diversion program NOTCD (Equation 130) is based on the assumption that offenders are in the program for seventy-five months. A structure analogous to the one just described operates for ex-offenders in the program.

\[
\text{NOCD}.K = \text{NOCD}.J + (\text{DT})(\text{NORCD}.JK - \text{NOTCD}.JK)
\]

NOCD\(=0\)

\[
\begin{align*}
\text{NOCD} &\quad \text{NEW OFFENDERS IN COURT DIVERSION PROGRAM} \\
\text{DT} &\quad \text{INTEGRATION INTERVAL (MONTHS)} \\
\text{NORCD} &\quad \text{NEW OFFENDERS REFERRED TO COURT DIVERSION PROGRAM (PERSONS/MONTH)} \\
\text{NOTCD} &\quad \text{NEW OFFENDERS TERMINATING COURT DIVERSION PROGRAM (PERSONS/MONTH)}
\end{align*}
\]

\[
\text{NORCD}.K = (\text{CRCD}.K / \text{CPS})(1 - \text{FXOR}.K)
\]

\[
\begin{align*}
\text{NORCD} &\quad \text{NEW OFFENDERS REFERRED TO COURT DIVERSION PROGRAM (PERSONS/MONTH)} \\
\text{CRCD} &\quad \text{CASES REFERRED TO COURT DIVERSION PROGRAM (CASES/MONTH)} \\
\text{CPS} &\quad \text{CASES PER SUSPECT (CASES/PERSO)} \\
\text{FXOR} &\quad \text{FRACTION OF EX-OFFENDERS REFERRED TO COURT DIVERSION PROGRAM (DIMENSIONLESS)}
\end{align*}
\]

\[
\text{FXOR}.K = \text{TABLE}(\text{FXORT}, \text{FXO}.K, 0, 1, 0.2)
\]

\[
\begin{align*}
\text{FXORT} &\quad 0.00/0.08/0.16/0.28/0.48/1.00 \\
\text{FXOR} &\quad \text{FRACTION OF EX-OFFENDERS REFERRED TO COURT DIVERSION PROGRAM (DIMENSIONLESS)} \\
\text{TABLE} &\quad \text{TABLE LOOK-UP FUNCTION} \\
\text{FXORT} &\quad \text{FRACTION OF EX-OFFENDERS REFERRED TO COURT DIVERSION PROGRAM TABLE (DIMENSIONLESS)} \\
\text{FXO} &\quad \text{FRACTION OF EX-OFFENDERS COMMITTING CRIMES (DIMENSIONLESS)}
\end{align*}
\]
NOTCD.KL = NOCD.K / PTCD  
PTCD = 75

NOTCD  - NEW OFFENDERS TERMINATING COURT DIVERSION PROGRAM (PERSONS/MONTH)
NOCD  - NEW OFFENDERS IN COURT DIVERSION PROGRAM (PERSONS)
PTCD  - PERIOD OF TIME IN COURT DIVERSION PROGRAM (MONTHS)

XOCD.K = XOCD.J + (DT)(XORCD.JK - XOTCD.JK)  
XOCD = 0

XOCD  - EX-OFFENDERS IN COURT DIVERSION PROGRAM (PERSONS)
DT  - INTEGRATION INTERVAL (MONTHS)
XORCD  - EX-OFFENDERS REFERRED TO COURT DIVERSION PROGRAM (PERSONS/MONTH)
XOTCD  - EX-OFFENDERS TERMINATING COURT DIVERSION PROGRAM (PERSONS/MONTH)

XORCD.KL = (CRCD.K / CPS)(FXOR.K)

XORCD  - EX-OFFENDERS REFERRED TO COURT DIVERSION PROGRAM (PERSONS/MONTH)
CRCD  - CASES REFERRED TO COURT DIVERSION PROGRAM (CASES/MONTH)
CPS  - CASES PER SUSPECT (CASES/PERSON)
FXOR  - FRACTION OF EX-OFFENDERS REFERRED TO COURT DIVERSION PROGRAM (DIMENSIONLESS)

XOTCD.KL = XOCD.K / PTCD

XOTCD  - EX-OFFENDERS TERMINATING COURT DIVERSION PROGRAM (PERSONS/MONTH)
XOCD  - EX-OFFENDERS IN COURT DIVERSION PROGRAM (PERSONS)
PTCD  - PERIOD OF TIME IN COURT DIVERSION PROGRAM (MONTHS)

A.11 Indicator Variables

Besides the variables that constitute the components of the system model, there are several variables used only for plotting.
They are listed here without an explanation, since their equations and definitions indicate their use.

\[ F_{\text{CRIME.K}} = \frac{\text{CRIME.K}}{\text{ICRIME}} \]

- \( F_{\text{CRIME}} \): Fractional change in crime (dimensionless)
- \( \text{CRIME} \): Crimes (cases/month)
- \( \text{ICRIME} \): Initial crimes (crimes/month)

\[ C_{\text{KNPL.K}} = C_{\text{CRIP.K}} + C_{\text{CRRT.P.T.K}} \]

- \( C_{\text{KNPL}} \): Cases known to police (cases/month)
- \( C_{\text{CRIP}} \): Crimes intercepted by police (cases/month)
- \( C_{\text{CRRT.P.T}} \): Crimes reported (cases/months)

\[ F_{\text{CKNP.N.L.K}} = \frac{\text{CKNP.N.L.K}}{\text{ICKNPL.N.L.K}} \]

- \( F_{\text{CKNP.N.L}} \): Fractional change in cases known to police
- \( \text{CKNP.N.L} \): Cases known to police (cases/month)
- \( \text{ICKNPL.N.L} \): Initial cases known to police (cases/month)
- \( \text{CNP.R.T} \): Crimes intercepted by police (cases/month)
- \( \text{CNP.R.P.T} \): Crimes reported (cases/months)

\[ P_{\text{CLF.K}} = \frac{\text{ARR.K}}{\text{CKNP.N.L.K}} \]

- \( P_{\text{CLF}} \): Police clearance fraction (dimensionless)
- \( \text{ARR} \): Arrests (cases/month)
- \( \text{CKNP.N.L} \): Cases known to police (cases/month)

\[ F_{\text{CARR.K}} = \frac{\text{ARR.K}}{\text{IARR.K}} \]

- \( F_{\text{CARR}} \): Fractional change in arrests (dimensionless)
- \( \text{ARR} \): Arrests (cases/month)
- \( \text{IARR} \): Initial arrests (cases/month)

\[ F_{\text{TOI.K}} = \frac{\text{TOI.K}}{\text{ITOI.K}} \]

- \( F_{\text{TOI}} \): Fraction of total offenders imprisoned (dimensionless)
- \( \text{TOI} \): Total offenders imprisoned (persons/month)
- \( \text{ITOI} \): Initial total offenders imprisoned (persons/month)
SCTGP.K=SCT.JK+SCGP.JK
SCTGP - SUPERIOR COURT TRIALS AND GUILTY PLEAS (CASES/MONTH)
SCT - SUPERIOR COURT TRIALS (CASES/MONTH)
SCGP - SUPERIOR COURT GUILTY PLEAS (CASES/MONTHS)

GPIJ.K=(NGPJ)(SCJ.K)-(NGPJ*ISCJ)
GPIJ - GUILTY PLEAS FROM INCREASED JUDGES (CASES/MONTH)
NGPJ - NORMAL GUILTY PLEAS PER JUDGE (CASES/PERSON-MONTH)
SCJ - SUPERIOR COURT JUDGES (PERSONS)
ISCJ - INITIAL SUPERIOR COURT JUDGES (PERSONS)

TIJ.K=(NTJD*4)(SCJ.K)+SCGP.JK-(NTJD*4)(ISCJ)
TIJ - TRIALS FROM INCREASED JUDGES (CASES/MONTH)
NTJD - NORMAL TRIALS PER JUDGE-DAY (CASES/PERSON-DAY)
SCJ - SUPERIOR COURT JUDGES (PERSONS)
SCGP - SUPERIOR COURT GUILTY PLEAS (CASES/MONTHS)
ISCJ - INITIAL SUPERIOR COURT JUDGES (PERSONS)

DIJ.K=(NDJ)(SCJ.K)+SCTGP.K-(NDJ)(ISCJ)
DIJ - DISMISSALS FROM INCREASED JUDGES (CASES/MONTH)
NDJ - NORMAL DISMISSALS PER JUDGE (CASES/PERSON-MONTH)
SCJ - SUPERIOR COURT JUDGES (PERSONS)
SCTGP - SUPERIOR COURT TRIALS AND GUILTY PLEAS (CASES/MONTH)
ISCJ - INITIAL SUPERIOR COURT JUDGES (PERSONS)

TCISC.K=APLS.JK+GJI.JK
TCISC - TOTAL CASES INTO SUPERIOR COURT (CASES/MONTH)
APLS - APPEALS TO SUPERIOR COURT (CASES/MONTH)
GJI - GRAND JURY INDICTMENTS (CASES/MONTH)

TCPSC.K=SCT.JK+SCCD.JK+SCGP.JK
TCPSC - TOTAL CASES PROCESSED IN SUPERIOR COURT (CASES/MONTH)
SCT - SUPERIOR COURT TRIALS (CASES/MONTH)
SCCD - SUPERIOR COURT CASES DISMISSED (CASES/MONTH)
SCGP - SUPERIOR COURT GUILTY PLEAS (CASES/MONTHS)
\[ FCTSC.K = TCPSC.K / ITCPSC \]
\[ ITCPSC = TCPSC \]

**FCTSC** - FRACTIONAL CHANGE IN TOTAL CASES PROCESSED IN SUPERIOR COURT (DIMENSIONLESS)

**TCPSC** - TOTAL CASES PROCESSED IN SUPERIOR COURT (CASES/MONTH)

**ITCPSC** - INITIAL TOTAL CASES PROCESSED IN SUPERIOR COURT (CASES/MONTH)

\[ SCIMP.K = DIPG.K + DIT.K \]

**SCIMP** - SUPERIOR COURT DEFENDANTS IMPRISONED (PERSONS/MONTH)

**DIPG** - DEFENDANTS IMPRISONED AFTER PLEADING GUILTY (PERSONS/MONTH)

**DIT** - DEFENDANTS IMPRISONED AFTER TRIAL (PERSONS/MONTH)

\[ FSCIMP.K = (SCIMP.K) / TCPSC.K \]

**FSCIMP** - FRACTION OF SUPERIOR COURT CASES IMPRISONED (DIMENSIONLESS)

**SCIMP** - SUPERIOR COURT DEFENDANTS IMPRISONED (PERSONS/MONTH)

**TCPSC** - TOTAL CASES PROCESSED IN SUPERIOR COURT (CASES/MONTH)

\[ FCPG.K = SCGP.JK / TCPSC.K \]

**FCPG** - FRACTION OF CASES PLEADING GUILTY (DIMENSIONLESS)

**SCGP** - SUPERIOR COURT GUILTY PLEAS (CASES/MONTHS)

**TCPSC** - TOTAL CASES PROCESSED IN SUPERIOR COURT (CASES/MONTH)

\[ FCCN.K = (SCGP.JK + SCT.JK * CNVR) / TCPSC.K \]

**FCCN** - FRACTION OF CASES CONVICTED (IN SUPERIOR COURT) (DIMENSIONLESS)

**SCGP** - SUPERIOR COURT GUILTY PLEAS (CASES/MONTHS)

**SCT** - SUPERIOR COURT TRIALS (CASES/MONTH)

**CNVR** - CONVICTION RATIO IN SUPERIOR COURT (DIMENSIONLESS)

**TCPSC** - TOTAL CASES PROCESSED IN SUPERIOR COURT (CASES/MONTH)
FCD.K = SCCD.JK/TCPSC.K
  FCD - FRACTION OF CASES DISMISSED (DIMENSIONLESS)
  SCCD - SUPERIOR COURT CASES DISMISSED (CASES/MONTH)
  TCPSC - TOTAL CASES PROCESSED IN SUPERIOR COURT (CASES/MONTH)

FCT.K = SCT.JK/TCPSC.K
  FCT - FRACTION OF CASES TRIED (IN SUPERIOR COURT) (DIMENSIONLESS)
  SCT - SUPERIOR COURT TRIALS (CASES/MONTH)
  TCPSC - TOTAL CASES PROCESSED IN SUPERIOR COURT (CASES/MONTH)

SCDL.K = SCB.K/TCPSC.K
  SCDL - SUPERIOR COURT DELAY (MONTHS)
  SCB - SUPERIOR COURT BACKLOG (CASES)
  TCPSC - TOTAL CASES PROCESSED IN SUPERIOR COURT (CASES/MONTH)

FCTPG.K = FCPG.K * FCT.K
  FCTPG - FRACTION OF CASES TRIED OR PLEADING GUILTY (DIMENSIONLESS)
  FCPG - FRACTION OF CASES PLEADING GUILTY (DIMENSIONLESS)
  FCT - FRACTION OF CASES TRIED (IN SUPERIOR COURT) (DIMENSIONLESS)

FAI.K = (TOI.K * CPS) / ARR.K
  FAI - FRACTION OF ARRESTS IMPRISONED (DIMENSIONLESS)
  TOI - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)
  CPS - CASES PER SUSPECT (CASES/PERSON)
  ARR - ARRESTS (CASES/MONTH)

FCROI.K = (TOI.K * CPS) / CRIME.K
  FCROI - FRACTION OF CRIMES RESULTING IN OFFENDER IMPRISONED (DIMENSIONLESS)
  TOI - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)
  CPS - CASES PER SUSPECT (CASES/PERSON)
  CRIME - CRIMES (CASES/MONTH)
APPENDIX B

SOURCES OF DATA ON THE

MASSACHUSETTS CRIMINAL JUSTICE SYSTEM

B.1 Purpose

The main body of this study uses several series of numerical data on the Massachusetts criminal justice system. This Appendix explains how the data were gathered and processed to produce some of the graphs in the study. The last part of this Appendix is an annotated DYNAMO program used to process the data. Presenting the actual program is the most succinct way of explaining the actual calculations. The first part of the Appendix provides some general explanation of the data collection.
B.2 Sources of Data

The study utilized three sources for data:

1. The FBI's Uniform Crime Reports (abbreviated UCR)\(^1\)

2. The Statistical Reports of the Commissioner of Corrections (abbreviated SRCC)\(^2\)

3. The Annual Report to the Justices of the Supreme Judicial Court (abbreviated RJSJC)\(^3\)

Uniform Crime Reports (UCR). The UCR provides the familiar crime index which covers seven serious crimes. They are:

1. Murder
2. Rape
3. Assault
4. Robbery
5. Burglary
6. Larceny
7. Auto Theft

The crime index represents cases known to the police.

Although the FBI has been keeping statistics since 1930, the crime index for states prior to 1958 has not been used because of changes in presenting the data. The crime index is based on voluntary reports by local police. The number of police departments reporting has varied. Prior to 1958, the FBI did not correct the crime index for variations in the number of departments reporting. Following a detailed study, the FBI began adjusting the state figure for changes in the number of reporting units. Consequently, the index only from 1958 through 1974 is used.
In 1973 the FBI changed procedures resulting in a large increase in larcenies. Since larcenies constitute a sizable fraction of the total crimes in the index, the total index was affected also. The FBI published a corrected series back to 1960 for the national index. I was unable to locate a similarly corrected index for Massachusetts.

An additional problem with the index is that it does not include all crimes, even all serious crimes. Although it provides an indicator of the increase in crime, it does not measure the full flow of cases reported to the police.

Statistical Reports of the Commissioner of Corrections (SRCC). The SRCC is a useful source of information on many aspects of criminal justice in Massachusetts. Starting in 1920, it provides a wealth of information whose potential researchers have only partly exploited. Its length of publication and its detail have made it a valuable resource in this study.

In the SRCC, crimes are disaggregated into three major categories with several subcategories:

1. Crimes Against Persons
   - Assault and battery
   - Assault with intent to murder
   - Assault with a dangerous weapon
   - Carnal abuse
   - Extortion
   - Manslaughter
   - Mayhem
   - Murder, first degree
   - Murder, second degree
   - Rape
   - Robbery
   - Robbery, armed
   - Other offenses (against persons)
### Table 32: All Counties - Total Indictments and Appeals by Offense

<table>
<thead>
<tr>
<th>Offense</th>
<th>Total</th>
<th>Acquitted</th>
<th>Convicted</th>
<th>Total convicted</th>
<th>Sentenced to</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grand Total</strong></td>
<td>21,032</td>
<td>1,563</td>
<td>19,469</td>
<td>19,469</td>
<td>224</td>
</tr>
<tr>
<td><strong>Total - Against Person</strong></td>
<td>3,445</td>
<td>945</td>
<td>2,500</td>
<td>2,500</td>
<td>48</td>
</tr>
<tr>
<td>Murder</td>
<td>120</td>
<td>66</td>
<td>54</td>
<td>54</td>
<td>2</td>
</tr>
<tr>
<td>Manslaughter</td>
<td>73</td>
<td>2</td>
<td>71</td>
<td>71</td>
<td>1</td>
</tr>
<tr>
<td>Rape &amp; Kidn., Assault</td>
<td>446</td>
<td>13</td>
<td>433</td>
<td>433</td>
<td>1</td>
</tr>
<tr>
<td>Robbery</td>
<td>805</td>
<td>14</td>
<td>791</td>
<td>791</td>
<td>12</td>
</tr>
<tr>
<td>Felonious Assault</td>
<td>778</td>
<td>31</td>
<td>747</td>
<td>747</td>
<td>13</td>
</tr>
<tr>
<td>Assault &amp; Battery</td>
<td>813</td>
<td>2</td>
<td>811</td>
<td>811</td>
<td>10</td>
</tr>
<tr>
<td>Other Offenses</td>
<td>330</td>
<td>6</td>
<td>324</td>
<td>324</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total - Against Property</strong></td>
<td>7,456</td>
<td>42</td>
<td>7,414</td>
<td>7,414</td>
<td>7</td>
</tr>
<tr>
<td>Arson</td>
<td>100</td>
<td>-</td>
<td>100</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>Bankrupt. &amp; Larc.</td>
<td>2,935</td>
<td>14</td>
<td>2,921</td>
<td>2,921</td>
<td>27</td>
</tr>
<tr>
<td>Larceny</td>
<td>1,773</td>
<td>11</td>
<td>1,762</td>
<td>1,762</td>
<td>11</td>
</tr>
<tr>
<td>Fraud &amp; Forgery</td>
<td>986</td>
<td>1</td>
<td>985</td>
<td>985</td>
<td>11</td>
</tr>
<tr>
<td>Larceny of Auto</td>
<td>229</td>
<td>5</td>
<td>224</td>
<td>224</td>
<td>6</td>
</tr>
<tr>
<td>Unlawful Appropriation</td>
<td>224</td>
<td>5</td>
<td>219</td>
<td>219</td>
<td>6</td>
</tr>
<tr>
<td>Receiving Stolen Property</td>
<td>768</td>
<td>10</td>
<td>758</td>
<td>758</td>
<td>6</td>
</tr>
<tr>
<td>Destroying Property</td>
<td>261</td>
<td>1</td>
<td>260</td>
<td>260</td>
<td>4</td>
</tr>
<tr>
<td>Other Offenses</td>
<td>170</td>
<td>-</td>
<td>170</td>
<td>170</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total - Against Public</strong></td>
<td>10,121</td>
<td>40</td>
<td>10,081</td>
<td>10,081</td>
<td>104</td>
</tr>
<tr>
<td>Other Offenses</td>
<td>1,775</td>
<td>7</td>
<td>1,768</td>
<td>1,768</td>
<td>7</td>
</tr>
</tbody>
</table>

---

**Figure B-1:** Page showing typical tabulation of Superior Court data in SRCC
## Table 55: Total All Counties — By Offenses

<table>
<thead>
<tr>
<th>Offense</th>
<th>Total</th>
<th>Sentenced to</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>In Effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fine only</td>
</tr>
</tbody>
</table>

### Table 55 Details

**Total — All Classes**
- 478837

**Total — Against the Person**
- 18673

**Total — Against Property**
- 42608

**Total — Against Public Order**
- 417356

**Figure B-2:** Page showing typical tabulation of District Court data in SRCC
2. Crimes Against Property

Arson
Breaking, entering, and larceny
Larceny
Fraud and forgery
Larceny of auto
Unlawful appropriation
Receiving stolen property
Destroying property
Other offenses (against property)

3. Crimes Against Public Order

Carrying weapons
Sex offenses
Non-support
Narcotic offenses
Liquor laws, violating
Driving to endanger
Driving under influence
Drunkenness
Disorderly conduct
Gaming and lottery
Motor Vehicle laws, violating
Other offenses

The SRCC reports figures in four areas of the criminal justice system:

1. Arrests by police
2. District Court
3. Superior Court
4. State correctional institutions and county houses of correction.

Despite the many advantages of this source, the SRCC has some problems. First, publication of the report has not been kept current. As of this writing, 1971 is the last
report published. Second, Kreindel et al.\textsuperscript{4} suggest that the backlogs ("pending untried") may be underreported, so that these data cannot be used to compute delays. Third, flows and backlogs are summed together to form the "total" figure. (See Figure B-1) Including the backlog with the flow is both misleading and dimensionally incorrect. Flows like "dismissed" are denominated in persons per month; "pending untried" denominated in person.

\textit{Annual Report to the Justices of the Supreme Judicial Court.} The RJSJC provides data on the number of trial days, the backlog of cases in the Superior Court, trials, and other dispositions. Data are aggregated for all categories of crimes. The report started in 1956 and, as of this writing, runs through 1974. However, I was unable to locate copies prior to 1959.

The RJSJC is a useful adjunct to the SRCC, but it has its problems. First, cases are reported on a fiscal year basis (ending June 30) instead of a calendar year basis as in the SRCC. Second, since there is no disaggregation of cases by offense, the data are contaminated by the volume of minor cases (see below). Third, the District Court data are not as useful as they might be, since data from the Boston Municipal Court are reported separately and differently from the District Courts. Although organizationally separate from the District Courts, the Boston Municipal Court has similar criminal jurisdiction.
Data on the lower courts should include cases in the Boston Municipal Court. This procedure is followed in the SRCC data on the District Courts. The fourth problem concerns the accuracy of the RJSJC data. In the 1974 report, page 72 includes the footnote:

The figures above are those reported to the Executive Secretary by the clerks of the several counties. Since their receipt, a team from the Superior Court has visited some of the counties and has determined that the procedures used for reporting those statistics generally do not involve actual docket audits. Many cases are included which should have been dismissed placed on file. The Executive Secretary is working with the Superior Court to revise this Report for the future.

This warning seems to suggest that backlog figures are overstated.

B.3 Overview of Data Collection

Most of the data used in this study came from the SRCC. The necessary step was to separate out the figures for minor crimes like drunkenness and traffic violations. Since data were listed with subtotals for the three major categories (crimes against persons, crimes against property, crimes against public order), a convenient means of excluding the minor crimes was to use only from the first two categories.
The units of measure deserve some comment. The SRCC reports the court figures in terms of persons prosecuted. The units are close to the underlying definition of a "case" as used in the models, that is, the collection of charges lodged against a defendant, for which he will receive a single trial if he chooses to go to trial. It is unclear whether an individual charged with two separate and unrelated crimes is counted once or twice in the SRCC data. Nevertheless, in the descriptions below the units are listed as cases, since they are comparable with model variables denominated in cases.

The data were incorporated into the DYNAMO program listed below. DYNAMO proved to provide a flexible language for data manipulation, tabulation, and plotting.
B.4 PROGRAM LISTING

The following is a DOCUMENTOR listing of the DYNAMO program used to produce the data figures and calculations.

-------------------------------
NAME - CTDAT
PURPOSE - GRAPHING AND PRINTING DATA ON MASSACHUSETTS CRIMINAL JUSTICE SYSTEM
DATE - 28 FEB 1976
VERSION - 1.05
AUTHOR - W. SHAFFER
SOURCE - APPENDIX B, COURT MANAGEMENT AND THE MASSACHUSETTS CRIMINAL JUSTICE SYSTEM
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PROGRAM ORGANIZATION
-------------------------------

THIS PROGRAM IS ORGANIZED INTO FIVE SECTIONS ACCORDING TO THE TYPE OF DATA.

1. SUPERIOR COURT BACKLOG AND JUDGES
2. SUPERIOR COURT DISPOSITIONS
3. DISTRICT COURT DISPOSITIONS
4. PRISON POPULATION
5. INDEX CRIMES
DATA SOURCES

(1)  Sirecc

MASSACHUSETTS, DEPARTMENT OF CORRECTIONS, ANNUAL REPORT OF THE COMMISSIONER OF CORRECTIONS, PUBLIC DOCUMENT 115, 1920-1940

MASSACHUSETTS, DEPARTMENT OF CORRECTIONS, STATISTICAL REPORTS OF THE COMMISSIONER OF CORRECTIONS, PUBLIC DOCUMENT 115, 1941-1971

(2)  Rjsjc

MASSACHUSETTS, SUPREME JUDICIAL COURT, EXECUTIVE SECRETARY, ANNUAL REPORT TO THE JUSTICES OF THE SUPREME JUDICIAL COURT, PUBLIC DOCUMENT 166, 1959-1974

(3)  Ucr

U.S., FEDERAL BUREAU OF INVESTIGATION, CRIME IN AMERICA, UNIFORM CRIME REPORTS, GOVERNMENT PRINTING OFFICE, 1945-1974
1. SUPERIOR COURT BACKLOG AND JUDGES

SOURCE: RJSJC

NOTE: FIGURES INCLUDE CASES FOR ALL CATEGORIES OF CRIMES

SCB.K=TABHL(SCBT,TIME,K,1959,1974,1) 9, A
SCBT=3848/4600/4071/5057/4901/6189/7750/10098/
11774/13667/18306/22656/28330/33488/35027/34336
SCB - SUPERIOR COURT BACKLOG (CASES)

SCJ.K=TABHL(SCJT,TIME,K,1959,1974,1) 10, A
SCJT=37/37/37/37/42/42/42/42/42/42/46/46/46/46/
46
SCJ - SUPERIOR COURT JUDGES (PERSONS)

NOTE: DATA ON SUPERIOR COURT JUDGES ARE DERIVED FROM DESCRIPTIVE MATERIAL OF INCREASES IN THE NUMBER OF JUDGES AUTHORIZED BY THE LEGISLATURE. THEREFORE, THE DATA DO NOT ACCOUNT FOR UNFILLED VACANCIES.

SCJWL.K=SCB.K/SCJ.I 12, A
SCJWL - SUPERIOR COURT JUDICIAL WORKLOAD (CASES/PERSON)
SCB - SUPERIOR COURT BACKLOG (CASES)
SCJ - SUPERIOR COURT JUDGES (PERSONS)

TDSCJ.K=TABHL(TDSCJT,TIME,K,1959,1974,1) 13, A
TDSCJT=1221/1541/1763/1575/1556/1930/2163/2147/
2234/2887/3270/3378/3532/4579/4433/4239
TDSCJ - TRIAL DAYS FOR SUPERIOR COURT JUDGES (PERSON-DAYS/YEAR)

TDDCJ.K=TABHL(TDDCJT,TIME,K,1959,1974,1) 14, A
TDDCJT=603/0/0/536/569/542/507/575/629/657/662/684/
800/861/884/870
TDDCJ - TRIAL DAYS FOR DISTRICT COURT JUDGES (IN SUPERIOR COURT)(PERSON-DAYS/YEAR)

TTD.K=TDSCJ.K*TDDCJ.K 15, A
TTD - TOTAL TRIAL DAYS (PERSON-DAYS/YEAR)
TDSCJ - TRIAL DAYS FOR SUPERIOR COURT JUDGES
(PERSON-DAYS/YEAR)
TDDCJ - TRIAL DAYS FOR DISTRICT COURT JUDGES (IN
SUPERIOR COURT) (PERSON-DAYS/YEAR)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTD</td>
<td>TOTAL TRIAL DAYS PER MONTH (PERSON-DAYS/MONTH)</td>
<td>16, A</td>
</tr>
<tr>
<td>SCJ</td>
<td>SUPERIOR COURT JUDGES (PERSONS)</td>
<td>17, A</td>
</tr>
</tbody>
</table>

JUF.K=(TTDM.K)/SCJ.K
JUF - JUDICIAL UTILIZATION FACTOR (DAYS/MONTH)
TTDM - TOTAL TRIAL DAYS PER MONTH (PERSON-DAYS/MONTH)
SCJ - SUPERIOR COURT JUDGES (PERSONS)

SCDS.P.K=TABHL(SCDSPT,TIME.K,1959,1974,1)
SCDSPT=13985/14227/15276/16768/16530/16704/17831/
18256/19880/22842/23703/26574/32702/36132/35259/34938
SCDSPT - SUPERIOR COURT DISPOSITIONS (CASES/YEAR)

SCTCT.K=TABHL(SCTCTT,TIME.K,1959,1974,1)
SCTCTT=3348/1957/2576/2978/2754/3132/2675/3023/
3263/3916/2921/3665/3634/4040/3950/3241
SCTCT - SUPERIOR COURT TRIALS AS REPORTED BY THE
COURT (CASES/MONTH)

NOTE: THE PREVIOUS TWO SERIES ARE FROM THE JRSJC
AND WILL NOT AGREE WITH TOTAL DISPOSITIONS
AND TRIALS LISTED IN THE NEXT SECTION

SCDL.K=(12)(SCB.K/SCDS.P.K)
SCDL - SUPERIOR COURT DELAY (MONTHS)
SCB - SUPERIOR COURT BACKLOG (CASES)
SCDS - SUPERIOR COURT DISPOSITIONS (CASES/YEAR)

DPDSC.K=TTD.K/SCDS.P.K
DPDSC - DAYS PER TOTAL DISPOSITIONS IN SUPERIOR
COURT (DAYS/CASE)
TTD - TOTAL TRIAL DAYS (PERSON-DAYS/YEAR)
SCDS - SUPERIOR COURT DISPOSITIONS (CASES/YEAR)

DPTSC.K=TTD.K/SCTCT.K
DPTSC - DAYS PER TRIAL IN SUPERIOR COURT (DAYS/CASE)
TTD - TOTAL TRIAL DAYS (PERSON-DAYS/YEAR)
SCTCT - SUPERIOR COURT TRIALS AS REPORTED BY THE
COURT (CASES/MONTH)
2. SUPERIOR COURT DISPOSITIONS

SOURCE: SRCC

NOTE: DATA MISSING FOR 1960. DATA FILLED IN BY LINEAR INTERPOLATION.

NOTE: DATA COVERS CRIMES AGAINST PERSONS AND AGAINST PROPERTY, BUT NOT AGAINST PUBLIC ORDER.

SCT.K=TABHL(SCTT,TIME.K,1950,1971,1) 24, A
SCTT=502/450/448/398/467/526/586/631/677/643/785/ 24.2, T
927/775/915/797/867/944/1032/1206/1062/1191/1593
SCT  - SUPERIOR COURT TRIALS (CASES/YEAR)

SCTM.K=SCT.K/12 25, A
SCTM  - SUPERIOR COURT TRIALS PER MONTH (AVERAGE)
       (CASES/MONTH)
SCT  - SUPERIOR COURT TRIALS (CASES/YEAR)

SCCD.K=TABHL(SCCDT,TIME.K,1950,1971,1) 26, A
395/363/573/669/584/636/847/1013/1040/1147/1397
SCCD  - SUPERIOR COURT CASES DISMISSED (CASES/YEAR)

SCCDM.K=SCCD.K/12 27, A
SCCDM  - SUPERIOR COURT CASES DISMISSED PER MONTH
       (AVERAGE) (CASES/MONTH)
SCCD  - SUPERIOR COURT CASES DISMISSED (CASES/YEAR)

SCGP.K=TABHL(SCGPT,TIME.K,1950,1971,1) 28, A
SCGPT=2657/2324/2064/2185/2328/2507/2700/3442/3594/ 28.2, T
4033/4104/4174/4375/4415/4137/4292/4103/4174/
4386/4281/4750/5877
SCGP  - SUPERIOR COURT GUILTY PLEAS (CASES/YEAR)

SCGPM.K=SCGP.K/12 29, A
SCGPM  - SUPERIOR COURT GUILTY PLEAS PER MONTH
       (AVERAGE) (CASES/MONTH)
SCGP  - SUPERIOR COURT GUILTY PLEAS (CASES/YEAR)

TCASC.K=SCT.K+SCCD.K+SCGP.K 30, A
TCASC  - TOTAL SUPERIOR COURT CASES PROCESSED (CASES/YEAR)
SCT  - SUPERIOR COURT TRIALS (CASES/YEAR)
SCCD  - SUPERIOR COURT CASES DISMISSED (CASES/YEAR)
SCGP - SUPERIOR COURT GUILTY PLEAS (CASES/YEAR)

FSCT.K = SCT.K / TCASC.K

FSCT - FRACTION OF SUPERIOR COURT CASES TRIED (DIMENSIONLESS)
SCT - SUPERIOR COURT TRIALS (CASES/YEAR)
TCASC - TOTAL SUPERIOR COURT CASES PROCESSED (CASES/YEAR)

FSCPG.K = SCGP.K / TCASC.K

FSCPG - FRACTION OF SUPERIOR COURT CASES PLEADING GUILTY (DIMENSIONLESS)
SCGP - SUPERIOR COURT GUILTY PLEAS (CASES/YEAR)
TCASC - TOTAL SUPERIOR COURT CASES PROCESSED (CASES/YEAR)

FSCCD.K = 1 - FSCT.K - FSCPG.K

FSCCD - FRACTION OF SUPERIOR COURT CASES DISMISSED (DIMENSIONLESS)
FSCT - FRACTION OF SUPERIOR COURT CASES TRIED (DIMENSIONLESS)
FSCPG - FRACTION OF SUPERIOR COURT CASES PLEADING GUILTY (DIMENSIONLESS)

FSCP GT.K = FSCT.K + FSCPG.K

FSCP GT - FRACTION OF SUPERIOR COURT CASES TRIED AND PLEADING GUILTY (DIMENSIONLESS)
FSCT - FRACTION OF SUPERIOR COURT CASES TRIED (DIMENSIONLESS)
FSCPG - FRACTION OF SUPERIOR COURT CASES PLEADING GUILTY (DIMENSIONLESS)

CNVTR.K = TABHL(CNVTR, TIME.K, 1950, 1971, 1)

CNVTR = CONVICTIONS FROM TRIALS (CASES/YEAR)

CNVR.K = CNVTR.K / SCT.K

CNVR - CONVICTION RATE FOR TRIALS (DIMENSIONLESS)
CNVTR - CONVICTIONS FROM TRIALS (CASES/YEAR)
SCT - SUPERIOR COURT TRIALS (CASES/YEAR)

SCIMP.K = TABHL(SCIMP, TIME.K, 1950, 1971, 1)

SCIMP = SUPERIOR COURT DEFENDANTS IMPRISONED (CASES/YEAR)
<table>
<thead>
<tr>
<th>Equation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIMP.K = SCIMP.K/12</td>
<td>Superior Court Defendants Imprisoned Per Month (Average) (Cases/Month)</td>
</tr>
<tr>
<td>SCIMP</td>
<td>Superior Court Defendants Imprisoned (Cases/Year)</td>
</tr>
<tr>
<td>FCNISC.K = SCIMP.K / (CNVTR.K + SCGP.K)</td>
<td>Fraction of Defendants Convicted Imprisoned in Superior Court (Dimensionless)</td>
</tr>
<tr>
<td>FCNISC</td>
<td>Superior Court Defendants Imprisoned (Cases/Year)</td>
</tr>
<tr>
<td>CNVTR</td>
<td>Convictions from Trials (Cases/Year)</td>
</tr>
<tr>
<td>SCGP</td>
<td>Superior Court Guilty Pleas (Cases/Year)</td>
</tr>
<tr>
<td>FDCVSC.K = (CNVTR.K + SCGP.K) / TCASC.K</td>
<td>Fraction of Defendants Convicted in Superior Court (Dimensionless)</td>
</tr>
<tr>
<td>FDCVSC</td>
<td>Convictions from Trials (Cases/Year)</td>
</tr>
<tr>
<td>SCGP</td>
<td>Superior Court Guilty Pleas (Cases/Year)</td>
</tr>
<tr>
<td>TCASC</td>
<td>Total Superior Court Cases Processed (Cases/Year)</td>
</tr>
<tr>
<td>FDISC.K = (FCNISC.K) / FDCVSC.K</td>
<td>Fraction Defendants Imprisoned in Superior Court (Dimensionless)</td>
</tr>
<tr>
<td>FDISC</td>
<td>Fraction of Defendants Convicted Imprisoned in Superior Court (Dimensionless)</td>
</tr>
<tr>
<td>FCNISC</td>
<td>Fraction of Defendants Convicted Imprisoned in Superior Court (Dimensionless)</td>
</tr>
<tr>
<td>FDCVSC</td>
<td>Fraction of Defendants Convicted in Superior Court (Dimensionless)</td>
</tr>
<tr>
<td>SCTJ.K = SCTM.K / SCJ.K</td>
<td>Superior Court Trials Per Judge (Cases/Person-Month)</td>
</tr>
<tr>
<td>SCTJ</td>
<td>Superior Court Trials Per Month (Average) (Cases/Month)</td>
</tr>
<tr>
<td>SCTM</td>
<td>Superior Court Judges (Persons)</td>
</tr>
<tr>
<td>SCCDJ.K = SCCDM.K / SCJ.K</td>
<td>Superior Court Cases Dismissed Per Judge (Cases/Person-Month)</td>
</tr>
<tr>
<td>SCCDJ</td>
<td>Superior Court Cases Dismissed Per Month (Average) (Cases/Month)</td>
</tr>
<tr>
<td>SCCDM</td>
<td>Superior Court Judges (Persons)</td>
</tr>
<tr>
<td>SCJ</td>
<td>Superior Court Judges (Persons)</td>
</tr>
<tr>
<td>SCGPJ.K = SCGPM.K / SCJ.K</td>
<td>Superior Court Guilty Pleas Per Judge (Cases/Person-Month)</td>
</tr>
<tr>
<td>SCGPJ</td>
<td>Superior Court Guilty Pleas Per Judge (Cases/Person-Month)</td>
</tr>
</tbody>
</table>
SCGPM - SUPERIOR COURT GUILTY PLEAS PER MONTH (CASES/MONTH)
SCJ - SUPERIOR COURT JUDGES (PERSONS)
3. DISTRICT COURT DISPOSITIONS

SOURCE: SRCC

NOTE: DATA MISSING FOR 1960. DATA FILLED IN BY LINEAR INTERPOLATION.

NOTE: DATA COVERS CRIMES AGAINST PERSONS AND AGAINST PROPERTY, BUT NOT AGAINST PUBLIC ORDER.

CRGJ.K=TABHL(CRGJT, TIME.K, 1950, 1971, 1)
46, A
CRGJT=2683/2388/2428/2454/3057/2972/2944/3111/4022/46.3, T
4151/4369/4587/4258/4921/5105/4964/5402/5626/
5799/6388/6947/9073
CRGJ - CASES BOUND OVER TO GRAND JURY (CASES/YEAR)

DCD.K=TABHL(DCDT, TIME.K, 1950, 1971, 1)
47, A
DCDT=2313/2215/2191/2354/2486/2428/2654/2818/2959/47.2, T
3197/3477/3757/3931/4540/5546/6389/6938/7177/
7603/9107/10743/12609
DCD - DISTRICT COURT DISMISSEALS (CASES/YEAR)

DCAQ.K=TABHL(DCAQT, TIME.K, 1950, 1971, 1)
48, A
DCAQT=1417/1269/1439/1427/1577/1393/1381/1455/1480/48.2, T
1672/1769/1865/1751/1932/2186/2890/2668/2942/
3452/3681/4216/4634
DCAQ - DISTRICT COURT ACQUITALS (CASES/YEAR)

DCCV.K=TABHL(DCCVT, TIME.K, 1950, 1971, 1)
49, A
DCCVT=8294/8224/8142/7900/6277/7556/8663/9349/
10312/11280/11685/12090/12509/13446/15199/14893/
15287/15165/16203/17948/20143/23428
DCCV - DISTRICT COURT CONVICTIONS (CASES/YEAR)

DCIM.K=TABHL(DCIMT, TIME.K, 1950, 1971, 1)
50, A
DCIMT=1745/1699/1645/1559/1744/1596/1626/1933/2128/50.3, T
2064/2157/2250/2276/2489/2546/3026/2787/2934/
3211/3360/3672/4498
DCIM - DISTRICT COURT IMPRISONMENT (CASES/YEAR)

APIMP.K=TABHL(APIMPT, TIME.K, 1950, 1971, 1)
51, A
APIMPT=678/763/650/589/659/552/519/716/725/732/750/51.2, T
767/726/929/970/1054/1186/1290/1576/1703/2006/
2560
APIMP - APPEALS FROM IMPRISONMENT (CASES/YEAR)
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APFN.K</td>
<td>Total appeals from fine only (cases/year)</td>
</tr>
<tr>
<td>APLS.K</td>
<td>Total appeals (cases/year)</td>
</tr>
<tr>
<td>APLSM.K</td>
<td>Appeals per month (average) (cases/month)</td>
</tr>
<tr>
<td>ARR.K</td>
<td>Arrests (total cases processed in district court) (cases/year)</td>
</tr>
<tr>
<td>FCRGJ.K</td>
<td>Fraction of cases bound over to grand jury (dimensionless)</td>
</tr>
<tr>
<td>FCD.K</td>
<td>Fraction of cases dismissed in district court (dimensionless)</td>
</tr>
<tr>
<td>FCAQ.K</td>
<td>Fraction of cases acquitted in district court (dimensionless)</td>
</tr>
</tbody>
</table>
FCCV.K = DCCV.K / (ARR.K - CRGJ.K)

FCCV - FRACTION OF CASES CONVICTED IN DISTRICT COURT (DIMENSIONLESS)
DCCV - DISTRICT COURT CONVICTIONS (CASES/YEAR)
ARR - ARRESTS (TOTAL CASES PROCESSED IN DISTRICT COURT) (CASES/YEAR)
CRGJ - CASES BOUND OVER TO GRAND JURY (CASES/YEAR)

BREAKDOWN OF IMPRISONMENT AND APPEALS

FAIDC.K = DCIM.K / ARR.K

FAIDC - FRACTION OF ARRESTS IMPRISONED IN DISTRICT COURT (DIMENSIONLESS)
DCIM - DISTRICT COURT IMPRISONMENT (CASES/YEAR)
ARR - ARRESTS (TOTAL CASES PROCESSED IN DISTRICT COURT) (CASES/YEAR)

FCNIDC.K = DCIM.K / DCCV.K

FCNIDC - FRACTION OF CONVICTIONS IMPRISONED IN DISTRICT COURT (DIMENSIONLESS)
DCIM - DISTRICT COURT IMPRISONMENT (CASES/YEAR)
DCCV - DISTRICT COURT CONVICTIONS (CASES/YEAR)

FINDC.K = (DCIM.K - APIIMP.K) / DCIM.K

FINDC - FRACTION OF IMPRISONMENTS NOT APPEALING (DIMENSIONLESS)
DCIM - DISTRICT COURT IMPRISONMENT (CASES/YEAR)
APIIMP - APPEALS FROM IMPRISONMENT (CASES/YEAR)

FDIDC.K = (DCIM.K - APIIMP.K) / ARR.K

FDIDC - FRACTION OF DEFENDANTS IMPRISONED IN DISTRICT COURT (AND NOT APPEALING) (DIMENSIONLESS)
DCIM - DISTRICT COURT IMPRISONMENT (CASES/YEAR)
APIIMP - APPEALS FROM IMPRISONMENT (CASES/YEAR)
ARR - ARRESTS (TOTAL CASES PROCESSED IN DISTRICT COURT) (CASES/YEAR)

FDNIA.K = APFN.K / (DCCV.K - DCIM.K)

FDNIA - FRACTION OF DEFENDANTS NOT IMPRISONED APPEALING (DIMENSIONLESS)
APFN - APPEALS FROM FINE ONLY (CASES/YEAR)
DCCV - DISTRICT COURT CONVICTIONS (CASES/YEAR)
DCIM - DISTRICT COURT IMPRISONMENT (CASES/YEAR)

FDIA.K = APIIMP.K / DCIM.K

FDIA - FRACTION OF DEFENDANTS IMPRISONED APPEALING (DIMENSIONLESS)
APIMP - APPEALS FROM IMPRISONMENT (CASES/YEAR)
DCIM - DISTRICT COURT IMPRISONMENT (CASES/YEAR)

FCA.K=APLS.K/ARR.K  
FCA - FRACTION OF CASES APPEALING (DIMENSIONLESS)
APLS - APPEALS (TOTAL) (CASES/YEAR)
ARR - ARRESTS (TOTAL CASES PROCESSED IN DISTRICT COURT) (CASES/YEAR)

TIMP.K=(DCIM.K-APIMP.K+SCIMP.K)  
TIMP - TOTAL IMPRISONMENTS (SUPERIOR AND DISTRICT COURTS) (CASES/MONTH)
DCIM - DISTRICT COURT IMPRISONMENT (CASES/YEAR)
APIMP - APPEALS FROM IMPRISONMENT (CASES/YEAR)
SCIMP - SUPERIOR COURT DEFENDANTS IMPRISONED (CASES/YEAR)

FAI.K=TIMP.K/ARR.K  
FAI - FRACTION OF ARRESTS IMPRISONED (DIMENSIONLESS)
TIMP - TOTAL IMPRISONMENTS (SUPERIOR AND DISTRICT COURTS) (CASES/MONTH)
ARR - ARRESTS (TOTAL CASES PROCESSED IN DISTRICT COURT) (CASES/YEAR)

DCDIM.K=(DCIM.K-APIMP.K)/12  
DCDIM - DISTRICT COURT DEFENDANTS IMPRISONED NOT APPEALING PER MONTH (CASES/MONTH)
DCIM - DISTRICT COURT IMPRISONMENT (CASES/YEAR)
APIMP - APPEALS FROM IMPRISONMENT (CASES/YEAR)
4. PRISON POPULATION

SOURCE: SRCC
NOTE: DATA MISSING FOR COUNTY HOUSES OF CORRECTION FOR 1960. DATA FILLED IN BY LINEAR INTERPOLATION.
NOTE: DATA COVER PERSONS IMPRISONED FOR ALL CRIMES. POPULATION OF COUNTY INSTITUTIONS INCLUDES DEFENDANTS HELD FOR TRIAL.
NOTE: PRISONER DATA CONSIST OF THREE SERIES
(1) 1920 - 1930 - POPULATION ON 30 SEP OF YEAR
DATA ON BRIDGEWATER (STATE FARM) ARE PRISONERS ONLY.
(2) 1931 - 1949 - AVERAGE DAILY POPULATION.
DATA ON BRIDGEWATER ARE PRISONERS ONLY.
(3) 1950 - 1971 - AVERAGE DAILY POPULATION.
DATA ON BRIDGEWATER INCLUDE TOTAL POPULATION OF INSTITUTION.

SPRSN.K=TABHL(SPRSNT,TIME.K,1920,1971,1) 74, A
SPRSNT=1358/1749/2059/2005/2359/2759/2992/3026/
3343/3259/3355/3467/3577/3730/3805/3893/3801/
4027/4312/4275/4170/3986/3835/3517/3127/3198/
3066/3150/3494/3475/4677/4385/4160/3905/3647/
3780/3677/3465/3541/3569/3688/3790/3885/3835/
3917/3763/3672/3395/3359/3288/3412/3404
SPRSN - STATE INSTITUTION PRISONERS (PERSONS)

CPRSN.K=TABHL(CPRSNT,TIME.K,1920,1971,1) 75, A
CPRSNT=994/1503/1551/1685/2164/2364/2450/2347/2585/
2517/2804/2653/2848/2982/3025/2851/2645/2674/
2688/2614/2547/2493/2411/1851/1652/1684/1727/
1964/2092/2174/1759/1715/1938/2064/2260/2267/
2257/2259/2353/2345/2285/2225/2349/2344/2333/
2262/1952/1835/1833/2045/2056/1874
CPRSN - COUNTY INSTITUTION PRISONERS (PERSONS)

BPRSN.K=TABHL(BPRSNT,TIME.K,1920,1971,1) 76, A
BPRSNT=250/440/524/618/815/927/936/997/1117/990/
1003/1016/1001/975/1052/975/826/970/1065/1059/
1102/1142/1029/771/604/577/519/625/777/842/2150/
2012/1866/1763/1547/1585/1609/1571/1573/1587/
1695/1769/1833/1825/1829/1747/1706/1526/1432/
1215/1187/1148
BPRSN - BRIDGEWATER PRISONERS (PERSONS)

PRSN.K=SPRSN.K+CPRSN.K-BPRSN.K
PRSN - TOTAL PRISONERS (PERSONS)
SPRSN - STATE INSTITUTION PRISONERS (PERSONS)
CPRSN - COUNTY INSTITUTION PRISONERS (PERSONS)
BPRSN - BRIDGEWATER PRISONERS (PERSONS)

NOTE: THE BRIDGEWATER POPULATION IS
EXCLUDED BECAUSE IT SOMETIMES
CONTAINS DATA FOR PATIENTS IN
THE HOSPITAL PORTION OF THE
FACILITY AND BECAUSE THE
MAJORITY OF PRISONERS IN
THE PRISON PORTION WERE THERE
FOR DRUNKENNESS. EXCLUDING
THIS POPULATION WAS THEREFORE IN
KEEPING WITH EXCLUDING MINOR CRIMES
IN OTHER DATA.

TOI.K=TIMP.K/(12*CPS)

CPS=1
TOI - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)
TIMP - TOTAL IMPRISONMENTS (SUPERIOR AND DISTRICT
COURTS)(CASES/MONTH)
CPS - CASES PER SUSPECT (CASES/PERSON)

AES.K=PRSN.K/TOI.K
AES - AVERAGE EFFECTIVE SENTENCE (MONTHS)
PRSN - TOTAL PRISONERS (PERSONS)
TOI - TOTAL OFFENDERS IMPRISONED (PERSONS/MONTH)

NOTE: CALCULATION FOR AVERAGE EFFECTIVE
SENTENCE IS BASED ON THREE ASSUMPTIONS:
(1) AVERAGE SENTENCE IS EQUAL TO
POPULATION DIVIDED BY OUTFLOW OF PRISONERS
RELEASED.
(2) INFLOW EQUALS OUTFLOW (SINCE PRISON
POPULATION IS NEARLY IN EQUILIBRIUM)
(3) TOI ACCURATELY REPRESENTS INFLOW
AND PRSN IS AN ACCURATE MEASURE OF
OFFENDERS IN PRISON FOR SERIOUS CRIMES.
5. INDEX CRIMES

SOURCE: UCR (UNLESS OTHERWISE NOTED)
NOTE: DATA ARE FOR SEVEN SERIOUS CRIMES (EXCEPT FOR POPULATION DATA OF COURSE)

INDEX CRIMES IN MASSACHUSETTS

IXCR.K=TABHL(IXCRT,TIME.K,1957,1974,1)
IXCRT=1/37701/36218/39046/48531/53162/59333/73139/
80610/89055/100989/129651/149807/170900/200796/
196261/263031/312211
IXCR - INDEX CRIMES (CASES/YEAR)

NOTE: DUMMY 1 PLACED IN 1957 POSITION FOR PLOTTING PURPOSES

FIXCR.K=IXCR.K/37701
FIXCR - FRACTIONAL INCREASE IN INDEX CRIMES (DIMENSIONLESS)
IXCR - INDEX CRIMES (CASES/YEAR)

POPULATION

POP.K=TABHL(POPT,TIME.K,1920,1970,5)
POP - MASSACHUSETTS POPULATION (PERSONS)

SOURCE: SRCC

IXCRR.K=(IXCR.K/POP.K)/100000
IXCRR - INDEX CRIME RATE (CASES/100,000 PERSON-YEARS)
IXCR - INDEX CRIMES (CASES/YEAR)
POP - MASSACHUSETTS POPULATION (PERSONS)

ARIXC.K=TABHL(ARIXCT,TIME.K,1965,1971,1)
ARIXCT=0/18225/20508/25724/24836/27785/33970
ARIXC - ARRESTS FOR INDEX CRIMES (CASES/YEAR)

SOURCE: SRCC
NOTE: DUMMY 0 PLACED IN 1965 POSITION FOR PLOTTING PURPOSES
PCLF.K=ARIXC.K/IXHR.K  
PCLF - POLICE CLEARANCE FRACTION (DIMENSIONLESS)  
ARIXC - ARRESTS FOR INDEX CRIMES (CASES/YEAR)  
IXCR - INDEX CRIMES (CASES/YEAR)  

PARR.K=TABHL(PARRT,TIME.K,1920,1959,1)  
PARR - ARRESTS (AS REPORTED BY POLICE) (PERSONS/YEAR)  

PARRT=20710/25813/23918/22238/23878/24237/22569/  
20578/22034/21651/22215/25015/25707/24610/23481/  
22335/22359/23500/24200/22372/21618/19838/17429/  
17511/17849/19383/20696/20253/19781/20630/19734/  
18570/19784/20373/22513/21719/23481/25623/27035/  
24433  

SOURCE: SRCC  

RPARRP.K=PARR.K/POP.K  
RPARRP - RATIO OF POLICE ARRESTS TO POPULATION (CASES/PERSON-MONTH)  
PARR - ARRESTS (AS REPORTED BY POLICE) (PERSONS/YEAR)  
POP - MASSACHUSETTS POPULATION (PERSONS)  

INDEX CRIMES FOR U.S.  

USPOP.K=TABHL(TUSPOP,TIME.K,1960,1974,1)  
211392E3  
USPOP - U.S. POPULATION (PERSONS)  

USMD.K=TABHL(TUSMD,TIME.K,1960,1974,1)  
TUSMD=9060/8690/8480/8590/9310/9910/10980/12170/  
13750/14680/15910/17680/18570/19530/20600  
USMD - MURDERS IN U.S. (CASES/YEAR)  

USRP.K=TABHL(TUSR,P,TIME.K,1960,1974,1)  
TUSR=17130/17160/17490/17590/21235/23330/25730/  
27530/31560/37050/37860/42120/46690/51230/55210  
USRP - RAPES IN U.S. (CASES/YEAR)  

USRB.K=TABHL(TUSB,P,TIME.K,1960,1974,1)  
TUSB=107570/106400/110580/116180/130050/138340/  
157590/202400/262180/298100/348980/386730/375350/
383260/441290
US_RB - ROBBERIES IN U.S. (CASES/YEAR)

US_AS.K=TABHL(TUS_AS,TIME.K,1960,1974,1) 96, A
TUS_AS=153140/155560/163310/172880/201500/213680/
233530/255190/284510/308710/332410/365940/390080/
417430/452720
US_AS - ASSAULTS IN U.S. (CASES/YEAR)

US_BG.K=TABHL(TUS_BG,TIME.K,1960,1974,1) 97, A
TUS_BG=906600/943800/988300/1079800/1205800/
1274700/1401500/1622200/1847600/1969900/2191600/
2384700/2361100/2549900/3020700
US_BG - BURGLARIES IN U.S. (CASES/YEAR)

US_LR.K=TABHL(TUS_LR,TIME.K,1960,1974,1) 98, A
TUS_LR=1843100/1900500/2075800/2282600/2497800/
2555600/2803300/3091000/3459700/3862900/4197900/
4394900/4123700/4319100/5227700
US_LR - LARCENIES IN U.S. (CASES/YEAR)

US_AT.K=TABHL(TUS_AT,TIME.K,1960,1974,1) 99, A
TUS_AT=327100/334900/365600/406900/471200/495200/
559300/657600/781000/875600/925300/945000/884200/
925700/973800
US_AT - AUTO THEFT IN U.S. (CASES/YEAR)

US_VC - TOTAL VIOLENT CRIMES IN U.S. (CASES/YEAR)
US_MD - MURDERS IN U.S. (CASES/YEAR)
US_RP - RAPES IN U.S. (CASES/YEAR)
US_RB - ROBBERIES IN U.S. (CASES/YEAR)
US_AS - ASSAULTS IN U.S. (CASES/YEAR)

US_PC - TOTAL PROPERTY CRIMES IN U.S. (CASES/YEAR)
US_BG - BURGLARIES IN U.S. (CASES/YEAR)
US_LR - LARCENIES IN U.S. (CASES/YEAR)
US_AT - AUTO THEFT IN U.S. (CASES/YEAR)

US_TL.K=US_VC.K+US_PC.K 102, A
US_TL - TOTAL INDEX CRIMES IN U.S. (CASES/YEAR)
US_VC - TOTAL VIOLENT CRIMES IN U.S. (CASES/YEAR)
US_PC - TOTAL PROPERTY CRIMES IN U.S. (CASES/YEAR)

COMPUTATION FOR GROWTH RATES

NOTE: GROWTH RATES FOR CRIMES REPORTED
IN CHAPTER 1, SECTION 1.2, WERE COMPUTED BY FITTING THE FOLLOWING EQUATIONS.

\[
\logn(\text{IXCR}.K) = A + B \cdot (\text{TIME}.K - \text{TIMEN})
\]

FOR MASSACHUSETTS

\[
\logn(\text{US_TL}.K) = A + B \cdot (\text{TIME}.K - \text{TIMEN})
\]

FOR U.S.

"B" YIELDS GROWTH RATE

\[
\text{IXCR}.K = \logn(\text{IXCR}.K)
\]

\text{LIXCR} - NATURAL LOG OF INDEX CRIMES IN MASSACHUSETTS

\text{IXCR} - INDEX CRIMES (CASES/YEAR)

\[
\text{US_TL}.K = \logn(\text{US_TL}.K)
\]

\text{LUS_TL} - NATURAL LOG OF INDEX CRIMES IN U.S.

\text{US_TL} - TOTAL INDEX CRIMES IN U.S. (CASES/YEAR)
8.5 Output Specification

The following is a listing of the rerun statements used to produce the graphs and numerical data based on CTDAT.

NOTE
NOTE COURT DATA MODEL/V 1.05
NOTE RERUNS FOR CHAPTERS 1, 3, 4, AND 5
NOTE OF COURT MANAGEMENT AND THE
NOTE MASSACHUSETTS CRIMINAL JUSTICE SYSTEM
NOTE
NOTE CHAPTER 1, SECTION 1.2
NOTE
NOTE PRINT PCLF,SCDL,FAI,AES
CP TIMEN=1955
CP LENGTH=1971
CP PLTPER=0
CP PRTPER=1
RUN CHAPTER 1
NOTE
NOTE
NOTE
NOTE GRAPHS FOR CHAPTER 3 AND 4
NOTE
NOTE FIG 3-5 - JUDGES, BACKLOG, AND
NOTE WORKLOAD IN THE SUPERIOR
NOTE COURT, 1959 - 1974
NOTE
NOTE CP TIMEN=1959
CP LENGTH=1974
CP PLTPER=0.5
PLOT SCB=B(0,40E3)/SCJ=J(0,48)/SCJWL=W(0,800)
CP PRTPER=0
RUN FIG 3-5
NOTE
NOTE FIG 3-6 - TRIAL-DAYS AND JUDICIAL UTILIZATION
NOTE FACTOR IN SUPERIOR COURT, 1959 - 1974
NOTE
NOTE CP TIMEN=1959
CP LENGTH=1974
CP PLTPER=0.5
CP PRTPER=0
PLOT TDSCJ=1,TDCJJ=2,TTD=T(0,6E3)/JUJF=J(0,10)
RUN 3-6
NOTE
NOTE FIG 3-12 - DISMISALS, GUILTY PLEAS, AND
NOTE TRIALS PER JUDGES IN SUPERIOR
NOTE COURT, 1959 - 1971
NOTE
NOTE CP TIMEN=1959
NOTE CP LENGTH=1971
NOTE CP PLTPER=0.5
NOTE CP PRTPER=0
NOTE PLOT SCTJ=T(0,6)/SCCDJ=D(0,4)/SCGPJ=G(0,40)
NOTE RUN 3-12
NOTE
NOTE FIG 3-13 - FRACTION OF CONVICTIONS
NOTE IMPRISONED, SUPERIOR COURT,
NOTE 1950 - 1971
NOTE
NOTE CP TIMEN=1950
NOTE CP LENGTH=1971
NOTE CP PLTPER=0.5
NOTE CP PRTPER=0
NOTE PLOT FCNISC=*(0,1)
NOTE RUN 3-13
NOTE
NOTE FIG 3-22 - FRACTION OF CASES CONVICTED,
NOTE FRACTION OF CONVICTIONS IMPRISONED,
NOTE AND FRACTION OF IMPRISONMENTS
NOTE APPEALED IN DISTRICT COURT,
NOTE 1950 - 1971
NOTE
NOTE CP TIMEN=1950
NOTE CP LENGTH=1971
NOTE CP PRTPER=0
NOTE CP PLTPER=0.5
NOTE PLOT FCCV=C,FCNIDC=1,FDIA=A(0,1)
NOTE RUN 3-22
NOTE
NOTE FIG 3-23 - FRACTION OF ARRESTS APPEALED AND
NOTE FRACTION OF ARRESTS REFERRED TO
NOTE GRAND JURY IN DISTRICT COURT,
NOTE 1950 - 1971
NOTE
NOTE CP TIMEN=1950
NOTE CP LENGTH=1971
NOTE CP PLTPER=0.5
NOTE CP PRTPER=0
NOTE PLOT FCA=A,FCRGJ=G(0,0.24)
NOTE RUN 3-23
NOTE FIG 3-24 - DAYS PER TRIAL IN SUPERIOR COURT, 1959 - 1974

NOTE CP TIMEN=1959
CP LENGTH=1974
CP PLTPER=0.5
CP PRTPER=0
PLOT DPTSC=(0,2)
RUN 3-24
NOTE FIG 4-9 - PRISON POPULATION IN MASSACHUSETTS, 1950 - 1971

NOTE CP TIMEN=1950
CP LENGTH=1971
CP PLTPER=0.5
PLOT PRSN=P(0,5E3)/TOI=T(0,640)
RUN 4-8
NOTE NOTE NOTE NOTE FIRST RUN
NOTE NOTE NOTE NOTE GRAHPING PARAMETERS
NOTE CP TIMEN=1955
CP LENGTH=1971
CP PRTPER=0
NOTE NOTE CRIMES
NOTE PLOT FIXCR=K(0,8)/PCLF=F(0,0.24)/AKRM=A(0,5000)
NOTE NOTE DISTRICT COURT
NOTE PLOT DCDIM=1,APLSM=A(0,400)/FCA=1,FDIDC=2(0,0.1)
NOTE NOTE SUPERIOR COURT (PANEL 1)
NOTE PLOT SCIMP=1,SCT=1,SCCDM=O(0,280)/SCGPM=G(0,500)
NOTE NOTE SUPERIOR COURT (PANNEL 2)
NOTE PLOT FSCP=G,FSCPRT=T,FDCVSC=C,FDISC=1(0,1)
NOTE NOTE CORRECTIONS
NOTE PLOTS PRSN=P(0.4800)/AES=$(0,20)/T01=0(0,640)/X
FAI=I(0,0.2)
NOTE RUN
NOTE SECOND RUN
NOTE GRAPHING PARAMETERS
NOTE C TME=1959
NOTE C LENGTH=1974
NOTE NOTE
NOTE SUPERIOR COURT (PANEL 3)
NOTE NOTE PLOT SCDL=Y(0,12)/SCJ=J(0,60)/TTCM=D(0,480)
RUN QUIT
FOOTNOTES


2 Massachusetts, Department of Corrections, Statistical Reports of the Commissioner of Corrections, Public Document 115 (Boston, 1959 - 1974)

3 Massachusetts, Supreme Judicial Court, Executive Secretary, Annual Report to the Justices of the Supreme Judicial Court, Public Document 166 (Boston, 1959 - 1974)

APPENDIX C

MODEL AND RERUN LISTINGS

C.1 Basic Criminal Justice Model

* 
NOTE  BASIC CRIMINAL JUSTICE MODEL  31/DEC/1.11
NOTE  ----------------------------------------
NOTE  NAME    -- BCJM
NOTE  AUTHOR  -- W. SHAFFER
NOTE  SOURCE -- CHAPTER 2, COURT MANAGEMENT AND THE
NOTE  MASSACHUSETTS CRIMINAL JUSTICE SYSTEM
NOTE  DATE    -- 31 DEC 1975
NOTE  VERSION -- 1.11
NOTE  SYSTEM -- DYNAMO 11/360
NOTE  
NOTE  PRISONS
NOTE  MACRO
MACRO   PROUT(NO1,XO1,STIN,PRCAP,PRSN,AES,FPOC)
L         PRSN.K=PRSN.J+(DT)(NO1.JK+XO1.JK-PROUT.J)
N         PRSN=PRCAP
A         PROUT.K=PRSN.K/AES.K
A         AES.K=($ACIS.K)($RSP.K)
A         $RSP.K=($NRSP.K)($EPCS.K)($SRP.K)
L         $NRSP.K=$NRSP.J+(DT/PRLAT)($RSP.J-$NRSP.J)
N         $NRSP=PRCAP/STIN
A         $EPCS.K=TABLE(EPCST,1.44*LOGN(FPOC.K),-1,1,.5)
A         FPOC.K=PRSN.K/PRCAP.K
N         FPOC=1
$SRP.K = \text{TABLE}(\text{SRPT}, \text{NSRP.K}, 0, 1.2, 0.2)

$ACIS.K = \text{TABLE}(\text{STST.K}, \text{PRSN.K})

$STST.K = \text{STST.J} + (\text{DT})(\text{STIN.J} - \text{STOUT.JK})

$STOUT.KL = \text{PROUT.K}(\text{STIN.J})/(\text{NOI} + \text{XO})

\text{EPCST} = 1.2/1.1/1.0/0.7/0.5

\text{SRPT} = 3.0/1.2/1.0/1.0/0.8/0.0

\text{PRLAT} = 8

\text{CRIMES}

\text{CRIME.K} = \text{CRIMO.K} + \text{CRINO.K}

\text{CRIME} = 10000

\text{CRIMO.K} = (\text{PNO.K})(\text{CRNNO})(\text{EDC.K})(\text{TEST.K})

\text{CRNNO} = (\text{CRIME})(1-\text{IFXO})

\text{CRNNO} = (\text{CRIME})(1-\text{IFXO})/\text{PNO}

\text{IFXO} = 0.1

\text{TEST.K} = 1 + \text{STEP(ACR, CRS)}

\text{ACR} = 0.05

\text{CRS} = 12

\text{CRXO.K} = (\text{XO.K})(\text{CRNKO})(\text{EDC.K})(\text{TEST.K})

\text{CRXO} = (\text{CRIME})(\text{IFXO})

\text{CRNKO} = (\text{CRIME})(\text{IFXO})/\text{XO}

\text{EDC.K} = (\text{EIC.K})(\text{ESC.K})

\text{EIC.K} = \text{TABLE}(\text{EICT}, 1.44*\text{LOGN(PIR.K)}, -2, 2, 0.5)

\text{EICT} = 3.20/3.00/2.50/1.60/1.00/0.64/0.40/0.24/0.15

\text{PIR.K} = (\text{P01.K} / \text{PCRIM.K}) / \text{NIF}

\text{NIF} = (\text{NOI} + \text{XO}) / \text{CRIME}

\text{PCRIM.K} = \text{PCRIM.J} + (\text{DT}/\text{DPT})(\text{CRIME.J} - \text{PCRIM.J})

\text{PCRIM} = \text{CRIME}

\text{DPT} = 30

\text{P01.K} = \text{P01.J} + (\text{DT}/\text{DPT})(\text{T01.J} - \text{P01.J})

\text{P01} = \text{T01}

\text{CASE PROCESSING}

\text{CJB.K} = \text{CJB.J} + (\text{DT})(\text{CRREP.JK} - \text{CADJ.J})

\text{CJB} = (\text{CJDL})(\text{CJCAP})

\text{CJDL} = 5

\text{CRREP.KL} = (\text{CRIE.K})(\text{FCR.K})

\text{FCR.K} = \text{TABLE}(\text{FCRT.WL.K}, 0.5, 1)

\text{FCRT} = 0.70/0.50/0.40/0.32/0.27/0.25

\text{WL.K} = (\text{CJB.K}/\text{CJCAP.K})/\text{ICJDL}

\text{CADJ.K} = (\text{CJCAP.K})(\text{CUF.K})

\text{CUF.K} = \text{TABLE}(\text{CUFT.WL.K}, 0.5, 0.5)

\text{CUFT} = 0.00/0.80/1.00/1.20/1.40/1.53/1.65/
1.75/1.85/1.93/2.00

CAPACITY ACQUISITION

CJCAP.K=CJCAP.J+(DT)(CAPAC.JK)
CJCAP=(CRIME)(TABLE(FCRT,1,0,5,1))
CAPAC.KL=(CJCAP.K)(PACAP.K-1)/CAT
CAT=150
PACAP.K=TABLE(PACAPT,1.44*LOGN(RWL.K),-2,2,1)
PACAPT=0.65/0.80/1.00/2.00/4.00
RWL.K=WL.WL/K/WLS.K
WLS.K=WLS.J+(DT)(CWLS.JK)
WLS=1
CWLS.KL=(WLS.K)(RWL.K-1)/SAT
SAT=120

SENTENCING

TOI.K=(CADJ.K/CPS)(FDI.K)
CPS=1
FDI.K=(NFDI)(PIW.K)
NFDI=.05
PIW.K=TABLE(PIWT,WL.K,0,5,1)
PIWT=1.30/1.00/0.80/0.60/0.50/0.40
CIS,K=(NCIS)(PSW.K)(1+STEP(ACS,SSW))
NCIS=24
ACS=0.5
SSW=10000
PSW.K=TABLE(PSWT,WL.K,0,5,1)
PSWT=1.40/1.00/0.70/0.60/0.55/0.50

CORRECTIONS

NOI.KL=(TOI.K)(1-FXO1.K)
XO1.KL=(TOI.K)(FXO1.K)
FXO1.K=CR1XO.K/CRIME.K
XO.K=XO.J+(DT)(PRL.JK-XO1.JK-XOAO.JK)
XO=(NOI)(XOLT)
XOAO.KL=XO.K/XOLT
XOLT=60
PRN.K=POP-(LTS)(XO.K+PRSN.K)
LTS=1
POP=5000000
PRRL.KL=PROUT(NO1.JK,XO1.JK,STIN.K,PRCAP.K,
PRSN.K,AES.K,FPOC.K)
STIN.K=(TOI.K)(CIS.K)
PRCAP.K=(IPRCAP)(1+STEP(APRCAP,PRSW))
IPRCAP=4000
C         APRCAP=0.5
C         PRSW=10000
NOTE
NOTE       EFFECT OF SENTENCE ON CRIME
NOTE
A         ESC.K=TABLE(ESCT, 1.44*LOGN(PAESR.K), -2, 2, 0.5)
T         ESCT=1.85/1.75/1.60/1.40/1.00/0.80/0.70/0.64/0.60
A         PAESR.K=PAES.K/NAES
N         NAES=AES
L         PAES.K=PAES.J+(DT/DPT)(AES.J-PAES.J)
N         PAES=AES
NOTE
NOTE       CONTROL CARDS
NOTE
PRINT      CJB,CRRPT,FCR,WL,CADJ,CUF,CJCAP,CAPAC
PRINT      PACAP,RWL,WLS,CNL.C,NOI,XOI,FXO1,FDI
PRINT      PRRL,PRCAP,STIN,PRSN,AES,CIS,XO1,XOA0
PRINT      CRIME,CRINO,PNO,CRIXO,EDC,EIC,CDLY
PRINT      PIR,POI,PCRIN,ESC,PAESR,TOI
NOTE
A         CDLY.K=CJB.K/CAJJ.K
NOTE
NOTE       PLOT CRIME==/EDC=0/PIR=1/WL=WLS=S/AES=/$
X         PRSN=P/NOI=N/XOI=X/XO=0
NOTE
SPEC       DT=1/PLTPER=12/PRTPER=0/LENGTH=480
RUN        BASE

C.2 Reruns for Basic Criminal Justice Model

NOTE
NOTE       RERUNS FOR CHAPTER 2, COURT MANAGEMENT
NOTE       AND THE MASSACHUSETTS CRIMINAL JUSTICE SYSTEM
NOTE
NOTE       4 JAN 76/VERSION 1.11
NOTE
NOTE       FIG 2-4 - SIMULATION OF LOOPS 1 AND 2:
NOTE       EXPONENTIAL GROWTH
NOTE
CP         IFXO=0
CP
ACR=0.2
CP
LTS=0
CP
CAT=1000000
TP
ESCT=1/1/1/1/1/1/1/1/1
TP
CUFT=1/1/1/1/1/1/1/1/1/1/1
TP
PIWT=1/1/1/1/1/1
TP
PSWT=1/1/1/1/1/1
T
EICT=5.29/3.48/2.30/1.52/1.00/0.660/0.435/
X
0.287/0.189
NOTE
SLOPE OF 1.2
CP
LENGTH=120
CP
PLTPER=3
PLOT
CRIME=*,PCRIM=P(0.50E3)/TEST=T(1,5)/
X
PIR=I(0.25,1.25)/EI1C=I(0,4)
RUN
F2-4
NOTE
FIG 2-5 - SIMULATION OF LOOPS 1 AND 2:
NOTE
EQUILIBRIUM
NOTE
T
EI C T=2.82/2.18/1.68/1.30/1.00/0.771/0.594/
X
0.459/0.354
NOTE
SLOPE OF 0.75
CP
PLTPER=6
CP
LENGTH=240
RUN
F2-5
NOTE
FIG 2-6 - SIMULATION OF LOOPS 1 AND 2:
NOTE
SIGMOIDAL GROWTH
NOTE
T
EI C T=3.20/3.00/2.50/1.60/1.00/0.64/0.40/0.24/0.15
RUN
F2-6
NOTE
FIG 2-7 - SIMULATION OF CASE PROCESSING
NOTE
EQUATIONS
NOTE
C
SAT=1000000
TP
CUFT=0.00/0.80/1.00/1.20/1.40/1.53/1.65/
X
1.75/1.85/1.93/2.00
TP
FCRT=0.70/0.50/0.40/0.32/0.27/0.25
TP
EI C T=1/1/1/1/1/1/1/1/1
CP
ACR=0.4
C
LENGTH=120
C
PLTPER=3
PLOT
CJB=B(0,100E3)/CRIME=*(0,50E3)/
X
CRERT=R,CADJ=A,CJCAP=C(0.8E3)/
X
WIL=W,WLS=S(0,2)/CDLY=Y(0,10)
RUN
F2-7
NOTE
FIG 2-13 - SIMULATION OF CAPACITY ACQUISITION

NOTE
T    CUFT=1/1/1/1/1/1/1/1/1/1
T    FCRT=0.5/0.5/0.5/0.5/0.5/0.5
CP   CAT=150
CP   PLTPER=12
CP   LENGTH=480
RUN   F2-14
NOTE
NOTE
FIG 2-14 - SIMULATION OF CASE PROCESSING AND
NOTE   CAPACITY ACQUISITION
NOTE
C    PLTPER=3
C    LENGTH=120
RUN   F2-14
NOTE
NOTE
FIG 2-18 - SIMULATIONS OF POLICE COURT
NOTE   SUBSYSTEM
NOTE
NOTE
GRAPH A
NOTE
TP    PJWT=1.3/1.0/0.8/0.6/0.5/0.4
TP    PSWT=1.4/1.0/0.7/0.6/0.55/0.5
CP    ACR=0.5
CP    PLTPER=6
CP    LENGTH=240
C    SAT=1000000
PLOT   CRIME=*,PCRIM=P(10E3,20E3)/TOI=1,P01=0(250,500)
RUN   F2-18A
NOTE
NOTE
GRAPH B
NOTE
RUN   F2-18B
NOTE
NOTE
FIG 2-32 - SIMULATION OF POLICE-COURT
NOTE   SUBSYSTEM: FASTER CAPACITY ACQUISITION AND
NOTE   REVISED PLEA BARGAINING POLICY
NOTE
NOTE
GRAPH A
NOTE
PLOT   CRIME=*(10E3,20E3)/CADJ=A,CJCAP=C(5E3,10E3)/
X    TOI=1(250,500)
RUN   F2-32A
NOTE
NOTE
GRAPH B
NOTE
T    CUFT=0.00/0.50/1.00/1.50/2.00/
X    2.10/2.20/2.25/2.30/2.30/2.30
T PIWT=1.40/1.00/0.60/0.40/0.40/0.40
T PSWT=1.50/1.00/0.50/0.40/0.40/0.40
RUN F2-32B
NOTE
NOTE FIG 2-19 - SIMULATION OF LOOPS 1 AND 8:
NOTE FIXED STANDARDS
NOTE
CP PLTPER=12
CP LENGTH=480
C SAT=1000000
TP EICT=3.20/3.00/2.50/1.60/1.00/0.64/0.40/0.40/0.24/0.15
X
PLOT CRIME=*(0,50E3)/TOI=1(0,1250)/PIR=1(0,2)
RUN F2-19
NOTE
NOTE FIG 2-20 - SIMULATION OF LOOPS 1 AND 8:
NOTE VARIABLE STANDARDS
NOTE
NOTE MODEL: BASE RUN
NOTE
CP ACR=0.05
CP LTS=1
CP IFxo=0.1
TP EICT=3.20/3.00/2.50/1.60/1.00/0.64/0.40/0.24/0.15
PLOT CRIME=*(0,50E3)/CJCAP=C,CRRPT=R,CADJ=A(0,25E3)/
X TOI=1,PRRL=R(0,1250)
PLOT ED=E(0,5)/PIR=1(0,2)/WLS=S,W=W(0,4)/CDLY=Y(0,20)
PLOT PRSN=P(0,8E3)/XO=0(0,32E3)/AES=$(0,28)
TP ESCT=1.85/1.75/1.60/1.40/1.00/0.80/0.70/0.64/0.60
CP PLTPER=12
CP LENGTH=480
RUN F2-28
NOTE
NOTE FIG 2-29 - SIMULATION OF BASIC CRIMINAL JUSTICE
NOTE MODEL: FASTER CAPACITY ACQUISITION
NOTE
C CAT=100
RUN F2-29
NOTE
NOTE FIG 2-31 - SIMULATION OF BASIC CRIMINAL JUSTICE
NOTE MODEL: REVISED PLEA BARGAINING POLICY
NOTE
T CUFT=0.00/0.50/1.00/1.50/2.00/2.10/2.20/
X 2.25/2.30/2.30/2.30
T PIWT=1.40/1.00/0.60/0.40/0.40/0.40/0.40
C.3 Court Management Model

* COURT MANAGEMENT MODEL  28/FEB/10.0
NOTE
NOTE -----------------------------------------------
NOTE NAME    -  CMH
NOTE DATE    -  28 FEB 76
NOTE VERSION -  10.3
NOTE AUTHOR  -  W. SHAFFER
NOTE SOURCE  -  COURT MANAGEMENT AND THE
NOTE MASSACHUSETTS CRIMINAL
NOTE SYSTEM  -  DYNAMO 11/370 TSO
NOTE
NOTE -----------------------------------------------
NOTE -----------------------------------------------
NOTE MACROS
NOTE
NOTE -----------------------------------------------
NOTE -----------------------------------------------
NOTE -----------------------------------------------
NOTE SWIITCH TABLE MACRO
NOTE -----------------------------------------------
NOTE MACRO STABLE(TAB1,TAB2,X,XLOW,XHIGH,XINCR,TSW)
A  $SW.K=STEP(1,TSW)
A  $V1.K=TABLE(TAB1,X.K,XLOW,XHIGH,XINCR)
A  $V2.K=TABLE(TAB2,X.K,XLOW,XHIGH,XINCR)
MEND
NOTE
NOTE  PRISON MACRO
NOTE
NOTE MACRO  PROUT(NO1,XO1,STIN,PRCAP,PRSN,AES,FPOC)
L  PRSN.K=PRSN.J+(uT)(NO1.JK+XO1.JK-PROUT.J)
N  PRSN=PRCAP
A  PROUT.K=PRSN.K/AES.K
A  AES.K=($ACIS.K)($RSP.K)
A  $RSP.K=($NRSP.K)($EPCS.K)($SRP.K)
L  $NRSP.K=$NRSP.J+(DT/PRLAT)($RSP.J-$NRSP.J)
N  $NRSP=PRCAP/STIN
A  $EPCS.K=TABLE(EPCST,1.44*LOGN(FPOC.K),-1,1,.5)
A  FPOC.K=PRSN.K/PRCAP.K
N  FPOC=1
A  $SRP.K=STABLE(SRPT11,SRPT2,$NRSP.K,0,1.2,0.2,MSSW)
A  $ACIS.K=ST(T STN,K/PRSN.K
L  $ST.T.K=ST(J+ (DT)(STN.J- $STOUT.JK)
N  $STOUT.KL=(PRCAP)(STIN)/(NO1+XO1)
R  $STOUT.KL=(PROUT.K)($ACIS.K)
MEND
T  EPCST=1.2/1.1/1.0/0.7/0.5
T  SRPT1=3.0/1.2/1.0/1.0/1.0/0.8/0.0
T  SRPT2=3.00/2.75/2.00/1.00/1.00/0.80/0.00
C  MSSW=10000
C  PRLAT=8
NOTE
NOTE  CHECK TABLE MACRO
NOTE
NOTE MACRO  CTABLE(TAB,AF,UF)
A  CTABLE=MIN($V2.K,$UL.K)
A  $UL.K=(1/UF.K)-(1/UF.K)(AF.K)
A  $V2.K=MAX($V1.K,$LL.K)
A  $LL.K=1-(1/UF.K)(AF.K)
A  $V1.K=TABLE(TAB,A.F.K,0,1,0.2)
MEND
NOTE
NOTE
NOTE  CAPACITY ACQUISITION MACRO
NOTE
NOTE MACRO
CAP(WL,WLS,TAB1,TAB2,SAT1,CAP,TSW,ACAP,INT)
A CAP.K=CAP.J+(DT)(CPAC.K)
N CAP=ICAP
NOTE NOTE
NOTE CLOSED LOOP POLICY
NOTE NOTE
A $CPAC1.K=(CAP.K)(PACAP.K)
A $PACAP.K=STABLE(TAB1,TAB2,$RWL.K,0,3,0,5,TSW)
A $RWL.K=WL.K/WLS.K
L WLS.K=WLS.J+(DT)(CWLS.K)
N WLS=WL
R $CWLS.KL=(WLS.K)(RWL.K-1)/SAT
NOTE NOTE
NOTE OPEN LOOP POLICY
NOTE NOTE
A $CPAC2.K=PULSE((ACAP*CAP.K)/DT,TSW,INT)
MEND
NOTE NOTE
NOTE CRIME SECTOR
NOTE NOTE
NOTE CRIMES COMMITTED
NOTE NOTE
A CRIME.K=SWITCH(CRINO.K+CRXO.K+CRINC.K+CRIXC.K,ICRIME,DTS)
X ICRIME=10000
C DTS=0
A CRINO.K=(PNO.K)(CRNNO)(ECD.K)(TEST.K)
N CRINO=(CRIME)(1-IFXO)
N CRNNO=CRINO/PNO
C IFXO=0.1
A TEST.K=EXP(TINP.K)
A TINP.K=STEP(SHGT,CRS)+
X NSW*SAMPLE(NORMN(0,ACR),SINT,0)+
X GRC*TIME.K
N SHGT=LOGN(1+ACR)
C ACR=0.05
C CRS=12
C NSW=0
EFFECT OF DETERRENCE ON CRIME

EDC.K = (EIC.K)(ESC.K)

EIC.K = TABLE(EICT,1.44*LOGN(PIR.K),-2,2,0.5)
EICT = 3.20/3.00/2.50/1.60/1.00/0.64/0.40/0.24/0.15
PIR.K = (PO1.K/PCRIM.K)/NIF
NIF = TO1/CRIME
PO1 = TO1
DPT = 30
PCRIM.K = PCRIM.J + (DT/DPT)(CRIME.J - PCRIM.J)

POLICE SECTOR

CRIMES INVESTIGATED

PCBL.K = PCBL.J + (DT)(CKRPT.JK - PCC.J)
PCBL = (PCPDN)(1FCAP)(NCPP)(1-IFCP)
PCPDN = 4
CKRPT.KL = (CRIME.K - CRIP.K)(FCR.K)
CKRPT = (1-NFCRIP)(CRIME)(1FCR)
IFCR = TABLE(FCRT,1,0,5,1)
FCR.K = TABLE(FCRT,PWL.K,0,5,1)
FCRT = 0.70/0.50/0.40/0.32/0.27/0.25
PWL.K = (PCBL.K/PIK.K)/NRBP
PWL=1
NRBP=(PCPDU)(NCPP)
PIM.K=(PCAP.K)(1-FPCP.K)
NCPP=CRRT/(1PCAP*(1-FPCP))
PCUF.K=TABLE(PCUFT,PWL.K,0.3,0.5)
PCUFT=0.00/0.60/1.00/1.40/1.80/2.00/2.00
ARR.K=IRA.K+CRIP.K
IRA.K=(PCC.K)(FARR.K)
FARR.K=TABLE(FART,PWL.K,0.3,1)
FART=0.25/0.10/0.05/0.025

POLICE CAPACITY

PCAP.K=CAP(PWL.K,PWLS.K,PAT1,PAT2,
PSAT,1PCAP,PCS,W,APCAP,PCINT)
PAT1=-0.005/-0.0025/0.000/0.003/0.012/0.025/0.050
PAT2=-0.005/-0.0025/0.000/0.006/0.024/0.050/0.100
PSAT=120
IPCAP=10000
PCSW=10000
APCAP=0
PCINT=10000

CRIMES INTERCEPTED BY POLICE

CRIP.K=(CRIME.K)(FCRIP.K)
CRIP=(CRIME)(NFCRIP)
FCRIP.K=(NFCRIP)(EPPC1.K)(ECPT.K)
NFCRIP=(1FCR*(ICLNF-IFARR))/
         (1-1FCR*IFARR-ICLNF*(1-1FCR))
IFARR=TABLE(FARR.T,1.0,3.1)
ICLNF=.225
EPPC1.K=TABLE(EPPC1T,1.44+LOGN(PATR.K),-2,2,1)
EPPC1T=0.70/0.85/1.00/1.20/1.50
PATR.K=(PPM.K/CRIME.K)/NPMC
NPMC=(1PCAP*1FPCP)/CRIME
PPM.K=(PCAP.K)(FPCP.K)
ECPT.K=TABLE(ECPTT,CPATR.K,0.2,0.5)
ECPTT=0.50/0.75/1.00/1.10/1.15
CPATR.K=CPATR.K/PPATR.K
PPATR.K=PPATR.J+(DT/DPT)(PATR.J-PPATR.J)

FRACTION OF POLICE CAPACITY
ON PATROL

FPCP.K=FPCP.J+(DT)(CFPCP.JK)
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COURT SECTOR
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ACQUISITION OF SUPERIOR COURT JUDGES
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SUPERIOR COURT BACKLOG
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SCB.K=SCB.J+(DT)(GJI.JK+APLS.JK-SCT.JK-SCCD.JK-SCGP.JK)
SCB=(GJI+APLS)(ISCDL)
ISCDL=3.0
SCJWL.K=(SCB.K/SCJ.K)/NRBJ
NRBJ=SCB/ISCJ
SCJWL=1

------------------------------------------------------------------------
SUPERIOR COURT JUDGES
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SCJ.K=CAP(SCJWL.K,SCJWLS.K,SCAT1,SCAT2,SCJSAT,ISCJ,SCJSW,ASCJ,SCJINT)
SCAT1=0.0E-2/0.0E-2/0.0E-2/0.05E-2/
0.2E-2/0.4E-2/0.8E-2
SCAT2=0.0E-2/0.0E-2/0.0E-2/0.1E-2/
0.4E-2/0.8E-2/1.0E-2
SCJSAT=180
ISCJ=37
SCJSW=10000
ASCJ=0
SCJINT=10000

------------------------------------------------------------------
NOTE
NOTE UTILIZATION OF JUDGES IN
NOTE SUPERIOR COURT TRIALS
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NOTE
NOTE SUPERIOR COURT TRIALS
NOTE
R SCT.KL=(NTJD)(SCS.K)(EDFT.K)
N NTJD=((GJI+APLS)(1FT))/ISCS
C IFT=0.16
NOTE EDFT IN IMPACT OF DEFENSE
ATTORNEY SUBSECTOR
A SCS.K=(ISCS.K)(PRRT.K)(DFRT.K)
A ISCS.K=(SCJ.K)(JUF.K)(JEFP.K)
A JUF.K=TABLE(JUFT,SCJWL.K,0,5,0.5)
T JUFT=0.0/2.8/4.0/4.8/5.2/5.6/6.0/
X 6.4/6.8/7.2/7.6
A JEFP.K=1+STEP(CJE,JEFS)
C CJE=0.5
C JEFS=10000
NOTE
NOTE REstrictions ON TRIALS FROM
NOTE PROSECutors AND DEFENSE ATTORNEYS
NOTE
A PRRT.K=TABLE(PRRT,4,44+LOGN(PRTR.K),-2,2,1)
A PRRT=0.80/0.90/1.00/1.12/1.25
A PRTR.K=(DA.K/ISCS.K)/NRPRRT
N NRPRRT=IDA/ISCS
A DFRT.K=TABLE(DFRTT,4,44+LOGN(DFTR.K),-2,2,1)
A DFRTT=0.80/0.90/1.00/1.12/1.25
A DFTR.K=(DFAT.K/ISCS.K)/NRDFRT
N NRDFRT=IDF/ISCS
NOTE
NOTE SUPERIOR COURT DISMISSALS
NOTE
NOTE SUPERIOR COURT CASES DISMISSED
NOTE
R SCCD.KL=(NDJ)(SCJ.K)(PDW.K)
N NDJ=(GJI+APLS)(1FD)/ISCJ
C IFD=0.08
PDW.K=TABLE(PDWT,SCWL.K,0,5,0.5)
PDWT=0.00/0.80/1.00/1.20/1.40/1.70/2.00/
X 2.50/3.00/3.50/4.00
A SCWL.K=(PWF)(PRWL.K)+(1-PWF)(SCJWL.K)
PWF=0.7
A PRWL.K=(SCB.K/DA.K)/NRBDA
N NRBDA=SCB/IDA
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![](https://latex.codecogs.com/png.image?\text{DISTRICT ATTORNEYS})
A DA.K=CAP(PRWL.K,PRWLS.K,DAT1,DAT2,
X DASAT,IDA,DASW,ADA,DAINCT)
T DAT1=-0.25E-2/-.15E-2/0.00E-2/0.25E-2/
X 1.00E-2/3.0E-2/7.0E-2
T DAT2=-0.25E-2/-.15E-2/0.00E-2/0.25E-2/
X 1.00E-2/3.0E-2/7.0E-2
C DASAT=120
C IDA=100
C DASW=10000
C ADA=0
C DAINCT=10000
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NOTE
NOTE CASES REFERRED TO COURT DIVERSION
NOTE PROGRAM
NOTE
A CRCD.K=(ARR.K)(FRCD.K)
A FRCD.K=STABLE(FRCDT1,FRCDT2,SCJWL.K,0.5,0.5,CDSW)
T FRCDT1=0.00/0.00/0.00/0.00/0.00/0.00/0.00/0.00
X 0.00/0.00/0.00/0.00/0.00/0.00
C FRCDD2=0.15/0.24/0.30/0.36/0.42/0.47/
X 0.51/0.54/0.57/0.59/0.60
CDSW=10000
NOTE NOTE CASES REFERRED TO GRAND JURY
NOTE NOTE
R GJ1.KL=(ARR.K)(FCBOI.K)
A FCBOI.K=(UFBO.K)(FCNDR.K)
A FCNDR.K=CTABLE(FCNDRT,FRCD.K,UFBO.K)
T FCNDRT=1.00/0.96/0.92/0.80/0.60/0.40
A UFBO.K=TABLE(UFBO,SCJWL.K,0.5,1)
T UFBO=0.20/0.18/0.18/0.18/0.18/0.18
NOTE NOTE FRACTION OF CASES CONVICTED
NOTE NOTE
A FACV.K=(FCCV.K)(1-FCBOI.K-FRCD.K)
A FCCV.K=TABLE(FCCVT,SCJWL.K,0.5,1)
T FCCVT=0.67/0.66/0.64/0.63/0.59/0.53
NOTE NOTE FRACTION OF CONVICTIONS IMPRISONED
NOTE NOTE
A FCVI.K=(UFCl.K)(PDClO.K)
NOTE NOTE PDClO IN SENTENCING SUBSECTOR
A UFCl.K=TABLE(UFClT1,UFClT2,SCJWL.K,0.5,1,DCPBSW)
T UFClT1=0.25/0.21/0.19/0.18/0.17
T UFClT2=0.27/0.21/0.18/0.14/0.12
C DCPBSW=10000
NOTE NOTE APPEALS TO SUPERIOR COURT
NOTE NOTE
R APLS.KL=(ARR.K)(FCA.K)
A FCA.K=(FACV.K)(FCVI.K*FDIA.K+(1-FCVI.K)*FDNIA.K)
A FDIA.K=TABLE(FDIA,PA.K,0.5,1)
T FDIA=0.00/0.55/0.65/0.65/0.90/0.95
A FDNIA.K=TABLE(FDNIA,PA.K,0.5,1)
T FDNIA=0.000/0.025/0.050/0.075/0.100/0.120
A PA.K=(PACC.K)(PAS.K)(EDFAP.K)
NOTE NOTE PRESSURE TO APPEAL FROM SENTENCE
NOTE
PAS.K=TABLE(PAST,DCSR.K,0,2,0.5)
PAST=0.40/0.60/1.00/1.35/2.00
DCSR.K=(RDSS.K/GPSR.K)(1/GPIR.K)/NDCSR
NDCSR=(RDSS/GPSR)(1/GPIR)
RDSS.K=TABLE(RDST1,RDST2,SCJW.L.K,0,5,1,DCP.BSW)
RDST1=0.21/0.16/0.13/0.11/0.10/0.09
RDST2=0.24/0.16/0.11/0.09/0.07/0.06

NOTE
NOTE PRESSURE TO APPEAL FROM
NOTE CASE CONSIDERATION
NOTE

PACC.K=TABLE(PACCT,DCJCR.K,0,2,0.5)
PACCT=0.50/0.75/1.00/1.40/2.00
DCJCR.K=(ARR.K/DCJ.K)/NCPDCJ
N DCJCR=1
N NCPDCJ=ARR/IDCJ
A DCJ.K=CAP(DCJCR.K,DCJCRS.K,DCAT1,DCAT2,
X DCJSAT,IDCJ,DCSW,ADCI,DCINT)
T DCAT1=0.000/0.000/0.000/0.004/0.008/0.015/0.025
T DCAT2=0.000/0.000/0.000/0.004/0.008/0.015/0.025
C DCJSAT=60
C IDCJ=70
C DCSW=10000
C ADCJ=0
C DCINT=10000

-----------------------------------------------
IMPACT OF DEFENSE ATTORNEYS
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EFFECT OF DEFENSE ATTORNEYS
ON TRIALS

EDFT.K=TABLE(EDFTT,DFWL.K,0,5,1)
EDFTT=0.50/1.00/1.15/1.25/1.30/1.32
DFWL.K=(SCB.K/DFAT.K)/NRBDF
N DFWL=1
N NRBDF=SCB/IDF

EFFECT OF DEFENSE ATTORNEYS ON
GUilty PleAS

EDFGP.K=TABLE(EDFSGP,DFWL.K,0,5,0.5)
EDFSGP=0.00/0.70/1.00/1.07/1.15/1.20/
X 1.25/1.27/1.30/1.31/1.32

EFFECT OF DEFENSE ATTORNEYS ON APPEALS
A EDFAP.K=TABLE(EDFAPT,DFWL.K,0.5,0.5)
T EDFAPT=2.00/1.35/1.00/0.90/0.80/0.75/0.70/
X 0.65/0.60/0.57/0.55
NOTE
NOTE DEFENSE ATTORNEYS
NOTE
A DFAT.K=CAP(DFWL.K,DFWLS.K,DFATT1,DFATT2,
X DFSAT,DFS,ADF,DFINT)
T DFATT1=-0.0025/-0.0015/0.000/0.0025/0.010/
X 0.030/0.070
T DFATT2=-0.0025/-0.0015/0.000/0.0025/0.010/
X 0.030/0.070
C DFSAT=120
C IDFS=50
C DFSW=10000
C ADF=0
C DFINT=10000
NOTE
NOTE SENTENCING
NOTE TOTALL OFFENDERS IMPRISONED
NOTE
A TOI.K=DCDI.K+DIPG.K+DIT.K
NOTE DISTRICT COURT DEFENDANTS
NOTE IMPRISONED
NOTE
A DCDI.K=(ARR.K/CPS)(FDIDC.K)
C CPS=1
A FDIDC.K=(FACV.K)(FCV1.K)(1-FDIA.K)
A PDC10.K=TABLE(PDC10T,FPOC.K,0.2,0.5)
T PDC10T=1.30/1.20/1.00/0.80/0.50
NOTE SUPERIOR COURT DEFENDANTS
NOTE IMPRISONED AFTER TRIAL
NOTE
A DIT.K=(SCT.JK/CPS)(CNVR)(FDT1.K)
C CNVR=0.6
A FDT1.K=TABLE(FDT1T1,FDT1T2,FPOC.K,0.2,0.5,MSSW)
T FDT1T1=0.90/0.85/0.60/0.60/0.30
T FDT1T2=1.00/0.95/0.90/0.70/0.40
NOTE SUPERIOR COURT DEFENDANTS
NOTE IMPRISONED AFTER GUILTY PLEAS
NOTE
COURT-IMPOSED SENTENCE

DISTRICT COURT-IMPOSED SENTENCE

SUPERIOR COURT-IMPOSED SENTENCE

\[
\text{DCIS.K} = (\text{RDSS.K})(\text{SCIS.K})
\]

\[
\text{SCIS.K} = (\text{NSCIS.K})(\text{PSPC.K})
\]

\[
\text{NSCIS.K} = 1 \times \text{SCIS} + \text{STEP} (\text{ASCIS}, \text{SCSS})
\]

\[
\text{ASCIS} = 9
\]

\[
\text{SCSS} = 10000
\]

\[
\text{PSPC.K} = \text{TABLE} (\text{PSPCT}, \text{FPOC.K}, 0, 2, 0.5)
\]

\[
\text{PSPCT} = 1.3/1.1/1.0/0.9/0.8
\]

\[
\text{SCISGP.K} = (\text{SCIS.K})(\text{GPSR.K})
\]

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CORRECTIONS SECTOR

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OFFENDERS IMPRISONED

\[
\text{NOI.KL} = (\text{TOI.K})(1 - \text{FXO1.K})
\]

\[
\text{FXO1.K} = \text{TABLE} (\text{FXO1T}, \text{FXO.K}, 0, 1, 0.2)
\]

\[
\text{FXO1T} = 0.00/0.45/0.70/0.90/0.95/1.00
\]

\[
\text{FXO.K} = (\text{CRIKO.K}/\text{CRIME.K})
\]

\[
\text{XO1.KL} = (\text{TO1.K})(\text{FXO1.K})
\]

PRISONERS

\[
\text{PRRL.KL} = \text{PROUT} (\text{NOI.JK}, \text{XO1.JK}, \text{STIN.K}, \text{PRCAP.K}, \text{PRSN.K}, \text{AES.K}, \text{FPOC.K})
\]

\[
\text{STIN.K} = (\text{DIPG.K} \times \text{SCISGP.K}) + (\text{DT.K} \times \text{SCIS.K}) + (\text{DCDI.K} \times \text{DCIS.K})
\]

EX-OFFENDERS AND POTENTIAL NEW OFFENDERS

\[
\text{XO.K} = \text{XO.J} + (\text{DT})(\text{PRRL.JK} + \text{XOTCD.JK} - \text{XO1.JK} - \text{XOA0.JK} - \text{XORCD.JK})
\]

X
N X0=(NOI)(XOLT)
R XOA0.KL=X0.K/XOLT
C XOLT=60
A PNO.K=POP-(LTS)(PRSN.K+NOCD.K+XOCD.K+X0.K)
C POP=5000000
C LTS=1
NOTE PRISON CAPACITY
NOTE
A PRCAP.K=CAP(FPOC.K,FPOCS.K,PRAT1,PRAT1,
X PRSAT,IPRCAP,PRSW,APRCAP,PRINT)
T PRAT1=0/0/0/0/0/0/0/0
C PRSAT=120
C IPRCAP=4000
C PRSW=10000
C APRCAP=0.5
C PRINT=10000
NOTE OFFENDERS IN COURT DIVERSION
NOTE PROGRAM
NOTE
L NOCD.K=NOCD.J+(2T)(NORCD.JK-NOTCD.JK)
N NOCD=0
R NORCD.KL=(CRCD.K/CPS)(1-FXOR.K)
A FXOR.K=TABLE(FXORT,FX0.K,0,1,0.2)
T FXORT=0.00/0.08/0.16/0.28/0.48/1.00
R NOTCD.KL=NOCD.K/PTCD
C PTCD=75
L XOCD.K=XOCD.J+(2T)(XORCD.JK-XOTCD.JK)
N XOCD=0
R XORCD.KL=(CRCD.K/CPS)(FXOR.K)
R XOTCD.KL=XOCD.K/PTCD
NOTE
NOTE
NOTE CONTROL CARDS
NOTE
NOTE
NOTE
NOTE INDICATOR VARIABLES
NOTE
NOTE
A FCRIME.K=CRIME.K/ICRIME
A CKNPL.K=CRIP.K+CRRT.PJK
A FCKNPL,K=CKNPL.K/ICKNPL
N ICKNPL=CRIP+CRRT
A PCLF.K=ARR.K/CKNPL.K
A FCARR.K=ARR.K/IARR
N IARR=ARR
A FTOI.K=TOI.K/ITOI
N ITOI=TOI
A SCTGP.K=SCT.JK+SCGP.JK
A GPIJ.K=(NGPJ)(SCJ.K)-(NGPJ*ISCJ)
A TIJ.K=(NTJD*4)(SCJ.K)+SCGP.JK-(NTJD*4)(ISCJ)
A DJ.K=(NDJ)(SCJ.K)+SCTGP.K-(NDJ)(ISCJ)
A TCI.SC.K=APLS.JK+GJL.JK
A TCPSC.K=SCT.JK+SCCD.JK+SCGP.JK
A FCTSC.K=TCPSC.K/ITCPSC
N ITCPSC=TCPSC
A SCIMP.K=DIPIG.K+DIT.K
A FSCIMP.K=(SCIMP.K)/TCPSC.K
A FCPG.K=SCGP.JK/ITCPSC.K
A FCCN.K=(SCGP.JK+SCT.JK*CNVR)/TCPSC.K
A FCD.K=SCCD.JK/ITCPSC.K
A FCT.K=SCT.JK/ITCPSC.K
A SCDL.K=SCB.K/ITCPSC.K
A FCTPG.K=FCPG.K+FCT.K
A FAI.K=(TOI.K*CPS)/ARR.K
A FCROI.K=(TOI.K*CPS)/CRIME.K

NOTE
NOTE ----------------------------------------------------
NOTE PRINT CARDS
NOTE ----------------------------------------------------
NOTE
NOTE CRIME RATE SECTOR
NOTE PRINT CRIME,CRINO,CRNNO,CRIXO,CRNXO,EDC,PNO,PIR
PRINT PCRIM,ESC,PAES,PAESR,TEST,POI
NOTE
NOTE POLICE SECTOR
NOTE PRINT CRIP,EPPCI,PATR,ECPT,CPATR,PPATR,FPFCP,FPFCP
PRINT PFPCP,PSPT,CPPP,CACR,SCRIM,PPP,W,PCBL,CRRPT
PRINT FCR,PCC,PCUF,PWL,ARR,PCAP,PAWS
NOTE
NOTE COURT SECTOR
NOTE PRINT CRCD,FRCD,GJI,FCBOI,FCNDR,UFBO
PRINT FACV,FCVI,PDCIO,APLS,FCA
PRINT PA,PA,DCSR,DCS,B,DS,B,EDFAP,PA
PRINT DCJCR,DCJ,DCJCRS,SCB,SCT,EDFT,SCS,ISC
PRINT JUF,SCJWLS,SCJ,SCJWLS,PRRT,PRTR,DFRT,DFTR
PRINT SCCD,PDW,SCWL,PRWL,DA,PRWLS,SCGP,ESRGP
C.4 Reruns for Court Management Model

Base Run

NOTE RERUNS FOR CHAPTER 5, COURT MANAGEMENT AND THE MASSACHUSETTS CRIMINAL JUSTICE SYSTEM
NOTE 14 MAR 1976/ VERSION 10.0

NOTE BASE RUN

NOTE FIG 5-2 - SIMULATION OF THE COURT MANAGEMENT MODEL:
BASE RUN - CRIMES, CRIMES KNOWN TO
POLICE, ARRESTS, AND TOTAL OFFENDERS
IMPRISONED

NOTE FCRIME=*, FCKNPL=K, FCARR=A, FTOI=0(0,6)

NOTE FIG 5-4 - SIMULATION OF THE COURT MANAGEMENT MODEL:
BASE RUN - DISPOSITION OF CASES IN
SUPERIOR COURT

NOTE SCGP=G, GPIJ=1, SGTGP=T, TIJ=2, TPSGC=N, DIJ=3(0,800)

NOTE FIG 5-5 - SIMULATION OF COURT MANAGEMENT MODEL:
BASE RUN - CASES ENTERING SUPERIOR COURT

NOTE GJ1=1, TCSG=A(0,800)

NOTE FIG 5-6 - SIMULATION OF COURT MANAGEMENT MODEL:
BASE RUN - SELECTED COURT VARIABLES

NOTE SCDL=Y(0,18)/SCJWL=W, SCWLS=S(0, )/SCJ=J(0,800)

NOTE FIG 5-7 - SIMULATION OF COURT MANAGEMENT MODEL:
BASE RUN - CORRECTIONS SECTOR

NOTE AES=S(0,28)/PRSN=P(0,6000)/XO=0(0,20E3)/PIR=1(0,2)

NOTE NEEDED TABULAR OUTPUT

NOTE C PRTPER=60
PRINT FCRIME, FCKNPL, FCARR, FTOI, SCDL, CRIME, PCAP, SCJ
PRINT TCPSC, GPIJ, TIJ, DIJ, SGTGP, SCGP, SCT, SCCD

NOTE FIG 5-3 - COMPARISON OF BASE, S1, S2, S3

NOTE CP SAVPER=12
CP ACR=0.5
CP PLTPER=0

NOTE S3 - FIXED STANDARDS, EFFECT OF SENTENCE
PSAT=1000000
SCJSAT=1000000
DASAT=1000000
DFSAT=1000000

S3

S1 - FIXED STANDARDS, NO EFFECT OF SENTENCE

PSAT=1000000
SCJSAT=1000000
DASAT=1000000
DFSAT=1000000
ESCT=1/1/1/1/1/1/1/1/1

S1

S2 - VARIABLE STANDARDS, NO EFFECT OF SENTENCE

BASE

ESCT=1.85/1.75/1.60/1.40/1.00/0.80/0.70/0.64/0.60
PLTPER=12
CRIME.S1=1,CRIME.S2=2,CRIME.S3=3,CRIME.BASE=B

BASE

Comparison Runs

RERUNS FOR VALIDATION FIGURES
CHAPTER 5, COURT MANAGEMENT AND THE MASSACHUSETTS CRIMINAL JUSTICE SYSTEM
11 MAR 1976
FIRST RUN
GRAPH PARAMETERS
NOTE
CP LENGTH=192
CP PLTPER=6
NOTE
NOTE FIG 5-7 - CRIMES
NOTE
NOTE FIG 5-8 - DISTRICT COURT
NOTE
NOTE PLOT FCKNPL=K(0,8)/PCLF=F(0,0.24)/ARR=A(0,5000)
NOTE
NOTE FIG 5-9 - SUPERIOR COURT (PANEL 1)
NOTE
NOTE PLOT SCIMP=1,SCT=T,SCCD=D(0,280)/SCGP=G(0,500)
NOTE
NOTE FIG 5-10 - SUPERIOR COURT (PANEL 2)
NOTE
NOTE PLOT FCPG=G,FCTPG=T,FCCN=C,FSCIMP=1(0,1)
NOTE
NOTE FIG 5-12 - CORRECTIONS
NOTE
NOTE PLOT PRSN=P(0,4800)/AES=$(0,20)/TOI=O(0,640)/
X
NOTE
NOTE RUN
NOTE
NOTE SECOND RUN
NOTE
NOTE FIG 5-11 - SUPERIOR COURT (PANEL 3)
NOTE
NOTE C LENGTH=240
NOTE PLOT SCDL=V(0,12)/SCJ=J(0,60)/ISCS=D(0,480)
NOTE
NOTE RUN
NOTE QUIT
Policy Runs (First Set)

NOTE RERUNS FOR CHAPTER 5, COURT MANAGEMENT
NOTE AND THE MASSACHUSETTS CRIMINAL JUSTICE SYSTEM
NOTE POLICY RERUNS
NOTE COMPARATIVE PLOTS FOR POLICY RUNS
NOTE CP SAVPER=12
NOTE CP PLTPER=0
NOTE CP PRTPER=60
NOTE NEEDED VARIABLES FOR PRINTING
NOTE PRINT CRIME,SCDL,PCAP,SCJ,TOI,ARR,PIR,AES
NOTE PRINT PRSN,EDC,EIC,ESC,XOCD,NOCD
NOTE BASE RUN FOR COMPARISONS
NOTE RUN BASE
NOTE FIG 5-14 - SIMULATION OF THE COURT MANAGEMENT MODEL:
NOTE COMPARISON OF CRIMES FOR RUNS
NOTE P1, P2, P3, P4, P5, AND BASE
NOTE P1 - INCREASED POLICE
NOTE C PCSW=192
NOTE RUN P1
NOTE P2 - INCREASED SUPERIOR COURT JUDGES
NOTE C SCJSW=192
NOTE RUN P2
NOTE P3 - INCREASED POLICE AND SUPERIOR
NOTE COURT JUDGES
NOTE C SCJSW=192
NOTE C PCSW=192
NOTE RUN P3
NOTE P4 - NO INCREASE IN POLICE
NOTE
C PCSW=192
C PAT2=0/0/0/0/0/0
RUN P4
NOTE
NOTE P5 - NO INCREASE IN JUDGES
NOTE
C SCJSW=192
T SCAT2=0/0/0/0/0/0
CPL/C
CRIME.P1=1,CRIME.P2=2,CRIME.P3=3,
X CRIME.P4=4,CRIME.P5=5,CRIME.BASE=B(30E3,60E3)
C PLTPER=12
RUN P5
NOTE
NOTE
NOTE FIG 5-16 - SIMULATION OF THE COURT MANAGEMENT MODEL:
NOTE COMPARISON OF CRIMES FOR RUNS P6, P7,
NOTE P8, AND BASE
NOTE
NOTE P6 - INCREASED PLEA BARGAINING IN SUPERIOR
NOTE COURT
NOTE CP PLTPER=0
C SCPBSW=192
RUN P6
NOTE
NOTE P7 - INCREASED PLEA BARGAINING IN DISTRICT
NOTE COURT
NOTE
C DCPBSW=192
RUN P7
NOTE
NOTE P8 - INCREASED PLEA BARGAINING IN SUPERIOR
NOTE COURT, IMPLEMENTED IN MONTH 30
NOTE
C SCPBSW=30
C PLTPER=12
CPL/C
CRIME.P6=6,CRIME.P7=7,CRIME.P8=8,
X CRIME.BASE=B(0,60E3)
RUN P8
NOTE
NOTE
NOTE FIG 5-23 - MANDATORY SENTENCING
NOTE
NOTE P9 - MANDATORY SENTENCING (COMPLETE)
NOTE
CP PLTPER=0
C MSSW=192
C      SCPSW=192
T      GPSRT2=0.72/0.60/0.54/0.48/0.42/0.39
T      GP1RT2=0.98/0.85/0.80/0.77/0.75/0.75
RUN    P9
NOTE   P10 - MANDATORY SENTENCING WITHOUT
NOTE   RESTRICTION ON PAROLE
NOTE   CRIME.P9=9, CRIME.P10=0, CRIME.BASE=B(0,60E3)/
X      PRSN.P9=A, PRSN.P10=B, PRSN.BASE=C(0,6E3)
RUN    P10
NOTE   FIG 2-24 - SIMULATION OF COURT MANAGEMENT MODEL:
NOTE   COMPARISON OF CRIMES FOR RUNS P11
NOTE   AND JASE
NOTE   P11 - INCREASED TRIAL EFFICIENCY
NOTE   CRIME.P11=1, CRIME.BASE=B(0,60E3)
RUN    P11
NOTE   FIG 5-26 - SIMULATION OF COURT MANAGEMENT MODEL:
NOTE   COMPARISON OF CRIMES FOR RUNS P12,
NOTE   P13, P14, AND BASE
NOTE   P12 - COURT DIVERSION PROGRAM (OPTION 1)
NOTE   CPLTTER=0
C      CDSW=192
RUN    P12
NOTE   P13 - COURT DIVERSION PROGRAM (OPTION 2)
NOTE   CDSW=192
C      ECDPC=1
RUN    P13
NOTE   P14 - COURT DIVERSION PROGRAM (OPTION 1),
NOTE   IMPLEMENTED IN MONTH 30
NOTE
C CDSW=30
C PLTPER=12
C PLOT CRIME.P12=2,CRIME.P13=3,CRIME.P14=4,
X CRIME.BASE=B(0,60E3)
RUN P14
QUIT

Test Runs

NOTE
NOTE TYPE 1 TESTS OF STRUCTURE - STEP INCREASE
NOTE IN RESOURCE - CRIMES HELD CONSTANT
NOTE FIG 5-15 - SIMULATION OF THE COURT MANAGEMENT MODEL:
NOTE TESTS FOR INCREASED POLICE AND INCREASED
NOTE SUPERIOR COURT JUDGES (T1 AND T2)
NOTE T1 - INCREASE IN POLICE
NOTE CP SAVPER=0
CP PLTPER=3
CP LENGTH=120
CP DTS=1
CP ACR=0
CP ASCJ=0.5
CP APCAP=0.5
CP APRCAP=0.5
C PCSW=3
PLOT SCJ=J(18.5,55.5)/PCAP=P(5E3,15E3)/PRCAP=C(2E3,6E3)/
X EDC=D,ESC=S,EIC=1,FCARR=A,FTOl=T(0.5,1.5)
RUN T1
NOTE T2 - INCREASE IN SUPERIOR COURT JUDGES
NOTE C SCJSW=3
RUN T2
NOTE FIG 5-27 - SIMULATION OF THE COURT MANAGEMENT MODEL:
NOTE TEST OF INCREASED PRISON CAPACITY (T9)
NOTE
C
PRSw=3
RUN
T9
NOTE
FIG 5-21 - SIMULATION OF THE COURT MANAGEMENT MODEL:
NOTE
TESTS FOR MANDATORY SENTENCING
NOTE
(T5 AND T6)
NOTE
T5 - INCREASE I: FRACTION OF DEFENDANTS
NOTE
TRIED AND IMPRISONED
NOTE
C
ASCJ=0
C
APCAP=0
C
APRCAP=0.5
C
MSSW=3
T
SRPT2=3.00/1.20/1.00/1.00/1.00/0.80/0.00
PLOT
EDC=D,ESC=S,E!C=I,FTOJ=T,FCARR=A(0.8,1.2)/
X
FCPG=G(0,0.8)
RUN
T5
NOTE
T6 - INCREASE I: GUILTY PLEA IMPRISONMENT
NOTE
RATIO
NOTE
C
GPIRT2=0.98/0.85/0.60/0.77/0.75/0.75
C
SCPBSW=3
T
GPSRT2=0.72/0.60/0.54/0.48/0.42/0.39
RUN
T6
NOTE
FIG 5-25 - SIMULATION OF COURT MANAGEMENT MODEL:
NOTE
TEST OF INCREASED TRIAL EFFICIENCY
NOTE
(T8)
NOTE
C
JEFS=3
PLOT
ISCS=1,SCS=S(74,222)/JEFP=P,FTOJ=T,FCTSC**(0.5,1.5)
RUN
T8
NOTE
TYPE 2 TESTS OF MODEL STRUCTURE - STEP INCREASE
NOTE
IN CRIME
NOTE
FIG 5-17 - SIMULATION OF THE COURT MANAGEMENT MODEL:
NOTE
TEST FOR INCREASED PLEA BARGAINING
NOTE
IN SUPERIOR AND DISTRICT COURTS
NOTE
(T3 AND T4)
NOTE
NOTE
BASE RUN
CP
DTS=0
CP
ACR=0.5
TP EICT=1/1/1/1/1/1/1/1
TP ESCT=1/1/1/1/1/1/1/1
CP LTS=0
CP IFX0=0
PLOT CRIME=*(10E3,20E3)/FCARR=A,FTOI=T(1,2)/
X SCJ=J(37,74)/PAESR=S(0,2)
RUN BASE
NOTE T3 - INCREASED PLEA BARGAINING IN SUPERIOR COURT
NOTE T GPIRT1=0.98/0.75/0.60/0.53/0.45/0.38
T GPSRT1=0.84/0.60/0.42/0.33/0.27/0.24
RUN T3
NOTE T4 - INCREASED PLEA BARGAINING IN DISTRICT COURT
NOTE T UFCIT1=0.27/0.21/0.18/0.16/0.14/0.12
T RDSST1=0.24/0.16/0.11/0.09/0.07/0.06
RUN T4
NOTE FIG 5-22 - SIMULATION OF THE COURT MANAGEMENT MODEL: TEST OF RESTRICTION ON PAROLE (T7)
NOTE NOTE BASE RUN
NOTE PLOT FTOI=T(1.0,1.5)/PRSN=P(4E3,6E3)/CRIME=*(10E3,15E3)/
X PIR=1,PAESR=2(0.6,1.4)
RUN BASE
NOTE T7 - RESTRICTION ON PAROLE
NOTE T SRPT1=3.00/2.75/2.00/1.00/1.00/0.80/0.70
RUN QUIT
Policy Runs (Second Set)  
and Sensitivity Runs

NOTE PRISON CAPACITY SIMULATIONS
NOTE FIG 5-28 - SIMULATION OF THE COURT MANAGEMENT MODEL:  
    RUN P15 - CRIME, CRIMES KNOWN TO POLICE,  
    ARRESTS, AND TOTAL OFFENDERS IMPRISONED
    CP SAVPER=12  
    CP PRSW=192  
    C PLTPER=12  
    PLOT FCRIME=*,FCKNPL=K,FCARR=A,FTOI=O(0,6)
NOTE FIG 5-29 - SIMULATION OF THE COURT MANAGEMENT MODEL:  
    RUN P15 - SELECTED COURT VARIABLES
    PLOT SCDL=Y(0,18)/SCJWL=W,SCJWLS=S(0,6)/SCJ=J(0,80)
NOTE FIG 5-30 - SIMULATION OF THE COURT MANAGEMENT MODEL:  
    RUN P15 - CORRECTIONS SECTOR
    PLOT AES=S(0,28)/PRSN=P(0,6E3)/XO=O(0,20E3)/PIR=I(0,2)
    RUN P15
NOTE FIG 5-31 - SIMULATION OF THE COURT MANAGEMENT MODEL:  
    COMPARISON OF RUNS P15, P16, P17, P18,  
    P19, AND BASE
NOTE RUN P16 - 40 PERCENT INCREASE IN PRISONS
    C APRCAP=0.4  
    CP PLTPER=0  
    RUN P16
NOTE RUN P17 - 30 PERCENT INCREASE IN PRISONS
    C APRCAP=0.3  
    RUN P17
NOTE RUN P18 - 20 PERCENT INCREASE IN PRISONS
    C APRCAP=0.2  
    RUN P18
NOTE
NOTE RUN P19 - 10 PERCENT INCREASE IN PRISONS
NOTE
C PLTPER=12
C APRCAP=0.1
C PLOT CRIME.P15=5,CRIME.P16=6,CRIME.P17=7,
X CRIME.P18=8,CRIME.P19=9,CRIME.BASE=B(0,60E3)
RUN P19
NOTE
NOTE FIG 5-32 - SIMULATION OF COURT MANAGEMENT MODEL:
NOTE COMPARISON OF S4, S5, S6, AND S7
NOTE
NOTE RUN S4 - FLATTER ESC RELATION
NOTE
CP ACR=0.4
C PRSW=10000
TP ESCT=1.23/1.15/1.11/1.04/1.00/0.945/
X 0.901/0.85/0.812
CP PLTPER=0
RUN S4
NOTE
NOTE RUN S5 - FLATTER ESC RELATION AND INCREASE
NOTE IN PRISON CAPACITY
NOTE
C PRSW=192
RUN S5
NOTE
NOTE RUN S6 - FLAT ESC RELATION
NOTE
TP ESCT=1/1/1/1/1/1/1/1
RUN S6
NOTE
NOTE RUN S7 - FLAT ESC RELATION WITH
NOTE INCREASE IN PRISON CAPACITY
NOTE
CP PRSW=192
CP PLTPER=12
C PLOT CRIME.S4=4,CRIME.S5=5,CRIME.S6=6,CRIME.S7=7(0,60E3)
RUN S7
NOTE
NOTE FIG 5-33 - SIMULATION ON COURT MANAGEMENT MODEL:
NOTE COMPARISON OF S8, S9, AND S10
NOTE
NOTE RUN S8 - EXOGENOUS INCREASE IN CRIME
NOTE NO DETERRENCE
NOTE
CP PLTPER=0
CP ACR=0
CP
GRC=0.005
T
ESCT=1/1/1/1/1/1/1/1/1/1/1/1
T
EICT=1/1/1/1/1/1/1/1/1/1/1/1
RUN
S8
NOTE
NOTE
RUN S9 - EXOGENOUS INCREASE IN CRIME,
NOTE
SOME EFFECT OF DETERRENCE
NOTE
TP
ESCT=1.23/1.15/1.11/1.04/1.00/0.945/0.901/
X
0.85/0.812
TP
EICT=1.51/1.35/1.23/1.11/1.00/0.0901/
X
0.812/0.72/0.66
RUN
S9
NOTE
NOTE
RUN S10 - EXOGENOUS INCREASE IN CRIME,
NOTE
SOME EFFECT OF DETERRENCE
NOTE
C
PLTPER=12
C
PRSW=192
C
PLOT
CRIME.S8=8,CRIME.S9=9,CRIME.S10=0(0,60E3)
RUN
S10
QUIT
### C.5 Variable Definitions

<table>
<thead>
<tr>
<th>NAME</th>
<th>DEFINITION</th>
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<tr>
<td>ACAP</td>
<td>ADDITION TO CAPACITY (DIMENSIONLESS)</td>
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<td>ADDITION TO CRIME RATE (DIMENSIONLESS)</td>
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<td>COURT DIVERSION PROGRAM SWITCH (MONTHS)</td>
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<td>CHANGE IN POLICE PATROL RATIO</td>
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CPPP  COMMUNITY PRESSURE FOR POLICE PATROL
        (DIMENSIONLESS)
CPPPT COMMUNITY PRESSURE FOR POLICE PATROL TABLE
CPS  CASES PER SUSPECT (CASES/PERSON)
CRCR  CASES REFERRED TO COURT DIVERSION PROGRAM
        (CASES/MONTH)
CRIME  CRIMES (CASES/MONTH)
CRINC  CRIMES BY NEW OFFENDERS IN COURT DIVERSION
        PROGRAM (CASES/MONTH)
CRINO  CRIMES BY NEW OFFENDERS (CASES/MONTH)
CRIP  CRIMES INTERCEPTED BY POLICE (CASES/MONTH)
CRICX  CRIMES BY EX-OFFENDERS IN COURT DIVERSION
        PROGRAM (CASES/MONTH)
CRIXO  CRIMES BY EX-OFFENDERS (CASES/MONTH)
CRINO  CRIME RATE FOR POTENTIAL NEW OFFENDERS
        (CASES/PERSON-MONTHS)
CRIXO  CRIME RATE NORMAL FOR EX-OFFENDERS (CASES/
        PERSON-MONTH)
CRRPT  CRIMES REPORTED (CASES/MONTHS)
CRS  CRIME RATE SWITCH (MONTHS)
CSAT  CRIME STANDARD ADJUSTMENT TIME (MONTHS)
CTABLE  CHECK TABLE FUNCTION
CUF  CAPACITY UTILIZATION FACTOR (DIMENSIONLESS)
CUFT  CAPACITY UTILIZATION FACTOR TABLE
CWLS  CHANGE IN WORKLOAD STANDARD (1/MONTH)
DA  DISTRICT ATTORNEYS (PERSONS)
DAINT  DISTRICT ATTORNEY INTERVAL (MONTHS)
DASAT  DISTRICT ATTORNEY STANDARD ADJUSTMENT TIME
        (MONTHS)
DASH  DISTRICT ATTORNEY SWITCH (MONTHS)
DAT1  DISTRICT ATTORNEY ADJUSTMENT TABLE (BASE)
DAT2  DISTRICT ATTORNEY ADJUSTMENT TABLE
        (REVISED)
DCAT1  DISTRICT COURT JUDGE ADJUSTMENT TABLE
        (BASE)
DCAT2  DISTRICT COURT JUDGE ADJUSTMENT TABLE
        (REVISED)
DCDI  DISTRICT COURT DEFENDANTS IMPRISONED
        (PERSONS/MONTH)
DCINT  DISTRICT COURT JUDGE INTERVAL (MONTHS)
DCIS  DISTRICT COURT IMPOSED SENTENCE (MONTHS)
DCJ  DISTRICT COURT JUDGES (PERSONS)
DCJCR  DISTRICT COURT JUDICIAL CASE RATIO
        (DIMENSIONLESS)
DCJCRS  DISTRICT COURT JUDICIAL CASE RATIO STANDARD
        (DIMENSIONLESS)
DCJSAT  DISTRICT COURT JUDICIAL STANDARD ADJUSTMENT
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EICT  EFFECT OF IMPRISONMENT ON CRIME TABLE
EPCST EFFECT OF PRISON CAPACITY ON SENTENCE TABLE
EPPCI EFFECT OF POLICE PATROL ON CRIMES
          INTERCEPTED (DIMENSIONLESS)
EPPCIT EFFECT OF POLICE PATROL ON CRIMES
          INTERCEPTED TABLE
ESC  EFFECT OF SENTENCE ON CRIME (DIMENSIONLESS)
ESCT EFFECT OF SENTENCE ON CRIME TABLE
ESRGP EFFECT OF SENTENCE RATIO ON GUILTY PLEAS
          (DIMENSIONLESS)
ESRGPT EFFECT OF SENTENCE RATIO ON GUILTY PLEAS
          TABLE
FACV FRACTION OF ARRESTS CONVICTED IN DISTRICT
          COURT (DIMENSIONLESS)
FAI FRACTION OF ARRESTS IMPRISONED
          (DIMENSIONLESS)
FARR FRACTION OF CASES RESULTING IN ARREST
          (DIMENSIONLESS)
FARRT FRACTION OF CASES RESULTING IN ARREST TABLE
FCA FRACTION OF CASES APPEALED (DIMENSIONLESS)
FCARR FRACTIONAL CHANGE IN ARRESTS
          (DIMENSIONLESS)
FCBOI FRACTION OF CASES BOUND OVER AND INDICTED
          (DIMENSIONLESS)
FCCN FRACTION OF CASES CONVICTED (IN SUPERIOR
          COURT) (DIMENSIONLESS)
FCCV FRACTION OF CASES CONVICTED (IN DISTRICT
          COURT) (DIMENSIONLESS)
FCCVT FRACTION OF CASES CONVICTED (IN DISTRICT
          COURT) (DIMENSIONLESS)
FCD FRACTION OF CASES DISMISSED (DIMENSIONLESS)
FCKNPL FRACTIONAL CHANGE IN CASES KNOWN TO POLICE
FCNDR FRACTION OF CASES NOT DIVERTED SUBJECT TO
          REFERRAL TO GRAND JURY (DIMENSIONLESS)
FCNDRT FRACTION OF CASES NOT DIVERTED REFERRED TO
          GRAND JURY TABLE
FCPG FRACTION OF CASES PLEADING GUILTY
          (DIMENSIONLESS)
FCR FRACTION OF CRIMES REPORTED (DIMENSIONLESS)
FCRCD FRACTION OF CASES REFERRED TO COURT
          DIVISION PROGRAM (DIMENSIONLESS)
FCRIME FRACTIONAL CHANGE IN CRIME (DIMENSIONLESS)
FCRIP FRACTION OF CRIMES INTERCEPTED
          (DIMENSIONLESS)
FCRUI FRACTION OF CRIMES RESULTING IN OFFENDER
          IMPRISONED (DIMENSIONLESS)
FCRIT FRACTION OF CRIMES REPORTED TABLE
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<td>Initial defense attorneys (persons)</td>
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<td>Normal Ratio of Backlog to Defense Attorneys (Cases/Person)</td>
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| NRBJ         | Normal Ratio of Backlog to Judges (Cases/
PDW  PRESSURE ON DISMISSEALS FROM WORKLOAD
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PDWT PRESSURE ON DISMISSEALS FROM WORKLOAD TABLE
PFPCP PRESSURE ON FRACTION OF POLICE CAPACITY ON
       PATROL (DIMENSIONLESS)
PIM POLICE INVESTIGATION MANPOWER (PERSONS)
PIR PERCEIVED IMPRISONMENT RATIO
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PIW PRESSURE ON IMPRISONMENT FROM WORKLOAD
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PIWT PRESSURE ON IMPRISONMENT FROM WORKLOAD
       TABLE
PLTPER PLOT PERIOD (MONTHS)
PNO POTENTIAL NEW OFFENDERS (PERSONS)
POI PERCEIVED OFFENDERS IMPRISONED (PERSONS/MONTH)
POP POPULATION (PERSONS)
PPAF POLICE PATROL ADJUSTMENT FRACTION (1/MONTH)
PPATR PERCEIVED POLICE PATROL RATIO
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PPM POLICE PATROL MANPOWER (PERSONS)
PPPW PRESSURE ON POLICE PATROL FROM WORKLOAD
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PRINT PRISON INTERVAL (MONTHS)
PRLAT PAROLE ADJUSTMENT TIME (MONTHS)
PROUT PRISONERS OUT (PERSONS/MONTH)
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PRRT PROSECUTOR RESTRICTION ON TRIALS
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PRRTT PROSECUTOR RESTRICTION ON TRIALS TABLE
PRSAT PRISON STANDARD ADJUSTMENT TIME (MONTHS)
PRSN PRISONERS (PERSONS)
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PTRPER PRINT PERIOD (MONTHS)
PRTR PROSECUTOR TRIAL RATIO (DIMENSIONLESS)
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PSAT POLICE STANDARD ADJUSTMENT TIME (MONTHS)
PSPC PRESSURE ON SENTENCE FROM PRISON CROWDING
       (DIMENSIONLESS)
PSPCT PRESSURE ON SENTENCE FROM PRISON CROWDING
       TABLE
PSPT PRESSURE FROM STANDARD PATROL
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PSPTT  PRESSURE FROM STANDARD PATROL TABLE
PSW   PRESSURE ON SENTENCE FROM WORKLOAD
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PTCD  PERIOD OF TIME IN COURT DIVERSION PROGRAM
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PULSE PULSE FUNCTION
PWF   PROSECUTOR WEIGHTING FACTOR (DIMENSIONLESS)
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RDSS  RATIO OF DISTRICT COURT SENTENCE TO
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RDSST1 RATIO OF DISTRICT COURT SENTENCE TO
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RDSST2 RATIO OF DISTRICT COURT SENTENCE TO
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SAT   STANDARD ADJUSTMENT TIME (MONTHS)
SCAT1 SUPERIOR COURT JUDGE ADJUSTMENT TABLE
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SCAT2 SUPERIOR COURT JUDGE ADJUSTMENT TABLE
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SCB   SUPERIOR COURT BACKLOG (CASES)
SCCD  SUPERIOR COURT CASES DISMISSED (CASES/MONTH)
SCDL  SUPERIOR COURT DELAY (MONTHS)
SCGP  SUPERIOR COURT GUILTY PLEAS (CASES/MONTHS)
SCIMP SUPERIOR COURT DEFENDANTS IMPRISONED
       (PERSONS/MONTH)
SCIS  SUPERIOR COURT IMPOSED SENTENCE (MONTHS)
SCISGP SUPERIOR COURT IMPOSED SENTENCE FOR GUILTY
       PLEA (MONTHS)
SCJ   SUPERIOR COURT JUDGES (PERSONS)
SCJINT SUPERIOR COURT JUDICIAL INTERVAL (MONTHS)
SCJSAT SUPERIOR COURT JUDICIAL STANDARD ADJUSTMENT
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SCJSW SUPERIOR COURT JUDICIAL SWITCH (MONTHS)
SCJWL  SUPERIOR COURT JUDICIAL WORKLOAD
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SCJWLS SUPERIOR COURT JUDICIAL WORKLOAD STANDARD
       (DIMENSIONLESS)
SCPBSW SUPERIOR COURT PLEA BARGAINING SWITCH
SCRIM STANDARD OF CRIME (DIMENSIONLESS)
SCS SUPERIOR COURT SESSION (PERSON-DAYS/MONTH)
SCSS SUPERIOR COURT SENTENCE SWITCH (MONTHS)
SCT  SUPERIOR COURT TRIALS (CASES/MONTH)
SCTGP SUPERIOR COURT TRIALS AND GUILTY PLEAS
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VITAE

PREVIOUS EDUCATION:

Princeton University: A.B., Economics (High Honors), 1968

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