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Technical Note: An Equation for Modelling Market Share

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Introduction

In modelling corporate problems one often needs to incorporate a relationship between a variable such as Advertising Spending and the resulting Market Share, it being assumed that there is a connection. There are various approaches to this, for example Coyle (1977) relates Market Share to Market Share Spending (which includes advertising, technical service, etc.) by a table function. The table function is calibrated against the firm's existing Market Share Spending and the assumed or estimated 'shelf life' of Market Share, i.e. the rate at which it would decline if no further spending took place, and hence the rate of spending needed just to prevent that decline. There is, of course, a time delay to reflect the perception time of the customers.

This approach has the merit of simplicity and only involves two pieces of 'data', the shelf life and the level of spending needed to prevent decline. It does not however, deal with other spending rates except by a table which is necessarily prone to error, at best, and, at worst, is completely arbitrary. The form of the table function should make it easy for the Marketing Manager to define what would happen to Market Share at different spending levels. In practice it may be difficult for him to do so as he is unlikely to have had a sufficiently wide range of experience, and he will probably find it hard to envisage the problem in dynamic terms.

The Little Model

An alternative approach, which appears to be more easily verifiable empirically, has been suggested by Little (1970), though not in a system dynamics context. He suggests an equation of the form:

M = M1+(M2-M1)*AS**ALPHA/(BETA+AS**ALPHA) (1)

where we express an algebraic equation in a syntax close to DYSMAP for ease of typing and layout.

ALPHA and BETA	are parameters to be determined and are in some way indicative of the product/market situation.
AS	is advertising spending at some unstated time, the implication being that it is 'current' spending.
M	is the market share resulting from that spending - the firm's current average market share.
M1 and M2	are respectively the lower limits below which market share would not fall if no advertising were done, and the upper limit beyond which it could not rise regardless of how much was spent.

We must be clear that the market share referred to is the prior share, i.e. the public's propensity to buy the product and not the posterior market share, i.e. the amount the company eventually sold, which would depend, inter alia, on the firm's capacity and production decisions.

We can express equation (1) in more suitable dynamic and dimensional terms by allowing AS to denote actual spending, £/M say, and using in its place PS for the spending perceived after a time lag.

To use the Little formula, management are also asked to estimate the market share MH which would be attained by a spending rate ASH (in our terms PSH), say 50% more than AS. This enables one to formulate two equations:-

M = M1+(M2-M1)*PS**ALPHA/(BETA+PS**ALPHA) (1)
MH = M1+(M2-M1)*PSH**ALPHA/(BETA+PSH**ALPHA) (2)

Equation (1) is restated for convenience but the advertising variable is put into perceived terms (the perception delay should not be hard to measure), and M1,M2,M,MH, PS and PSH are all 'data'.

From equation (1) we obtain

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M*(BETA+PS**ALPHA)=M1*(BETA+PS**ALPHA)+(M2-M1)*PS**ALPHA
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or

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(M-M1)*BETA = (M2-M)*PS**ALPHA                                    (3)
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and similarly from equation (2) we get

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(MH-M1)*BETA = (M2-MH)*PSH**ALPHA                                 (4)
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Taking logarithms to any convenient base we obtain, from (3) and (4) respectively:

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LOGN(M-M1)+LOGN(BETA)=LOGN(M2-M)+ALPHA*LOGN(PS)                   (5)
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and

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LOGN(MH-M1)+LOGN(BETA)=LOGN(M2-MH)+ALPHA*LOGN(PSH)                (6)
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and hence we obtain two equations which can be used in a DYSMAP program as computed constants:-

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N   ALPHA = (LOGN(PSH)-LOGN(PS))/(LOGN(MH-M1)-LOGN(M-M1))         (7)
N   BETA  = (M2-M)*PSH**ALPHA/(MH-M1)                             (8)
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The 'data' values PSH, PS, MH, M1 and M2 are defined on C cards in the usual way.

From these equations it can be seen that ALPHA is dimensionless and BETA has the same dimensions as PS.

Equations (7) and (8) are used in conjunction with an auxiliary DYSMAP equation:-

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A   CM.K  =  M1+ (M2-M1)*CPS**ALPHA/(BETA+CPS**ALPHA)             (9)
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which when translated into DYSMAP relates the current perceived spending CPS to the ensuing current market share CM.

Other Applications

It is implied in the technique that the function connecting CM and CPS is continuous, smooth and roughly S-shaped, passing through the points (0,M), (PS,M), (PSH,MH) and saturating at M2. A similar, though decreasing, relationship can plausibly be postulated between Delivery Delay, D, and CM and between Price, P, and CM. Again, D and P imply the values perceived by the market rather than those at the firms. The equations (7), (8) and (9) could be used for such cases, distinguishing of course between say the ALPHA due to advertising and the different ALPHA for the Delivery Delay effect.

With some caution, one could use equations (7), (8) and (9) for R + D spending but great care would have to be exercised to identify those parts of R + D which do affect market share fairly directly (e.g. customer problem-solving), and those which require other decisions before they have an effect (e.g. new product development). In practical modelling it would usually be better to group the first type of R + D into 'advertising', call the result 'market share spending', and assume that the firm could competently make the appropriate choice of how the total should be divided between the separate activities.

Most firms do, in fact, have market-share spending, delivery delay, and pricing going on at the same time. An appropriate approach could be to use equations (7), (8) and (9) three times to generate three prior market share values and use the least of those in the order rate equation. This could suggest some rather subtle measures of performance reflecting say, the extent to which delivery delay problems are vitiating the results of advertising, as measured by the 'lost' prior market share.

References

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Little, J.D.C. "Models and Managers: The Concept of a Decision Calculus" Management Science 16, 8, April, 1970, pp B466.