Product Development Plans†

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A decision as to which of several possible products should be developed involves at least two different phases:

(a) The technical phase, during which attempts are made to improve some aspects of the product.
(b) The commercial phase, during which the product is produced and hopefully sold.

Both phases are uncertain and this paper tries to provide explicit treatment of the combined uncertainty in the two phases.

The expected value of return is maximized subject to budget constraints and chance-constraints on total return and/or pay-back requirements.

The distributions consist of spikes and Poisson distributions and a formula is developed to compute compound probabilities. Dynamic programming is used for the numerical solution.

An application of the method in a company is described.

INTRODUCTION

It is frequently said that the development of new products is too expensive because many products which are developed never become commercially profitable. It is often maintained that of twenty new product ideas only one will yield a profitable product and in retailing this relation is said to be sixty to one (see Goodman10). It is valuable of course to develop methods that discontinue unprofitable products at an early stage.

At least two kinds of uncertainty associated with the development of new products can be identified.

(a) Uncertainty during the technical phase when the product is developed (e.g. uncertainty about its quality and time required for development).

(b) Uncertainty associated with the commercial phase during which the product is produced and hopefully sold (e.g. uncertainty about consumer tastes and the actions taken by competitors).

Published work dealing with uncertainty during the technical phase, includes Hess12 and Rosen and Souder,15 with commercial uncertainty by Charnes et al.6-8 and Urban,18 and models involving simulation of the two kinds of uncertainty simultaneously, by Atkinson and Bobis.3 A review of the literature is given in Baker and Pound4 and Sellstedt,17 see also Ansoff and Brandenburg2 and Chambers.5

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We will now develop an analytical method which takes both commercial and technical uncertainty into consideration.

THE UNCERTAINTIES

We can illustrate the basic structure of the decision problem as in Figure 1.

At time $t_1$ a decision has to be made as to whether to start developing a new product or not. At time $t_2$, which may be uncertain, the technical phase is over and a new decision must be made as to whether the commercial phase should be started or not.

![Diagram showing technical phase ending at $t_1$ and commercial phase beginning at $t_1$. There is a decision point at $t_2$ where a choice is made to discontinue or continue.]

Technical and commercial uncertainties must, as a rule, be estimated by people in the organization and probability distributions used to represent these uncertainties have to:

(a) closely describe the actual situations, and
(b) make analytical (or simulation) solutions possible.

In product development it is important to be able to show that the degree of risk might vary between projects and specifically that the risk of failure is very great.

It is shown that the Poisson distribution is very useful for dealing with product development problems. The usefulness of the Poisson distribution for PERT networks was recently discussed by Parks and Ramsing. \(^\text{14}\)

Beginning with the commercial phase we assume that every finished product, $i$, will yield a cash flow consisting of a sum of money $l_i$ arriving $a_i$ times during a certain period.

Assume that a certain sum of money $l_i$ (cheques of $10,000$), arrives in a Poisson stream with mean $a_1$ cheques/unit of time. Assume that the sum $l_2$, (cheques of $20,000$), arrives in a Poisson stream with mean $a_2$/unit of time and a sum of money $l_n$ arrives in a Poisson stream of mean $a_n$/unit of time. Since the sum of independent Poisson streams is itself a Poisson stream, the number of cheques is a Poisson stream with the mean $\sum_{i=1}^{n} a_i$. But since the cheques are of different size the average sum of money is $\mu = \sum_{i=1}^{n} l_i a_i$ and the variance is $\sigma^2 = \sum_{i=1}^{n} l_i^2 a_i$.