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MEDIAC

An On-Line Media Selection System

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M.I.T.

MEDIAC is a computerized system to aid media planners in selecting advertising media. MEDIAC differs from most other media selection systems in the following ways: (1) The advertising effectiveness process is treated in greater detail. (2) The system is on-line; i.e., communication with the computer is a continuous question-and-answer process and the computer is available to the user at any time through a teletype terminal in the user's office. (3) The computations are fast, so that the system is economical to use.

Out talk will be divided into four parts: (1) a brief history of computer media selection, (2) design specification for a selection system, (3) a description of MEDIAC, and (4) a demonstration.

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* * *

The term "model" or "mathematical model" comes up several times below and so here is a short definition: a model is a mathematical (rather than verbal) description of how something works. For our purposes, the description must be sufficiently detailed that a person can put in data and get out predicted effects. Thus a media model describes media processes in such a way that input decisions can be explicitly related to output results.

History The problem of preparing a media schedule is a natural one for the application of models and computers. The decisions of what media to use and when to use them are very explicit. There are many such decisions. Considerable data are involved. A great deal of arithmetic often goes into the process. Finally, the relevant factors are interrelated in complex ways.

The first major media model in this country was "Mediametrics," a joint effort by BBDO and the computing firm CEIR. A description can be found in Buzzell [2]. This model deserves great credit as a pioneering effort, but has a number of disadvantages. In particular the model, as demonstrated in examples, is linear. This means that increasing advertising exposure brings no diminishing returns. This in turn tends to produce a schedule with certain kinds of distortions.

Since the appearance of Mediametrics, a variety of other models have been proposed. Day [3], Engel and Warshaw [4] and Bass and Lonsdale [5] discuss linear programming approaches very similar to Mediametrics. Brown and Warshaw [6] bring in diminishing returns but in a way that is not too satisfactory. These models have certain other problems too: time is not taken into account, nor is consumer forgetting, and market segmentation is not handled very well.

There has been some rather interesting work in England. Lee and Burkart [7], Taylor [8], and Lee [9,10] have developed models oriented toward print media. These models require less input data then most models in the U.S. This is achieved by making certain specific assumptions. In some cases easily applied rules for optimal media selection have been worked out mathematically.

Simulation has become popular. The word is used differently by different people; in a sense our model involves simulation. However, we shall here use simulation, (or better, microsimulation) to refer to models which treat the individuals in a population one at a time. The models of Gensch [11] and Brown [12] are simulations in this sense and that of Beale, Hughes and Broadbent [13] more or less so. Microsimulation is a versatile tool, and the models mentioned include quite a few advertising phenomena. However, they leave others out, notably the process of consumer forgetting. Simulation tends to require considerable computer time if adequate sample sizes are used, and sometimes much of the computational effort is expended on effects not really important to the problem.

There have also been a number of unpublished or incompletely published models. As far as can be determined, many of these tend to resemble some of the models mentioned above.

We feel we have resolved a number of important difficulties inherent in previous models. A first version of our model has been published in [1] and a revised version is in process.

Design Specification: Let us turn to the question of what should be included in a computer assisted media selection system. We ask:

(1) What are the expected sources of payoff?

(2) What phenomena should be in the model?

(3) What capabilities should a system have?

(4) What type of man-computer interaction should take place?

Sources of Payoff: The principal reasons to expect that the computer can enable people to prepare better media schedules are:

- Computers are enthusiastic clerks. They can evaluate many more alternatives within reasonable time and cost limits than can people.
- A computer can handle complexity with ease, e.g., local media mixed with national media across several market segments would cause no difficulty.
- A model permits the joining of field data and expert judgment in a single unifying structure. With such a structure, the alternatives can be evaluated quickly, consistently, and cheaply.
- A model provides a structure for thinking about the problem and sets up explicit requirements for data and judgments. The requirements are laid out in manageable pieces.
- The use of models and computers seems certain to stimulate better media data by setting up requirements for it.

Phenomena to include in a model: The steps in setting up an advertising campaign include: identifying the audience, picking the message, preparing the copy treatment, and selecting the media. The steps are not independent, but once the audience has been specified,

the questions of message and copy can be separated reasonably well from the media question: how to expose the audience to our advertising efficiently. This is our focus. (It would be possible, however, to bring certain types of copy effects into our model, if appropriate data were available.)

An adequate media model should include at least the following phenomena:

- market segmentation
- sales potential of individual segments
- media coverage differences in each segment
- media overlaps, both across media and across time
- forgetting by consumers
- diminishing returns at high exposure rates
- differing media costs
- intermedia differences in the value of an exposure
- seasonality in sales potential and media audiences

System capabilities: The system must be able to:

- evaluate a given media schedule
- improve or optimize a schedule, i.e., start with a large number of media alternatives and construct a schedule that is good or optimal in terms of the criteria of the model.

Man-computer interaction: To have a really effective system, the interaction between man and computer should meet the following requirements:

- immediate access to the computer
- English language communication

- self-instructing computer programs
- low cost per problem solved
- no elaborate computer overhead in personnel, space, or cost.

These requirements are attainable in modern time-shared computer systems. "Time-sharing" involves many simultaneous users of a central computer; the users communicating with the central computer via small remote terminals, such as teletype machines.

Description of the Model: A verbal description of how the model works will now be given. It is not difficult to explain the mathematical details by tracing through a sample calculation, but that would require more time than we have today.

First, it is supposed that market segments have been defined. Perhaps men and women have different sales potential and therefore are represented as different segments. In addition, perhaps these are each broken down further into geographic regions and income classes. In an industrial application the market segments might be defined by SIC codes.

Second, an advertising insertion in a given medium creates a probability of exposure for a person in a specified market segment. The probability of exposure depends on the audience of the medium within the segment, and on the size, length, color, or other characteristics of the insertion. (Exposure to a medium is not independent of exposure to other media or to the same medium at another time, but depends on media overlap probabilities.)

Third, the advertising exposure creates value in the people exposed, i.e., disposes them more toward buying the product. The amount of value

created by one exposure depends on the medium and is called the exposure value of the medium.

Fourth, people forget. It is assumed that people forget a constant percentage of their current exposure level in each time period. Figure 1 shows how the average exposure level of an individual might change with time:

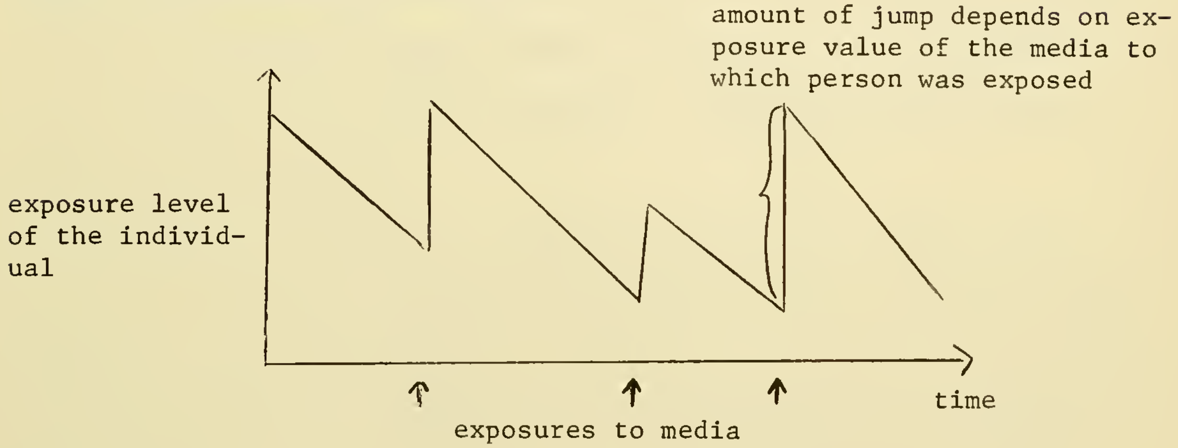

Figure 1. Exposure level as it might vary over time for a specific individual.

Finally, people act. As the exposure level in a market segment rises, so does the anticipated response, but it does so with diminishing returns. The relationship might be shown in Figure 2.

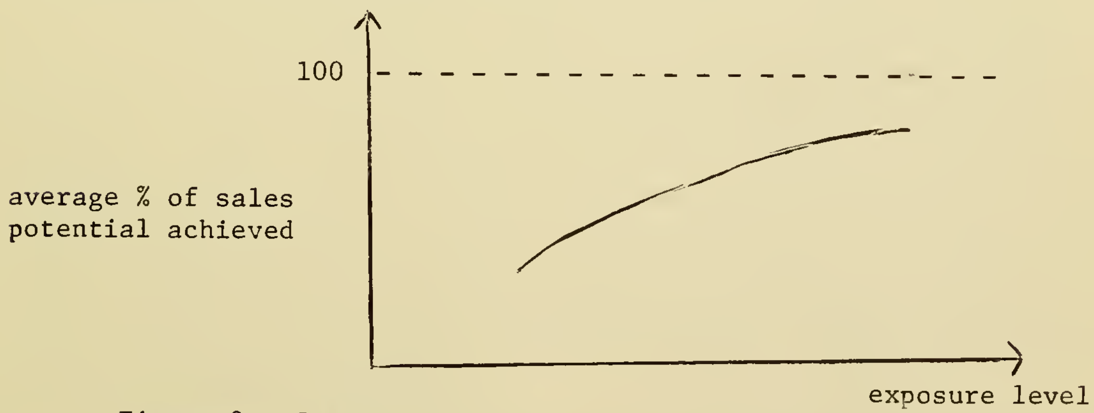

Figure 2. Customer Response.

The anticipated impact in a time period is the sales potential of each market segment times the percent of potential achieved in that segment summed over all segments.

To summarize: advertising insertions in media generate exposures in the market segments. Exposures have value and raise the exposure level of people in the segments, although this will decrease with time because of forgetting unless further exposures occur. The exposure level generates an anticipated response. Diminishing returns occur at high exposure levels.

Schedule improvement is an integral part of the MEDIAC system. In [1] we describe an optimization procedure based on the mathematical technique of dynamic programming. This works well for one market segment but is very time consuming for multiple segments. Accordingly, MEDIAC currently employs schedule improvement methods of the type generally called heuristic programming. These generate schedules that are good, possibly optimal, but not always guaranteed to be optimal.

<u>Demonstration</u>: A sample media selection problem is worked out in detail below using the MEDIAC interactive computer systems. The example involves 4 media, 8 time periods, and 2 market segments. Much more complex problems can, of course, be handled. For example, we have solved one with 11 media, 12 time periods, and 20 market segments, and substantially larger problems are feasible. Although the example below is set up for a consumer product, it could as well have been an industrial product.

In the transcript of the interactive computer session below, all lines with a → in front were typed in by the decision maker; the rest

of the transcript was typed by the computer. Note that the computer asks for the data it needs in English. Once data is typed in, the user then has the option of changing any data he typed in, evaluating a schedule which he has constructed in terms of its expected effects and costs, or having the computer find a good allocation for him. The small type on the right presents comments typed in after to help explain the system.

A summary of all input data is given in Table 1. The data are completely hypothetical and have no relation to any specific problem we have solved. The purpose of the example is to show what data the MEDIAC system needs in order to construct a media allocation.

The detailed definition of the data categories found in Table 1 may be found in Annex 1.

PRODUCT: "MINI-WIDGETS"

Budget: $350,000

Time periods: 8 weeks

Media Alternatives (4):	60 sec. TV Program A	60 sec. TV Program B	4 color page Magazine A	4 color page Magazine B
Cost/insertion	$25,000	$45,000	$26,000	$10,000
Exposure probability for audience member	.9	.9	.7	.4
Exposure value	2.0	2.5	1.5	.75

Upper bounds: 1 insertion/period for each media alternative
Audience seasonality: none

Market Segments (2):	Men over 20	Women over 20
Population	45,000,000	50,000,000
Sales potential ($/person/week)	.05	.14
Seasonality	none	none
Initial exposure value	0	0

Memory constant: .6

% Potential Realized:	
at saturation	15
1 average exposure	6
2 average exposures	9
3 average exposures	11

Market Coverage:

	Men	Women
TV A	.01	.20
TV B	.25	.18
Mag A	.35	.20
Mag B	.01	.17

Media Vehicle Duplication:

	TV A	TV B	Mag A	Mag B
TV A	.060	.020	.030	.015
TV B	.020	.110	.070	.025
Mag A	.030	.070	.150	.035
Mag B	.015	.025	.035	.050

Table 1. Data for Sample Problem

Begin data bank generating program

```
LOAD FILE: /PINP/

READY
RUN
TYPE NO. OF DOLLARS IN BUDGET,F9.
35[illegible].,
TYPE THE NO. OF TIME PERS,I3
5,
TYPE NO. OF MKT SEGMENTS,I3
2,
TYPE NO. OF MEDIA,I4
4,
TYPE THE PERCENT OF POTENTIAL REALIZED
AFTER COMPLETE SATURATION WITH EXPOSURES,F4
15.,
TYPE PERCENT OF POTENTIAL REALIZED
 AFTER  1AVERAGE EXPOSURES/CAPITA,F4.
5.,
TYPE PERCENT OF POTENTIAL REALIZED
 AFTER  2AVERAGE EXPOSURES/CAPITA,F4.
9.,11?
TYPE PERCENT OF POTENTIAL REALIZED
 AFTER  3AVERAGE EXPOSURES/CAPITA,F4.
11.,
TYPE NAME OF MKT SEG     1 A6
MEN029
TYPE NO. OF PEOPLE,POTENTIAL FOR SEGMENT MEN029F9.
45000.,.05,
TYPE NAME OF MKT SEG     2 A6
WOM029
TYPE NO. OF PEOPLE,POTENTIAL FOR SEGMENT WOM029F9.
53013.,.14,
 TYPE MEMORY CONSTANT,F4.
.5,
TYPE NAME OF MEDIA     1 A6
ATELEV
TYPE EXPOSURE VALUE,PROB. OF EXPOSURE,2F3.,OF ATELEV
2.,.9,
TYPE NAME OF MEDIA     2 A6
BTELEV
TYPE EXPOSURE VALUE,PROB. OF EXPOSURE,2F3.,OF BTELEV
2.5,.9,
TYPE NAME OF MEDIA     3 A6
AMAGAZ
TYPE EXPOSURE VALUE,PROB. OF EXPOSURE,2F3.,OF AMAGAZ
1.5,.7,
TYPE NAME OF MEDIA     4 A6
BMAGAZ
TYPE EXPOSURE VALUE,PROB. OF EXPOSURE,2F3.,OF BMAGAZ
.75,.4,
IF THERE IS NO MEDIA SEASONALITY,TYPE 1,OTHERWISE 2
1,
IF SEG. COVER. OF MOST MEDIA IS 4.,TYPE 1,ELSE2
2,
TYPE MKT. SEG. COVERAGE OF ATELEV SEGMENTS
MEN0WOM0
.444.444
.114.231
TYPE MKT. SEG. COVERAGE OF BTELEV SEGMENTS
```

The computer asks for all data needed. The F, I, and A letters refer to input format.

The "11" was a mistake and was easily corrected by typing "?" This erased everything back to the comma.

```
→ .251.141
  TYPE MKT. SEG. COVERAGE OF AMAGAZ SEGMENTS
  MEND4MEND
  .XXX.XXX
→ .351.204
  TYPE MKT. SEG. COVERAGE OF BMAGAZ SEGMENTS
  MEND4MEND
  .XXX.XXX
→ .311.179
  TYPE COST PER INSERT F6. FOR  ATELEV
→ 25199.,
  TYPE COST PER INSERT F6. FOR  BTELEV
→ 45049.,
  TYPE COST PER INSERT F6. FOR  AMAGAZ
→ 26199.,
  TYPE COST PER INSERT F6. FOR  BMAGAZ
→ 10000.,
  TYPE NO OF SEGS WITH SEASONAL POTENTIAL
→ 0,
  TYPE NO. OF CASES(PERIODS*MEDIA) WITH
  UPPER BOUNDS NOT EQUAL TO ONE
→ 4,
  TYPE1 IF DUPLS ARE AVAI, 2MEANS INDEPENDENC
  1,
  TYPE DUPLICATIONS OF ATELEV WITH
  ATELBTELAMAGBMAG
  .XXX.XXX.XXX.XXX
  .067.029.039.015
  TYPE DUPLICATIONS OF BTELEV WITH
  BTELAMAGBMAG
  .XXX.XXX.XXX
  .110.073.025
  TYPE DUPLICATIONS OF AMAGAZ WITH
  AMAGBMAG
  .XXX.XXX
  .154.035
  TYPE DUPLICATIONS OF BMAGAZ WITH
  BMAG
  .XXX
  .054
```

The data bank for this problem is now created

```
STOP

+
+
0

XFOS

LOAD FROM: /MEDIAC2/
```

The user asks for the MEDIAC 2 media selection program which uses data from the data bank

```
LOAD SUBPROGRAMS FROM: "XFLI"

READY
SPACE AVAILABLE --> 45 WORDS
+GO
 TYPE 1 IF DATA CHANGE WANTED, OTHERWISE 2
2,
TYPE 1 TO DO SELECTION,2 TO DO EVALUATION,3 TO END PROG
1,
TYPE INITIAL EXPOSURES/CAP. IN SEGMENTMEND01 F4.
.0,
```

```
TYPE INITIAL EXPOSURES/CAP. IN SEGMENTWOM020 F4.
.1,
TYPE 1 IF SOME MEDIA HAVE ALREADY BEENSTSELECTED
2,
```

If some media must be in schedule, they are added here

```
1 INSERT IN ATELEV TIME PER  1 COST   25000.REALIZED POT.    331.
1 INSERT IN ATELEV TIME PER  4 COST   50000.REALIZED POT.    554.
1 INSERT IN ATELEV TIME PER  7 COST   75000.REALIZED POT.    734.
1 INSERT IN AMAGAZ TIME PER  3 COST  101000.REALIZED POT.   1167.
1 INSERT IN AMAGAZ TIME PER  5 COST  127000.REALIZED POT.   1449.
1 INSERT IN AMAGAZ TIME PER  2 COST  153000.REALIZED POT.   1742.
1 INSERT IN AMAGAZ TIME PER  1 COST  179000.REALIZED POT.   2016.
1 INSERT IN AMAGAZ TIME PER  4 COST  205000.REALIZED POT.   2277.
1 INSERT IN AMAGAZ TIME PER  7 COST  231000.REALIZED POT.   2543.
1 INSERT IN ATELEV TIME PER  8 COST  256000.REALIZED POT.   2632.
1 INSERT IN BTELEV TIME PER  3 COST  301000.REALIZED POT.   2983.
1 INSERT IN BTELEV TIME PER  1 COST  346000.REALIZED POT.   3492.
1 INSERT IN BTELEV TIME PER  4 COST  391000.REALIZED POT.   3794.
TYPE1 FOR DETAILED OUTPUT,ELSE2
,
```

The MEDIAC 2 system has selected the above schedule. The user also wants to see a detailed output of the expected effects of the selected schedule in each segment.

```
SEGMENT TIME P EX VAL/CP  REALIZED POTENTIAL
 MEN020     1    .94300       91.
 MEN020     2    .93630       95.
 MEN020     3    .56173       67.
 MEN020     4   1.23547      123.
 MEN020     5   1.13354      116.
 MEN020     6    .38312       32.
 MEN020     7    .79537       39.
 MEN020     8   1.42522      131.
 MEN020     9    .85513       94.
 MEN020    10    .51303       66.
 WOM020     1    .97500      296.
 WOM020     2    .79500      255.
 WOM020     3    .47700      133.
 WOM020     4   1.26120      336.
 WOM020     5    .96672      323.
 WOM020     6    .53403      226.
 WOM020     7    .91302      315.
 WOM020     8   1.52531      432.
 WOM020     9    .91549      313.
 WOM020    10    .54929      226.
TYPE 1 IF DATA CHANGE WANTED,OTHERWISE 2
,
TYPE 1 FOR COST,2 EXPOSURE VAL.,3 MKT SEG COVERAGE
4 FOR MEMORY,5 POTENTIAL,6 UP POS,7 MEDIA SEASONALS
8 RESPONSE,9 BUDGET,10 POTENTIAL SEASONALS,11 DUPLIC.
2,
TYPE THE NUMBER OF CHANGES
,
  TYPE MEDIA NUMBER AND EXPOSURE VALUE,I2,F3.
,1.7,
ATELEV FACTOR NOW IS   1.70
IF MORE CHANGES TYPE1,ELSE2
2,
TYPE 1 TO DO SELECTION,2 TO DO EVALUATION,3 TO END PROG
,
TYPE INITIAL EXPOSURES/CAP. IN SEGMENTMEN020 F4.
.1,
TYPE INITIAL EXPOSURES/CAP. IN SEGMENTWOM020 F4.
.1,
TYPE 1 IF SOME MEDIA HAVE ALREADY BEENSTSELECTED
2,
```

The user wishes to change the exposure value of "ATELEV" to 1.70 from 2.00

Computer confirms the change

The user asks for a redo of the media selection

```
1 INSERT IN AMAGAZ TIME PER  1 COST    26000.REALIZED POT.      321.
1 INSERT IN AMAGAZ TIME PER  4 COST    52000.REALIZED POT.      634.
1 INSERT IN AMAGAZ TIME PER  7 COST    78000.REALIZED POT.      907.
1 INSERT IN ATELEV TIME PER  3 COST   103000.REALIZED POT.     1120.
1 INSERT IN ATELEV TIME PER  5 COST   128000.REALIZED POT.     1368.
1 INSERT IN ATELEV TIME PER  2 COST   153000.REALIZED POT.     1625.
1 INSERT IN AMAGAZ TIME PER  3 COST   179000.REALIZED POT.     1836.
1 INSERT IN AMAGAZ TIME PER  5 COST   205000.REALIZED POT.     2094.
1 INSERT IN AMAGAZ TIME PER  2 COST   231000.REALIZED POT.     2340.
1 INSERT IN BTELEV TIME PER  8 COST   276000.REALIZED POT.     2551.
1 INSERT IN BTELEV TIME PER  5 COST   321000.REALIZED POT.     3023.
1 INSERT IN BTELEV TIME PER  1 COST   366000.REALIZED POT.     3423.
 TYPE1 FOR DETAILED OUTPUT,ELSE2
2,
 TYPE 1 IF DATA CHANGE WANTED,OTHERWISE 2
2,
TYPE 1 TO DO SELECTION,2 TO DO EVALUATION,3 TO END PROG
3,

STOP
```

The selection has changed slightly showing some sensitivity to the exposure value of "ATELEV"

Annex I

MEDIAC II INPUT

I. Media Characteristics: Data Needed for Each Media Alternative. (Examples of media alternatives are a one page black and white bleed ad in SPORTS ILLUSTRATED, a one minute spot on BONANZA, etc. A media vehicle would be the magazine SPORTS ILLUSTRATED, or the show BONANZA).

1. The alternative's name.
2. Cost per insertion of the alternative.
3. Exposure probability for audience member. The probability a person is exposed to the particular ad in the vehicle given that he is in the audience of the vehicle, (e.g., the probability that a reader of SPORTS ILLUSTRATED will see the one page black and white bleed ad).
4. Upper bounds on insertions. The maximum number of times the ad could be run in the media vehicle in each time period.
5. Audience seasonality. The audience size for each time period for the media vehicle, expressed as an index with an average value of 1.0. If audience size is not seasonal, no data need be supplied.
6. Exposure value. The value of an exposure may differ from one media alternative to another. Exposure value answers the question: Given the choice of a person seeing an ad in LIFE or the same person seeing it in LOOK, does the advertiser have any preference, and, if so what is the statement of that preference? In the same manner, intermedia exposure values are also rated,

e.g., an exposure to a 30-second radio spot is to be rated on the same scale as an exposure to a half page newspaper ad. The units for exposure value are arbitrary except that they must be tied to a response function. It is best to conceive of an average media alternative and assign it a value of 1.0 and then assign values for other media alternatives relative to it.

II. Market Characteristics: Data needed for each market segment.

1. Segment name.
2. Population of the segment.
3. Sales potential per person in the segment. The units in which sales potential is measured are chosen by the user.
4. Seasonality of sales potential. This is an index with a value for each time period in the advertising plan plus two time periods for ending effects. The average value over a full year is 1.00. If potential is not seasonal, no data need be supplied.
5. Initial average exposure value per person in the segment. As a substitute for this data, a list of the media insertions planned for two months before the computer generated schedule is to start will suffice; e.g., if the MEDIAC system is to plan insertions for January through December of 1968, then the planned insertions for November and December of 1967 can be used to establish initial conditions in each segment.

III. Media - Segment Data

1. Market coverage. For each media vehicle in each segment, the fraction of the segment population who will be in the audience

of the media vehicle. E.g., the fraction of people in each segment who will read SPORTS ILLUSTRATED, or watch BONANZA. Essentially, this amounts to rating points in the market segment.

IV. Media Vehicle Duplications

1. Audience duplication. For each possible pair of media vehicles the fraction of people out of the total in all segments who will be in the audience of both vehicles. E.g., the fraction of people who read both SPORTS ILLUSTRATED and LIFE. Also needed is the fraction of people who will be in the audience of two appearances of the vehicle. If duplication data is not available, the system will approximate them using the assumption of independence between media.

V. Other Data Needed

1. Memory constant. The fraction of a person's exposure value that is remembered from one time period to the next.
2. The percent of potential realized after saturation with exposures.
3. The percent of potential realized when one, two and three average exposures are retained by a person. (An average exposure is defined as an exposure to a media alternative with exposure value of 1.0). These inputs may be viewed as expressing the expected effect of having one, two and three exposures presented to a person in a short period of time. When combined with the saturation level, these inputs determine the diminishing returns aspect of exposures.

4. Number of media alternatives, market segments, and time periods.
5. Budget.

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