

Developments in Business Simulation & Experiential Exercises, Volume 15, 1988

ADVERTISING RESPONSE IN THE GOLD AND PRAY ALGORITHM: A CRITICAL ASSESSMENT

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ABSTRACT

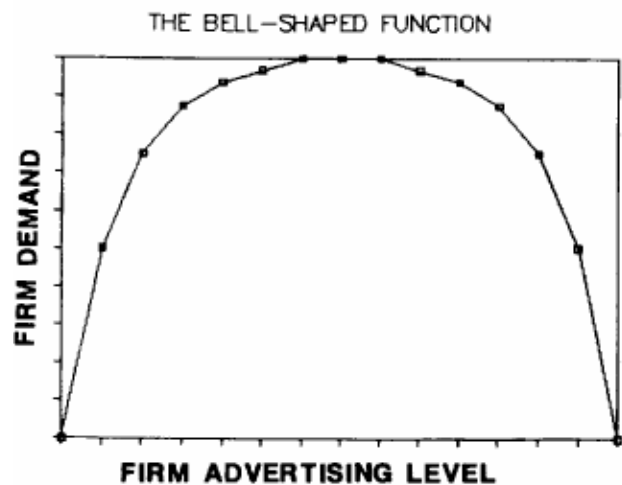
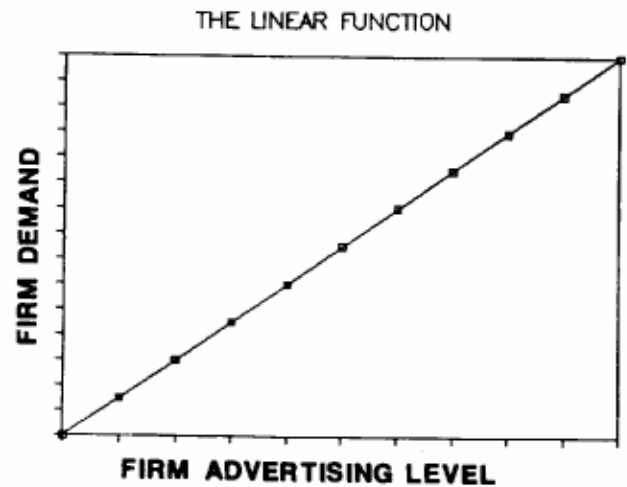
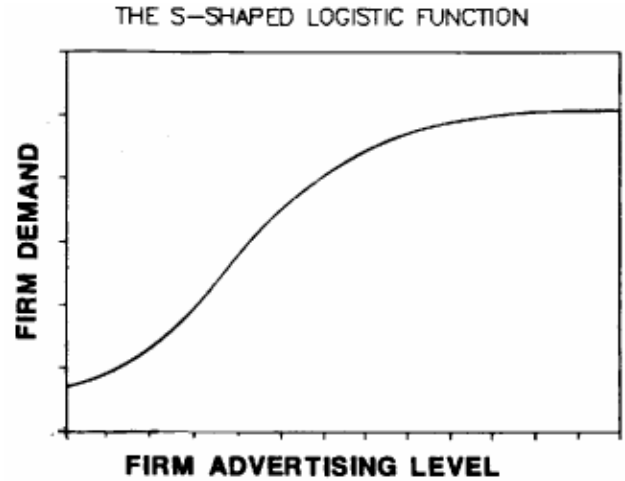
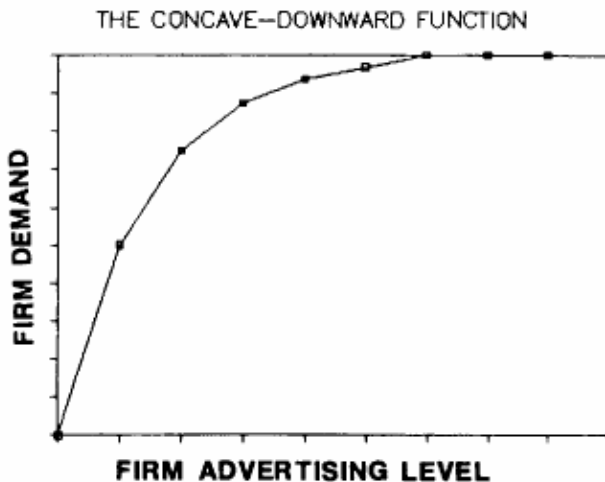
Simulations provide a powerful means of teaching a range of lessons from the valuable to the dysfunctional. If we are to maximize the likelihood of positive learning experiences for our students, it is vital that the simulations we use accurately model the phenomena under study. Otherwise, students learn things which are not so, or they learn not to take the simulation seriously. Therefore, it is important that response functions in simulations reproduce the reality they attempt to simulate. This is especially critical in view of the misconceptions students bring with them to the simulation, particularly concerning "familiar" topics such as advertising. Although familiar as a result of daily exposure, advertising remains mysterious and seemingly all-powerful. Many students have the notion that advertising can accomplish miracles in the marketplace. For these reasons, it is important that the advertising response functions incorporated in business simulations be carefully considered.

THE ADVERTISING RESPONSE FUNCTION

The advertising response function specifies the relationship between advertising expenditure and firm-level sales. There have been several functional forms specified to relate these two variables (see Figure 1):

- (1) the concave-downward function,
- (2) the S-shaped logistic function,
- (3) the linear increasing function, and
- (4) the bell-shaped function.

FIGURE 1



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The first two functions listed, are very similar. In that both view advertising response as characterized by diminishing returns at high levels of expenditure, followed by a plateau. They differ in that the S-shaped function incorporates a point of inflection at low levels, and has a section of increasing returns to scale, not included in the concave-downward function. The literature in this area provides support for both forms [11]. For pedagogical simulations, the difference between these two forms is minor. A simulation incorporating either the concave-downward or the S-shaped function should perform reasonably.

The linear increasing function receives no support in the literature, but is feasible and seems to be the function often favored by students, as demonstrated by their decision making behavior. The seminal work of Ebbinghaus in 1885 concerning the psychology of learning (Ebbinghaus forgetting curves) could be interpreted as supporting a linear increasing advertising response function [2]. However, generalizing Ebbinghaus' work (on the memorization of nonsense syllables) to advertising response functions requires a stretch of the imagination. A stretch that only a few advertising textbook authors have been willing to make.

The bell-shaped advertising response function suggests a loss of advertising impact beyond some maximum exposure level. Ackoff and Emshoff formulated, and later failed to support, the hypothesis that at very high levels of advertising, which they call supersaturation, the market responds negatively to increases in advertising. Findings of their field study at Anheuser-Busch, Inc. have been misinterpreted by some to support a bell-shaped advertising response function. In fact, Ackoff and Emshoff demonstrated carryover effects of advertising, but did not provide conclusive evidence that a supersaturation point exists. In summarizing their experiments at Anheuser - Busch, during which sales increased while advertising was decreased, they note: 'It would be foolish, of course, to claim that this improvement in performance was due entirely to changes in advertising... (1, p. 12). In reviewing what is known about the impacts of frequency upon advertising effectiveness, Naples [9, p. 72] notes "... increasing frequency continues to build advertising effectiveness at a decreasing rate, but with no evidence of a decline.

Consistent with Ackoff and Emshoff's findings, Krugman [7] suggests that advertisers might be spending at higher levels than necessary. Kamin [6] depicts the probability of optimal exposure level as a bell-shaped function, but does not suggest that this implies negative response to high levels of ad exposure.

There is a possibility that excessive exposure to advertising

may produce negative attitudinal effects. It must be noted, however, that not all advertising has or should have an attitudinal objective. Much advertising has awareness, recognition, or "top of mindedness" as primary objectives. Negative results from high exposure levels are impossible outside the realm of attitudinal considerations. Any response, positive or negative, reinforces awareness.

In the advertising literature, the concave-downward and the S-shaped functions are widely recognized as the most likely descriptors of the advertising response function [8]. Simon and Arndt [11] reviewed over 100 studies of advertising response, and note that almost all research examined support

either the concave-downward or the S-shaped functions. The linear increasing function has little empirical support. The bell-shaped function, while not out of the realm of possibility, is counter intuitive, not generally accepted by advertising theory, and is empirically unsubstantiated. It is more pedagogically sound to incorporate the most accepted and reasonable advertising response functions in a business simulation, rather than one which is highly speculative and primarily based on tentative findings in a single field study.

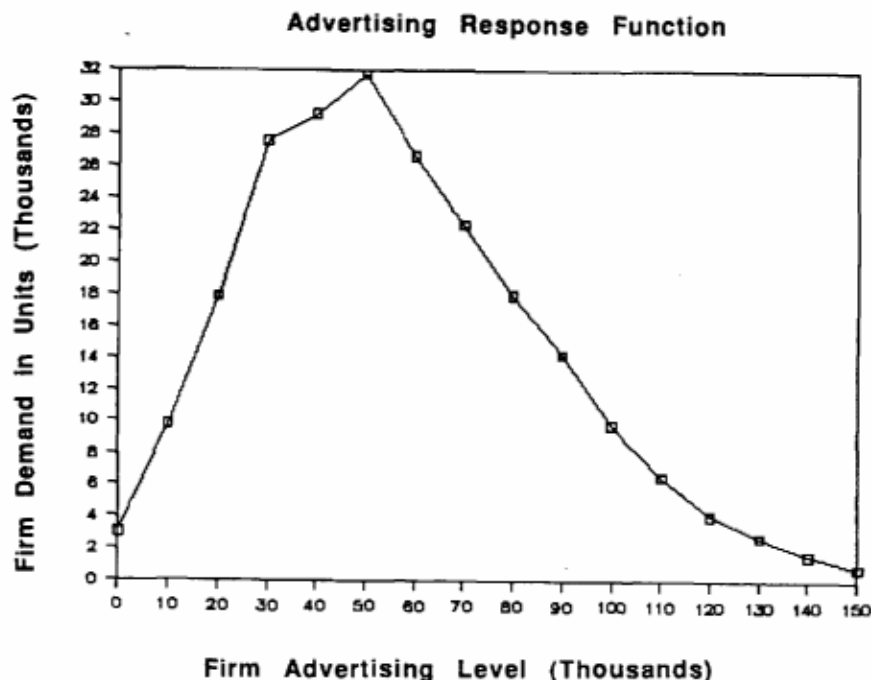
THE GOLD AND PRAY ALGORITHM

Gold and Pray have made significant and continuing contributions to the development of business simulations as documented in numerous editions of ABSEL proceedings. In particular, their 1982 article [5] brought the internal workings of business simulations out of the "black box," making the underlying algorithms accessible for various applications. It is the expressed intent of Gold and Pray to provide a model simulating demand based on contemporary marketing theory [5, p.101]. In this spirit, their model requires modification to better reflect the current understanding and accepted theory of advertising response.

In developing their set of equations, Gold and Pray describe an advertising elasticity function which turns negative at some predetermined expenditure level such that increases in advertising beyond that point, will result in decreased demand due to "oversaturation" [5, p. 105]. We first discovered this experientially, via student complaints during their participation in the AIRWAYS simulation [3]. AIRWAYS market and firm demand functions are based upon the Gold and Pray system [4, p. 3].

To examine the shape of the advertising response function in AIRWAYS, a series of ceteris paribus tests of the effects of different levels of advertising expenditure were made. The resulting curve of advertising response is shown in Figure 2.

FIGURE 2



As illustrated, sales increased at an initial increasing rate, then, briefly, at a decreasing rate, at which point sales turn sharply negative and approach zero.

In view of the lack of empirical support for this response function (as previously discussed) we assume that this function was selected to safeguard against the possibility of students using a single variable, such as advertising, as the magic key to success in the simulation. Pray and Gold reflect that

Inadequate diminishing returns can cause the variable to be the 'driving force' in the simulation game. This, in turn, leads to a winning strategy which can quickly become conventional wisdom to participants" [10, p.114]. However, the danger inherent in the bell-shaped function, at least as implemented in AIRWAYS, is that students quickly discover the optimal advertising level and stay with it for the remainder of the game. More important is the implied message: students can conclude either that advertising actually behaves in this fashion (an erroneous conclusion); or that the simulation bears no resemblance to reality, which undermines the pedagogical usefulness of the simulation.

If the concave--downward or the S-shaped response functions were used, advertising expenditures would result in increasing demand up to a point at which sales would plateau but profits would be negatively affected. This succeeds in making the point of Ackoff and Emshoff [1] that

the firm can over spend on advertising. It also assures that advertising will not become the driving force of the simulation

If, for some reason, it is deemed essential to include a supersaturation point in an advertising response function, the function should not be as sharply negative at high advertising levels, or as quick to turn at the peak as that shown in Figure 2. A function closer to the one reported by Ackoff and Emshoff in their figure 5 tie p. 9] would be a much more reasonably behaving function. In that function, an advertising level change up to three times that of steady state advertising level produced sales Just slightly below steady state sales.

CONCLUSION

Although this paper is limited to an assessment of the functional form of one variable in the Gold and Pray algorithm as operationalized in one simulation, we believe it is significant for two reasons: (1) that the advertising function is a key variable in many product-markets in terms of expenditure level and market impact, and as such, should be realistically portrayed; and (2) that the Gold and Pray algorithm represents a substantial contribution to simulation development which will have an impact on the structure of future business simulations. The change we suggest is a minor one from an algorithmic standpoint, but may have a major pedagogical impact.

Developments in Business Simulation & Experiential Exercises, Volume 15, 1988

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