A RE-ISSUE POLICY MODEL

By

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Abstract

Publishing firms of books and records follow a well-known policy of reissuing their products in a different format some time after the initial introduction. Paperbacks and budget-label discs are two typical formats. As they usually are accompanied by some price cut, two questions arise:

- When should the product be reissued?
- At what price should the product be marketed again?

The following paper considers these questions from the viewpoint of quantitative analysis. A simple model is presented, deriving from a case study in the recording industry. Possibilities of implementation are discussed.
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1. INTRODUCTION: THE PROBLEM

In the book and recording industries it has been a common policy ever since to reissue books and records in a different format, some time after their first introduction to and subsequent withdrawal from the market. As a particular book or record aims at some specific market segment there will normally be some saturation or even a decline in sales. Reissuing the same product, especially when the price is cut considerably, will overcome this saturation or open another market segment to which the product's different characteristics (including price) might appeal. Two typical formats with which we are dealing here are

- paperback books and
- budget label records

as opposed to the original hard-cover editions or full price discs.

This reissue policy poses two difficult questions (see also (5) for a general discussion):

1. Should the product be reissued and, if so, at what time?
2. At what price (or in which price category) should the product be reissued?

In managerial practice, both problems are often dealt with in a lack-adaisical manner, though this does not mean that decisions were "wrong". Rather, support for these appears to be very weak. We shall try, therefore, to supply a simple model, gathering together relevant details and the information available to the manager. In this, we are guided to some extent by Little's principles of a decision calculus (4), in as much as the model will be simple, robust, easy to control, complete on the important issues
and easy to communicate with. The model, however, shows adaptive properties only to a limited degree as the decision will be a unique one. Though the problem comes up every half year or year, the alternatives have changed completely. Information on the performance of reissued products at stage t-1 cannot be brought to bear directly on the list of alternatives for decision at stage t.

In the following we shall restrict ourselves to the case of record reissue policies which have to cover both of the questions revised above (see (2)). Book reissues, quite often, do not touch the first of these, as paperbacks follow closely on the heels of hard-cover editions. Fig. 1 shows this graphically:

![Graph showing the function S(t) with S(t) as the decision variable and t as the stage variable. The graph illustrates the relationship between S(t) and t, with S(t) increasing as t increases.]
Replacement of a hard-cover edition by a paperback one theoretically may take place when - for the former - average sales equals marginal sales, i.e.:

\[ \frac{S(t)}{t} = \frac{dS(t)}{dt} \]

where average sales is maximum. At \( t^* \), the time the original edition is withdrawn, another life cycle for the new edition starts, leading hopefully to increased sales. With books, it may even happen that both editions continue to exist side by side for some time, supposedly to attract different buyer classes in a particular market segment.

In the classical record business, on the other hand, which we shall have to consider primarily (see (2)), there will be nearly always a considerable time lag between the withdrawal of a disc from the catalogs and its reinstalment on a budget label. A typical example is the appearance of so called "historical" recordings from the Thirties or Forties that had been buried in the companies' archives for some decades. Fig. 2 illustrates this clearly:

![Fig. 2](image-url)
The market segment of any record is typically composed of the following sub-sets of the population:

- devotees of the work or piece of music (e.g., a particular symphony by Beethoven)
- devotees of the artist(s) involved
- devotees of the record make (for reasons of ourstanding recording technique, finish or presentation)

lastly, if the record offers a coupling of works or artists

- devotees of a particular coupling

The market audience for budget records, thus, is made up of the following categories of potential customers

- those who missed the record the first time round for some reason
- those who had to miss it the first time because they could not afford it
- those who might like to replace a worn-out copy
- those who were interested to have the disc but did not think it worth the full price asked
- those that came new to the scene during the interval $t^0_2$

As will be clear from these specifications, there is nothing more overly bothersome in record marketing planning than estimation of relevant market potentials. Things can even get harder, if older titles are coupled across. In the following, we shall assume that older material will be reissued "straight", i.e., without changing the coupling, as was the general rule with the company for which this case was investigated. However, even with "straight" reissuing of deletions, the firm will incur costs, not only of pressing, handling and marketing the disc. In many cases, there will be additional costs such as

- cost of technical refurbishing
- cost of new sleeves (cover art, design and sleeve notes)
- cost of new matrices

With every disc, therefore, we can associate some fixed investment. Cost of recording, on the other hand, will be regarded as sunk, also considering the long time lags between deletion and reissue.

As regards production, companies usually set aside some capacity for pressing and packaging of reissues. This is done with respect to seasonal fluctuations in production when some job smoothing is called for. Typically, record companies will subject the decision on what, when and how to reissue older material to a budget constraint as is also the case with new projects. Another characteristic seems to be that reissues are produced in limited lots only at the beginning. In case of commercial success, companies are willing to follow up rapidly with additional output on a standing basis. This requires a priori surplus production of a base stock of sleeves, cost for which has to be incorporated in the fixed investment mentioned above. The base stock, incidentally, is an arbitrary figure set by management according to experience. We have not subjected this to sensitivity analyses in the process of the study. Therefore, analysis of the system's flexibility was not undertaken in detail.

As will be seen later, the model depends in a critical way on a variety of subjectively estimated data or subjectively estimated corrections of historical data that lend themselves to adaptation for the present case. However, this should not hamper any successful application of the model as long as data changes can be dealt with effectively and quickly.

2. The Model

As the problem has been structured in detail, we can now proceed to develop the model. Assume that we have a list of n discrete reissue alternatives \((i = 1, \ldots, n)\). Typically, there will be a number of discrete price
categories in which the reissued product could be marketed. Let \( p_{ik} \) be the \( k \)-th price category for product \( i \) \( (k = 1, \ldots, e) \). We shall develop the model for a planning period of \( T \) time units \( (t = 1, \ldots, T) \). During this time span the product may be either released immediately or postponed to a later date. Hence, we define a binary variable:

\[
y_{ikt} = \begin{cases} 
1, & \text{if } i \text{ is selected for reissue at time } t \text{ and price } k \\
0, & \text{otherwise}
\end{cases}
\]

\((i = 1, \ldots, n; k = 1, \ldots, e; t = 1, \ldots, T)\)

Assume further that the market has been divided into a set of market segments \((s = 1, \ldots, m)\). Of course, product \( i \) will not necessarily appeal to potential customers in segments. Therefore, the market potential in any such segment will be zero. Let the market potential of segments be denoted \( M_s \) (in units). As the company, regularly, will have to face competition in its markets, it will eventually succeed in capturing only a fraction of the market potential in any segment. This fraction of the market potential in segment \( s \) will be denoted by \( \alpha_s \), where

\[
2.2 \quad 0 \leq \alpha_s \leq 1 \quad (s = 1, \ldots, M)
\]

As we have to regard market segments as open to a variety of products, this market share applies to the entire line of products appealing to a particular segment. For any product out of this line there will be again only a fraction of the firm's total share in segments. Let this product share be denoted by \( \beta_{iks} \). It will not only depend on \( i \), but on the price category \( k \) in which the product \( i \) has been placed. On the other hand, there will be a dependency of \( \beta_{iks} \) on a variety of other - more or less indirect - factors such as

- competition through other albums of the firm's existing catalog \( (C_k) \)
- competition through albums of competitors' existing catalogs \( (\Gamma_k) \)
- forthcoming new releases by the company \( (D_k) \)
- forthcoming new releases by the company's competitors ($\Delta_k$)

where we could further differentiate according to the price categories applicable to the various products. We may assume, on the basis of empirical evidence, that price categories in this highly oligopolistic market are the same for all firms concerned. Thus we should rewrite $\beta_{iks}$ implicitly as follows:

$$2.3 \; \beta_{iks} = \beta_{iks} (i, p_{ik} | c_k, g_k, d_k, \Delta_k)$$

(all $i, k, s$)

and define

$$2.4 \; 0 \leq \beta_{iks} \leq 1 \quad i = 1, \ldots, n$$

$$k = 1, \ldots, e$$

$$s = 1, \ldots, m$$

In Chapter 3 we shall discuss (2.3) and a method for estimating the quantity $\beta_{iks}$.

We are now in a position to describe sales of a product $i$ at price $k$ in segment $s$, denoted by $x_{ikst}$, at any time $t$:

$$2.5 \; x_{ikst} = \beta_{ikst} \alpha_{st} M_{st} (t, i, k, s \text{ as above})$$

As we are considering a planning period of $T$ time units we shall discount net earnings and cost to present value, adopting $q^{-t}$ as the discount factor. Cost can be roughly broken down into two categories. Let $c_i$ be variable production cost per output unit. This cost is often seen to be linearly dependent on the output $x_{ikst}$ and constant over time. The second category will be some "fixed" cost, denoted by $r_i$, which includes cost of technical refurbishing, cover art and design, sleeve notes and base stock. The parameter $r_i$ can be reviewed as time - invariant and to be incurred whenever $i$ is selected. Contrary to common belief, $r_i$ will not be different for alternative price categories $k$, and it was not for the case under review. Thus, total production cost at any time $t$ can be written as follows:
Likewise, total "fixed" cost will be

\[ R_t = \sum_i \sum_k \sum_l \sum_s c_{ikst} y_{ikt} \quad (\text{all } t, t = t' \text{ if } y_{ikt} = 1) \]

where \( t' \) denotes the time of reissue. Let \( B_0 \) be the budget constraint related to \( R \) and \( B_t \) the periodical budget restriction. Then

\[ \sum_i \sum_k \sum_l \sum_s c_{ikst} y_{ikt} \leq B_0 \quad (t = t_i') \]

and

\[ \sum_i \sum_k \sum_l \sum_s c_{ikst} y_{ikt} \leq B_t \]

Besides budget constraints we shall have to observe capacity restrictions on production. Let \( b_{jt} \) be the capacity of production facility \( j \) in \( t \) (\( j = 1, \ldots, h; \ t = t_i' \)) and \( a_{ij} \) the technical coefficient of producing one output unit of \( i \) at facility \( j \) (\( i = 1, \ldots, m \)). Then the capacity constraint reads as follows:

\[ \sum_i \sum_k \sum_l \sum_s a_{ij} x_{ikst} y_{ikt} \leq b_{jt} \quad (j = 1, \ldots, h; \ t = t_i') \]

So far we have not dealt with the problem of defining an appropriate decision criterion. As we have to compare earnings and costs, it follows necessarily that profit will have to be adopted as the objective. Profit need not be the only criterion. We have not considered in detail the flexibility aspects of the problem. Hence, in another context, some flexibility criterion might be applied, too. Here we have as the objective function:

\[ \text{Maximize } Q = \sum_{t=t_i'}^{T} \left\{ \sum_i \sum_k \sum_l \sum_s \left[ (p_{ik} - c_i) x_{ikst} - r_i \right] y_{ikt} \right\} q^{-t} \]

where \( Q \) is the present value of cash flow surplus. The optimization problem, thus, will be to maximize (2.11) subject to (2.8) - (2.10), observing the definitions in (2.1) - (2.5). As we want to know whether, when and at which
price product \( i \) should be reissued, we evaluate \( Q \) for a variety of \((t', p_{ik})\) combinations. This involves the manager's judgment if the number of combinations is to be kept within operational bounds. We shall discuss a heuristic evaluation routine in Chapter 4.

3. Obtaining the Data

It will not be necessary to deal extensively with the gathering of information on such parameters as \( c_i, a_{ij}, \) and \( b_{jt} \). They can be obtained by conventional methods in the company's plants. Rather, we shall have to look more closely to such critical external parameters as \( \alpha_{st}, M_{st} \) and, most important, \( \beta_{ikst} \).

Let us begin with \( M_{st} \) for which either historical data or subjective estimation or forecasts or both will be required. If historical data is available we could transfer it as follows. Assume that, at the beginning of operations, there existed a market potential in segment \( s \) of \( M_{s1} \). Then we have \( M_{st} \) \((t = 2, ---, T)\) from this relation:

\[
3.1 \quad M_{st} = (1 + \gamma)^t M_{s1} - \sum_{t=2}^{T-1} \sum_{i} \sum_{k} \gamma_{ikst} \quad (s = 1, ---, m; t = 2, --- T)
\]

where \( \gamma \) is a growth factor that will have to be estimated by analogy with the help of the historical data and present municipal statistical material. \( M_{s1} \), however, would have either to be borrowed from historical information (updated by extrapolation or some other more refined technique) or estimated subjectively, making use of the manager's knowledge and experience (see (3) for a similar concept).

The parameter \( \alpha_s \) may be estimated according to past market positions. Typically, management will have at hand some statistics of past market shares versus past promotional expenditures and new product investment which might
provide some first clues to this quantity. Subjective judgment, however, will have to be applied, too, at this point in order to estimate possible increases in market share from changes in expenditures. The greatest difficulties, no doubt, will be incurred when dealing with product shares of market potentials as represented by \( \beta_{ikst} \). As was noted in (2.3) these parameters depend on a multitude of controllable and uncontrollable variables. Moreover, the parameters \( \beta_{ikst} \), measuring market response, suffer highly from uncertainty. Hence, we shall propose that these parameters might not be estimated directly and deterministically. Rather, it is recommended to apply a Bayesian concept in this case, as was done in (1) for another type of pricing strategy. According to this, we transform the implicit function (2.3) into a decision free of the following form (excerpt) for product i in segments at time t:

\[
\begin{align*}
P_{ik} & \quad C_r & \quad \bigoplus_k \quad D_k & \quad \Delta_k & \quad \beta_{ikst} \\
\text{Strong} & \quad \text{Strong} & \quad t & \quad t+1 & \quad \beta_{ilst} \\
\text{Moderate} & \quad \text{Moderate} & \quad t+2 & \quad t+1 & \quad \beta_{i2st} \\
\text{Weak} & \quad \text{Weak} & \quad t+\theta & \quad t+\theta & \quad \beta_{iest}
\end{align*}
\]
At any of these stages we shall have to estimate conditional probabilities for the various events subjectively. The conditional probability of $\beta_{ik}$ will be obtained by sequential application of the multiplication rule, where we are supposed to observe the following definitions of events:

- price of product
  
  3.2 $P_{ik} = \{P_{i1}, P_{i2}, \ldots, P_{i1}\}$

- "internal" competition from the product line
  
  3.3 $C_k = \{C_{k1}, C_{k2}, C_{k3} \mid P_{ik}\}$

- "external" competition from the product line
  
  3.4 $\Gamma_k = \{\kappa_{k1}, \kappa_{k2}, \kappa_{k3} \mid C_{k}, P_{ik}\}$

- forthcoming new releases from the company
  
  3.5 $D_k = \{D_{k0}, D_{k1}, D_{k2}, \ldots, D_{k\theta} \mid \Gamma_k, C_{k}, P_{ik}\}$

- forthcoming new releases from the competitors
  
  3.6 $\Delta_k = \{\Delta_{k0}, \Delta_{k1}, \Delta_{k2}, \ldots, \Delta_{k\theta} \mid D_{k}, \Gamma_k, C_{k}, P_{ik}\}$

In any case, an estimate of the consequence $\beta_{ik}$ of the chain of events is required which, normally, can be provided only by subjective judgment. Hence, we shall use expected values of the $\beta_{ik}$ and not their direct estimates in the analysis. In doing so, we may hope to clarify the intricate dependencies of these parameters and to give better support to managerial judgment in data collection.

The method sketched above may seem to be cumbersome if a great many alternatives in products and price categories exist. This is true. However, in the company's practice, the list of alternatives will not exceed a dozen items at each stage from which about one half are chosen for immediate reissue. Moreover, the number of price categories does not exceed four and not all of them will be applicable to any product $i$. Low price categories are highly correlated to the age of the material considered for reissue as technical deficiencies
require some compensatory discount.

Attention should be drawn to the fact that market segmentation in the record business has been done judgmentally. We have left this status quo untouched so far. This amounts to some fuzzy definition of segments and possible overlapping might introduce some bias into the analysis. However, we have the feeling that possible biases are balanced by the fact that the problem's structure has been laid open for the first time. No doubt, things ought to improve in some respects after implementation and when first results are available. At this point we should stress the necessity of sensitivity analyses which we shall have to conduct in view of a multitude of highly uncertain, subjectively estimated parameters. At least, optimistic, pessimistic and most likely values of certain parameters will have to be tried in testing model and solution.

4. A Heuristic Evaluation Routine

Though the model appears to be clear cut in structure and dimensions, it is not necessary to devise a special algorithm for solution. A heuristic evaluation routine, which we shall develop, should prove to be satisfactory. Solutions obtained may not be optimal, but in practice we could make do with near-optimal ones. The heuristic might best be described as a ranking-cum-checking routine as is common in capital budgeting problems of a similar kind. Here we could try to rank projects by the following quantity.

(See (3), p. 215 ff. for a similar approach):

\[ S_i = \frac{Q_i}{K_i + R_i} \quad (i = 1, \ldots, n) \]

where

\[ Q_i = \sum_{t=1}^{T} \left\{ \sum_{k} \sum_{s} \left[ (p_{ik} - c_i)x_{ikst}^t - r_i \right] y_{ikt} \right\} q^{-t} \quad (i=1, \ldots, n) \]
\[ K_i = \sum_k \sum_s c_{ikst} y_{ikt} q^{-t} \quad (i = 1, \ldots, n) \]
\[ R_i = \sum_k r_i y_{ikt} q^{-t} \quad (i = 1, \ldots, n) \]

Having ranked projects in this way, we delete those from the list as probably unsuccessful which have \( S_i \leq 1 \). Hence, we arrive at a reduced list \( i'_t \). We save the deleted items for a project list \( i_{t+1} \) in time \( t+1 \).

The next stages will be a sequence of constraint checks:

(1) First we check the investment budget \( B \).

Here we calculate:
\[ B^*_{ot} = B_{ot} - \sum_k \sum_i r_i y_{ikt}, \quad i = i'_t \]
If \( B^*_{ot} \geq 0 \), covering \( i'_t \) in total, we continue. If not we have to partition \( i'_t \) into the following sets:
- \( i'_t(1)_1 \), being the list of feasible items (i.e., those items with \( S_i > 1 \) that can be managed under \( B_{ot} \)).
- \( i'_t(1)_2 \), being the number of items that cannot be managed under \( B \) during the planning period, though \( S_i > 1 \) holds. However, their rank is too low to allow for inclusion in the feasible list. We save \( i'_t(1)_2 \) for the list in \( t+1 \), i.e., \( i_{t+1} \). Note that
\[ i'_t = i'_t(1)_1 + i'_t(1)_2 \]

and
\[ B_{ot} = B_{o} - \sum_{t=1}^{t-1} \sum_k \sum_i r_i y_{ikt} \]
We continue then with the reduced list \( i'_t(1)_1 \) which is covered by \( B_{ot} \).

(2) Next we check the cost budget constraint \( B_t \). Here we calculate the quantity \( B^*_{t} \) defined as follows for either \( i_t \), \( i'_t \) or \( i'_t(1)_1 \):
\[ B^*_{t} = B_{t} - K^*_{t}, \]
where \( K^*_{t} \) is given by (2.6).
If $B^*_t \geq 0$, covering $i_t, i'_t$ or $i'_t(1)_1$ in total, we continue. If not, we partition $i'_t$ or $i'_t(1)_1$ into the following sets:

4.9 $i_t = i_t(2)_1 + i_t(2)_2$

4.10 $i'_t = i'_t(2)_1 + i'_t(2)_2$

4.11 $i'_t(1)_1 = i'_t(1,2)_1 + i'_t(1,2)_2$

where

- $i_t(2)_1, i'_t(2)_1, i'_t(1,2)_1$, respectively, are the lists of feasible items at stage 2 (i.e., the subsets of items that can be managed under $B^*_t$).

- $i_t(2)_2, i'_t(2)_2$ and $i'_t(1,2)_2$ are the sets of non-feasible items that cannot be managed under $B^*_t$. We save these sets for inclusion in the list of $t+1$, i.e., $i_{t+1}$.

After this we continue with either lists $i_t, i'_t(1)_1$ (if still feasible) or the reduced sets $i_t(2)_2, i'_t(2)_2, i'_t(1,2)_2$ respectively, from stage 2.

(3) Finally we check whether any of the feasible lists from stage 2 meet with capacity restrictions $b^*_{jt}$. Thus, we calculate the quantity $b^*_{jt}$ as follows:

4.12 $b^*_{jt} = b_{jt} - \sum_i \sum_k \sum_s a_{ij} x_{ik} y_{ikt}$,

where

4.13 $i = \{ i_t, i'_t, i'_t(1)_1, i_t(2)_1, i'_t(2)_1, i'_t(1,2)_1 \}$

one at a time.

If $b^*_{jt} \geq 0$, covering the respective set from (4.13) in total, we continue (i.e., we reissue the items in this list). If not, we partition the sets from (4.13) again as before in feasible and non-feasible sets as follows:
4.14 \( i_t = i_t'(3)_1 + i_t'(3)_2 \)

4.15 \( i'_t = i'_t'(3)_1 + i'_t'(3)_2 \)

4.16 \( i'_t(1)_1 = i'_t(1,3)_1 + i'_t(1,3)_2 \)

4.17 \( i'_t(2)_1 = i'_t(2,3)_1 + i'_t(2,3)_2 \)

4.18 \( i'_t(2)_1 = i'_t(2,3)_1 + i'_t(2,3)_2 \)

4.19 \( i'_t(1,2)_1 = i'_t(1,2,3)_1 + i'_t(1,2,3)_2 \)

where

- \( i_t'(3)_1 \), \( i_t'(3)_2 \), \( i'_t(1,3)_1 \), \( i'_t(1,3)_2 \), \( i'_t(2,3)_1 \), \( i'_t(2,3)_2 \),

and \( i'_t(1,2,3)_1 \), \( i'_t(1,2,3)_2 \), are the feasible subsets under \( b_j \) and, consequently,

- \( i_t'(3)_2 \), \( i_t'(3)_2 \), \( i'_t(1,3)_2 \), \( i'_t(1,3)_2 \), \( i'_t(2,3)_2 \), \( i'_t(2,3)_2 \)

and \( i'_t(1,2,3)_2 \), the six non-feasible subsets.

Again, we save the items from the non-feasible subsets for inclusion in the list for \( t+1 \), i.e., \( i_{t+1}' \).

This ranking and checking procedure is repeated \( T \) times, i.e., according to the length of the planning period and for, possibly, different price categories. In the end, we arrive at a reissue program, telling us what (and whether at all) should be reissued as well as the time and price of each item under review.

The routine is best summarized in the following flow chart:
Initialize

List \( t = 1, \ldots, n_t \) \((t=1, \ldots, T)\)

Calculate \( s_i \)

\( s_i > 1 \quad \text{no issue} \)

\( s_i \leq 1 \quad \text{no issues} \) → Terminate

Partition \( i_t \)

Continue \( i_t \) or \( i'_t \)

Calculate \( B_{ot} \)

\( B_{ot} > 0 \quad \text{partition sets} \)

\( B_{ot} > 0 \quad \text{partition sets} \)

Calculate \( B_{t} \)

\( B_{t} > 0 \quad \text{partition sets} \)

\( B_{t} > 0 \quad \text{partition sets} \)

Calculate \( b_{i_t} \)

\( b_{i_t} > 0 \quad \text{partition sets} \)

\( b_{i_t} > 0 \quad \text{partition sets} \)

\( t = T \) ter\( \text{inate} \)
5. CONCLUSIONS

Presently, the foregoing model is tested against hypothetical, though not unrealistic data. It will depend on the model's performance in these test runs whether it can be implemented as it stands or whether some "grinding" on it needs to be done. Results shall be reported in (2).

The study is part of a larger project concerned with the analysis of repertoire policy in the recording industry. Other fields currently investigated are new product decisions (closely linked to reissue policy), distribution and measurement problems (such as forecasting of market potential under technological change).

Let us review the properties of the model in the light of Little's (4) postulates. As it is, the model can be regarded as to be of the simplest possible form. It contains no more detail than is absolutely necessary. The user will find it difficult to make the model yield answers that make no sense or appear to be trivial. Hence, we may claim for a certain degree of robustness. As will be seen from the flow chart, the model is easy to control, once the meaning of set partitioning has been explained. Moreover, the model will be found to be complete as it contains all phenomena which management regards as vital and critical to the problem under analysis. We have taken no liberties in "assuming away" important characteristics which we felt were "too hot to handle". Subjective judgment and estimation have been the basis of our analysis. Of course, as time passes with implementation, we should be in a position to adapt incoming new information for the purposes of restructuring the model and redefining as well as estimating its parameters. Though the model, hitherto, has not been put on line, communication appears to be easy, the more so as project lists, price categories and time horizons are not too long or numerous, respectively. An attempt will and must be made to use an on-line system in order to facilitate efficient communication between the model and the decision-maker.
LITERATURE


