AN EXPERIMENTAL ANALYSIS OF ADVERTISING STRATEGIES AND ADVERTISING FUNCTIONS

Kenneth Goosen
Micro Business Publications, Inc.
krgoosen@cei.net

ABSTRACT

This paper explores the relationship of different kinds of advertising functions and different advertising strategies. Do certain advertising strategies work better than other strategies? Also, what effect does a given type of advertising function have on a particular advertising strategy? Nine theoretical experiments were conducted with four different types of strategies. Each experiment involved a different type of advertising function while in each experiment the same advertising strategies were employed. Surprisingly, the strategy that in six cases out of nine proved to be the most effective was the Follow the Leader strategy.

INTRODUCTION

In business simulations, there are important decision consequences that must be simulated, for example, market demand and production capacity. Most computer generated values depend on sales demand and the availability of inventory to meet that demand. The validity of the simulations as a learning experience depends greatly on the simulation being able to determine the market demand for the product based on price and advertising decisions. The demand algorithm in a business simulation is also the starting point for other important simulated results such as number of factory workers to hire and production capacity. Two major question explored in this paper are: (1) how is advertising meaningfully handled within the demand algorithm and (2) what advertising strategy works best in achieving maximum net income?

In a previous paper, the author presented the results of theoretical experiments involving the use of four different price strategies. The paper ended with the conclusion that a price strategy that works is primarily the result of luck because of the hidden market demand parameters set by the game designer. This paper presents the results of similar experiments with advertising rather than price as discussed in the aforementioned paper.

NATURE AND PURPOSE OF ADVERTISING

What does advertising do? This question is not actually the right question for purposes of this paper. The right question is: what does advertising do in business simulations? The role of advertising is part and parcel of the demand algorithm in business simulation. To understand the role of advertising, it is necessary to understand the nature of the demand algorithm in simulations.

To duplicate the effect of real world advertising within a simulation, it seems logical that one must first understand the nature and purpose of advertising. The purpose and value of advertising has always been the subject of considerable debate.

A ....the purpose of advertising is to make potential buyers respond more favorably to the firm's offering. It seeks to do this by providing information to customers, by trying to modify their desires, and by supplying reasons to prefer the company's product.@ 1967, (Kotler, 1967).

The question is: how can such a purpose in a business simulation be achieved? Ultimately, the main achievement of advertising is to increase sales. In a simulation, there are no real people and, also, no actual advertising message or selection of advertising media. Consequently, the form of advertising does not matter. If the message and the type of media can be ignored, then all that the dollar amount of advertising can do is increase the quantity demanded and sold. Since the foundation of simulation demand algorithms is a demand curve, the only practical way for advertising to work in a simulation is to cause a shift in the demand curve.

THE DEMAND ALGORITHM IN BUSINESS SIMULATION

The demand algorithm in business simulations is primarily based on economic price theory. The demand algorithm in business simulations typically involves the following

A firm demand curve

An industry demand curve

The determination of industry demand based on average industry price

The allocation of industry demand to the industry firms based on firm demand

The firm demand curve primarily determines firm market share. The industry demand curve determines the magnitude of industry demand. For a detailed discussion of these two demand curves, see Goosen (2007). A linear demand function can be mathematically defined as follows:

$$P = P_o - k(Q)$$

Where: P - Price
Po - Price at the Y-intercept
k. - A coefficient (line slope)

Given this equation, then quantity demanded can be defined as follows:

$$Q = \frac{P_o - P}{k}$$

Given this form of the demand curve, only two values are needed to determine the demand function: (1) a value for the Y-Intercept and (2) the slope of the line (k)

FIGURE 1

Figure 1.A

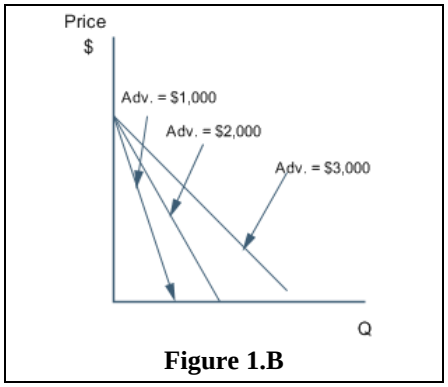
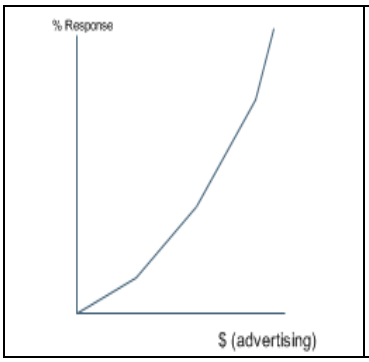


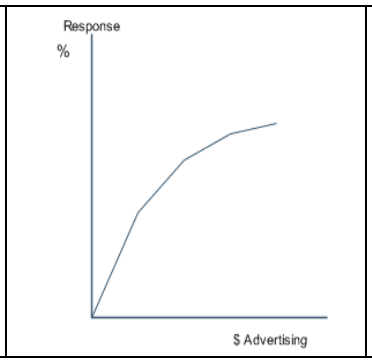
Figure 1.B

FIGURE 2 Different Kinds of Advertising Functions

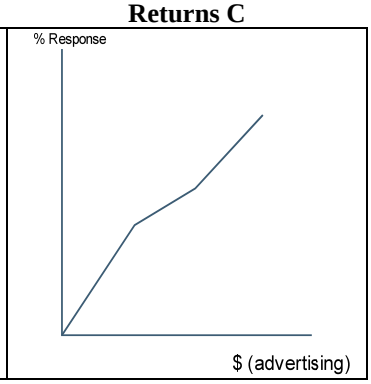
Increasing Returns A



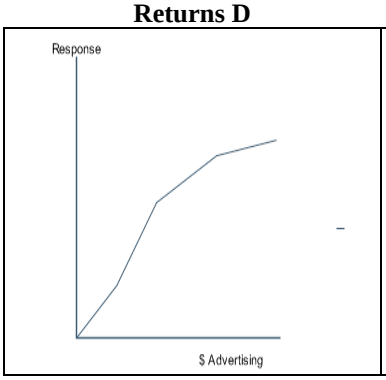
Decreasing Returns B



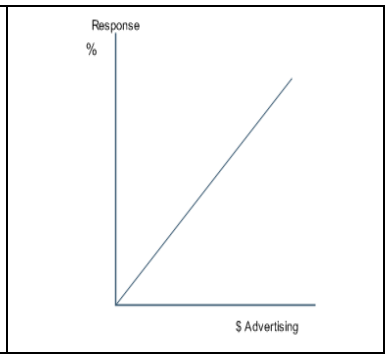
Decreasing/Increasing Returns C



Increasing/decreasing Returns D



Constant Returns E



In addition to price in most business simulations, other market variables that affect demand include:

1. Advertising
2. Research and development
3. Quality control expenditures
4. Number of sales people

Only price and advertising will be addressed in this paper. Advertising in a business simulation, consequently, serves two primary purposes in a business simulation:

1. It increases or decreases firm demand, and other things equal, also market share.
2. It increases or decreases the magnitude of industry demand.

THE ADVERTISING FUNCTION IN BUSINESS SIMULATIONS

To make advertising work, it is necessary to create two advertising functions. A firm advertising function and a market demand(industry) function. These functions respectively cause shifts in the firm and industry demand curves. Each time advertising is increased, the demand curve should shift upwards and to the right. What does not normally change is the Y-intercept. Since the Y-intercept does not change, the elasticity of price

Figure 3

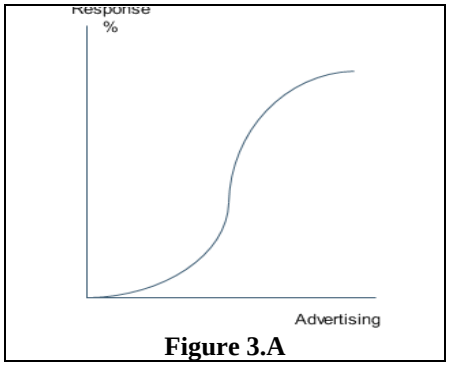


Figure 3.A

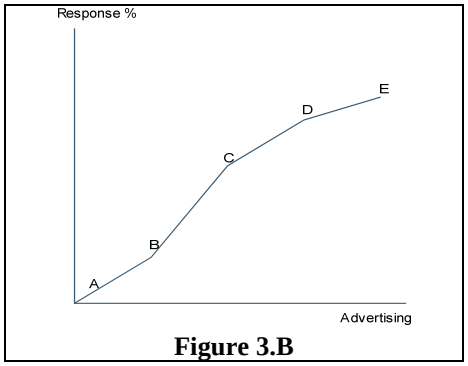


Figure 3.B

demand also does not change with each shift. Figure 1.A shows a demand curve where advertising is assumed to be $1,000. Now if advertising become either $2,000 or $3,000 we then have shifts as illustrated in Figure 1.B.

In order to achieve these shifts, an advertising function must be created. The question is: what is the nature of this function? There is actually very little research on this question. Some possibilities include the following:

Increasing return functions
Decreasing return functions
Constant return function
Increasing/decreasing return function
Decreasing/increasing return function

These five possibilities are illustrated in Figure 2.

Modeling Advertising Functions

From a realistic standpoint, an advertising function would be a curvilinear function. Because of the difficulties in developing or finding equations that create a continuous function as illustrated in Figure 3.A , linear line segments may be used to emulate continuous functions as illustrated in Figure 3.B. Each line segment has a different slope and an assigned range, for example $1,000. Each line can be mathematically stated in the following general form:

$$AP = a + b(\Delta A)$$

Where:

AP - advertising percentage
b - the assigned line slope for a given line segment
Δ A - dollar amount of increase in advertising above advertising at end of previous line segment
a - the ending advertising percentage of the previous line segment

The independent variable Δ A is difference between total advertising and the total advertising at the beginning of the linear line segment in which total advertising happens to fall. Δ A = total advertising minus the highest advertising allowed in the previous line segment. If total advertising is $3,500 and the total advertising at the end of the last line segment is $3,000, then Δ A is equal to $500 ($3,500 - $3,000). Δ A causes an increase or decrease in the advertising percentage and does not directly determine the total advertising percentage.

The consequences of advertising then depend on the parameters that are assigned to each line segment. In the example above (Figure 3.B), each function consists of four connected line segment and each segment has a difference slope. For example, concerning Figure 3.B, the following parameters may be assigned:

	Slope
Line A - B	.0001
Line B - C	.0002
Line C - D	.00006
Line D - E	.00016

Advertising range of each line $1,000

Consequently:

line A - B may be mathematically defined as follows:

$$AP = 0 + .0001(\Delta A)$$

Line B - C may be mathematically defined as follows:

$$AP = .1 + .0002(\Delta A)$$

Line C-D may be mathematically defined as follows:

$$AP = .3 + .0006(\Delta A)$$

Line D-E may be mathematically defined as follows:

$$AP = 9 + .0016(\Delta A)$$

Where: ΔA - Amount of advertising in excess of the maximum advertising in the previous line segment.
AP - Advertising percentage (percentage that demand will increase)

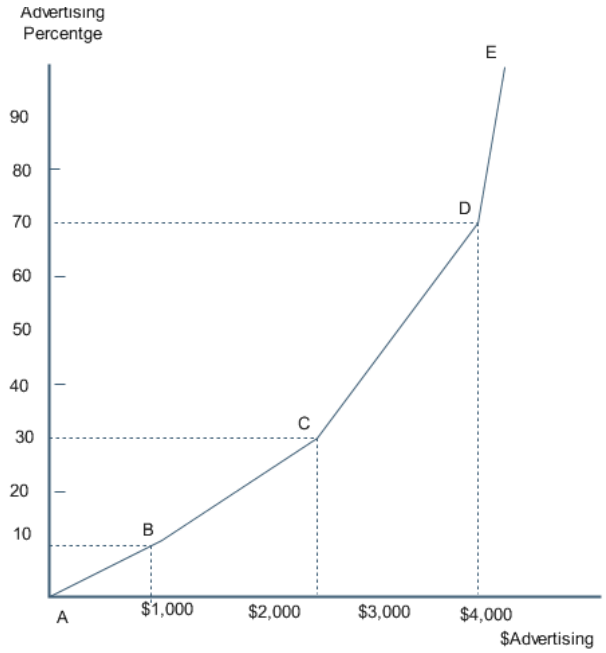
Given these assigned values, we can compute the advertising percentage at any dollar amount of advertising. If advertising is $3,500, then the advertising percentage would be determined by the line segment D-E as follows:

$$AP = .9 + .0016 = 1.7 \text{ or } 170\%$$

The assignment of a value to a slope of each line segment is a trial and error process on the part of the game designer. The final values assigned in part depend on the desired results.

Assume for the moment that this equation represents the industry advertising function. If quantity demanded at a price of $12.00 at zero advertising is 1,000, then the demand based on both price and advertising would be 1,000 x (1.+ 1.7) or 2,700. The

Figure 4 Example of an Advertising Function



advertising function percentage represents the percentage by which demand based on advertising alone will increase. Consequently, total industry demand is demand based on price alone times 1 + the advertising percentage.

The total industry demand quantity (QI) may be defined, therefore, as:

$$QI = QP + AP(QP) = QP(1 + AP)$$

Where:

QI - Total industry quantity demanded
QP - Total quantity based on price alone

QP is a base or starting quantity at zero advertising. If price is decreased, for example, then this base amount will be become larger at zero advertising.

UNDERSTANDING THE ADVERTISING DEMAND FUNCTION

The demand function is extremely complex because of the interaction of the firm advertising function and the industry advertising function. Even with the functions completely visible and all the parameters known, determining the consequences of an advertising decision is not easy for the following reasons.

1. Depending on the slopes of the various line segments of the function, increasing advertising will increase industry demand.
2. Advertising also affects firm demand and, consequently, causes change in firm allocation percentages..
3. Depending on the assigned slopes of the different line segments, the degree to which industry demand increases can be insignificant or highly significant.
4. Depending on the slopes of line segments of the firm advertising function, the affect on market share can be minor or major.
5. When a function has both increasing and decreasing returns, the effect on demand of increasing advertising is difficult to predict and impossible when the parameters are not known.
6. Increasing advertising in the short run may seem to be a bad decision when in the long run it may be a good decision.

Given the advertising function in Figure 4, assume that the assigned parameters are as follows:

Line A-B	.0001
Line B-C	.0002
Line C-D	.0004
Line D-E	.0008

Assume for the moment that demand at zero advertising is 1,000 units at a price of $10.00. Given this information, we can compute the following advertising percentages for each line segment: See Table 1 below.

The interpretation of these values are:

A $1,000 advertising budget will cause a 10% advertising percentage {(0 + ($1,000 x .0001)}

An increase of advertising by $1,000 to $2,000 will result in a 20% increase in demand

(.20 x $1,000). Consequently, the total advertising percentage becomes 30%.

An increase in advertising from $2,000 to $3,000 will result in an advertising percentage of 70%

{.3 + (.0004 x $1,000) = .7}

TABLE 1

	Line A-B	Line B-C	Line C-D	Line D-E
Advertising	$1,000	$2,000	$3,000	$4,000
Advertising percentage	10%	30%	70%	150%
Industry demand	1,100	1,300	1,700	2,500
Increase in demand	----	200	400	800
Percentage increase in demand		18.18%	30.76%	47.06%

Now assume that price is $10 and variable cost is $4.00. Therefore, the contribution of each additional unit sold is $6. Consequently, each $1,000 increase in advertising requires a 167 increase in units demanded ($1,000/$6). Furthermore, assume that at zero advertising industry demand based on price alone is 1,000. If we assume for the moment that all firms in the industry increase advertising by the same dollar amount, then firm demand will remain equal at the same percentage. Therefore, the only affect of advertising would be to increase industry demand.

Increasing advertising from zero to $1,000 by all firms will result in an advertising percentage of 10% (.0001 x $1,000) and an increase in industry demand of 100 units (.10 x 1,000). If the industry consists of four firms, then the demand for each firm would increase only 25 units, far short of the required 167 units per firm to just break even on the increased advertising expenditure.

At an advertising expenditure of $4,000 per firm, the required increase in demand per firm would be 667 units ($4,000/$6). Given this level of expenditure by each firm, average advertising would also be $4,000 and, therefore, the advertising percentage would be 150%. Industry demand would, therefore, increase to a total of 2,500 ((1 + 1.5) x 1,000) or an increase of 1,500 units (2,500 - 1,000). Consequently, each firm=s share of the increase would be 375, again far short of the 667 required increase. In this scenario, total industry demand would be 2,500 (1,000 + 1,500).

The assumption that all firms will equally increase advertising and, therefore, equally share the market is highly unrealistic. When one firm advertises more than another, the firm with the greater advertising would normally increase its market share. Consequently, a firm can increase its share of the total industry demand in two ways: (1) by a share of the increase in industry demand and (2) by taking away industry demand away from the other firms in the industry. How much is taken away from other firms will depend on the advertising of other firms and the slope of the line segments of the firm advertising function.

INTERACTION IN FIRM AND INDUSTRY ADVERTISING FUNCTION

Because the advertising component of the demand algorithm involves two functions, one for the firm and one for the industry, there exists then a number of demand combinations including the following:

	Firm	Industry
Case 1	Increasing returns	Decreasing returns
Case 2	Decreasing returns	Increasing returns
Case 3	Increasing returns	Increasing returns
Case 4	Decreasing returns	Decreasing returns
Case 5	Increasing/decreasing	Increasing/decreasing returns
Case 6	Increasing/decreasing	Decreasing/increasing
Case 7	Decreasing/increasing	Decreasing/increasing
Case 8	Decreasing/increasing	Increasing/decreasing
Case 9	Constant returns	Constant returns

By increasing returns is meant an absolute increase in either firm or industry demand per $1 of advertising. The bench mark for computing this absolute change is always demand at zero advertising. By decreasing returns is meant that when total advertising falls in the next linear line segment, the increase in demand will be less per $1 of advertising. Identifying the desired combinations and then assigning the appropriate parameters is a challenging and not so simple a task. The game designer must be careful not create functions that cause irrational and unacceptable consequences.

The primary purpose now of this paper is to investigate the various combinations as identified above to determine the consequences on net income when different advertising strategies are employed. The consequences once determined then can be analyzed and evaluated against marketing theory and normal expectations.

ADVERTISING STRATEGY IN BUSINESS SIMULATIONS

A major concern in simulation play is advertising strategy. Given the possible variations in the advertising functions as illustrated in Figure 2, the question becomes: what advertising strategy works and does not work in business simulations? A search of simulation literature found no research on this question. Conceptually, for purposes of this paper, strategy will be defined as setting a policy of consistently increasing advertising from period to period by a given amount. In addition, the strategy of making the same advertising decision as the income leader will be explored or, in other words, a “Follow the Leader” strategy.

More specifically, the four strategies to be tested in this paper are the following:

1. Large increase in advertising (for example, a 200% increase initially)
2. A moderate increase (for example, a 100% increase)
3. A small increase (for example a 20% increase)
4. Follow the leader (advertising is changed only to match the advertising of the leading firm)

ADVERTISING STRATEGY AND ADVERTISING FUNCTIONS EXPERIMENT

To test these strategies against different advertising functions, the following experiment was conducted:

1. For each type of advertising functions as described in Figure 2, appropriate parameters were assigned to each line segments.
2. A simple simulation consisting of only two decisions (price and advertising) for research purposes was developed and used. Price in all cases was maintained constant at $10.00. Linear demand functions were created having the following values:

	Firm	Industry
Y-intercept	15	25
Line slope	.01	.05

Given these parameters, the elasticity of firm demand will always be greater than the elasticity of industry demand. Demand at zero advertising was as follows;

Firm	1,000
Industry	1,500

The use of linear demand functions in simulations is explained in detail by Goosen (2007).

3. An industry of 4 firms was created. In each experiment, the simulation was played for 8 periods.
   The strategy of each firm was:

Firm 1	Increase advertising by $1,000 each period
Firm 2	Increase advertising by $500 each period
Firm 3	Increase advertising by $100 each period
Firm 4	Follow the leader (change advertising to be equal to the firm with the largest amount of net income)

4. The dollar range of each advertising line segment was set at $1,000.
5. Nine experiments were done, one for each type of advertising function: See Table 2 below.
6. Advertising for all firms in period 1 was set at $500.
7. For each period, the net income of each firm was recorded . Given the assigned parameters to the firm and industry demand curves and the assigned parameters to different types of advertising functions, net income was computed for each case over eight periods where each firm had a different advertising strategy.

Table 2

Experiment 1	Firm:	Increasing returns	Industry	Increasing returns
Experiment 2	Firm:	Decreasing returns	Industry	Increasing returns
Experiment 3	Firm:	Increasing returns	Industry:	Decreasing returns
Experiment 4	Firm:	Decreasing returns	Industry:	Decreasing returns
Experiment 5	Firm:	Increasing/decreasing returns	Industry:	Increasing/decreasing returns
Experiment 6	Firm:	Increasing/decreasing returns	Industry:	Decreasing/increasing returns
Experiment 7	Firm:	Decreasing/increasing returns	Industry:	Decreasing/Increasing returns
Experiment 8	Firm:	Decreasing/increasing returns	Industry:	Increasing/decreasing Returns
Experiment 9	Firm:	constant returns	Industry:	Constant returns

RESULTS OF EXPERIMENT

Experiment 1. Firm: Increasing Returns
Industry: Increasing Returns

Parameters assigned to the advertising function in this experiment are shown in Table 3, below.

The net income results for experiment are shown in Chart 1.

In this experiment, Firm 4 ranked first with a total net income of $12,944. Firm 1 ranked third. At the end of period 8, Firm 1's net income had declined from $1,863 in period 1 to $738 in period 8. In order to maintain net income, Firm 1 must increase sales by 167 units ($1,000/6) each period to offset the increase in advertising expense. In period 8, in order for Firm 1 to make $1,863, the firm needed for its share of allocated demand to be 1,563 ($1,863 + $7,500)/$6. However, the actual allocated demand was 1,543--20 units short of making $1,863. Nevertheless, in period 8 Firm 4 was the income leader.

Chart 1 clearly shows that the specific advertising functions in this experiment did not support increasing advertising for any of the firms. Actually, Firm 4 was not the leader in net income except for period 8. Nevertheless, the strategy of following the leader allowed Firm 4 to eventually be the industry leader in total net income. See Table 4 below.

Table 3

	Segment 1	Segment 2	Segment 3	Segment 4
Firm	.0001	.0002	.0004	.0008
Industry	.0001	.0002	.0004	.0008

Chart 1

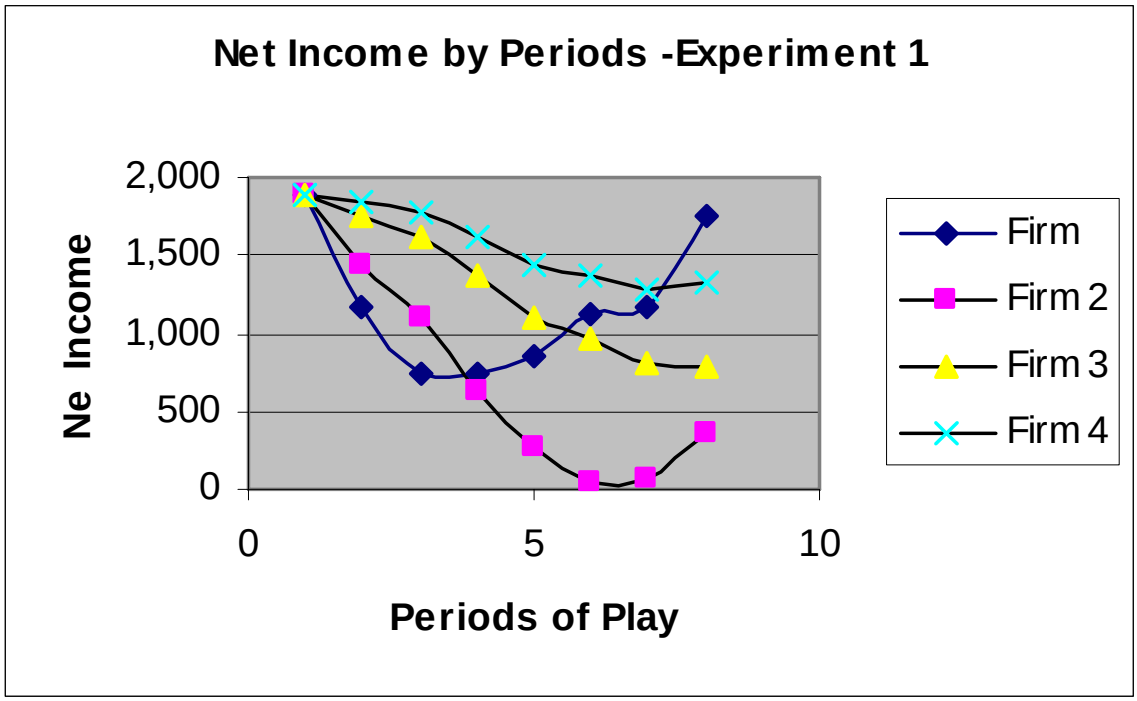


Table 4

	Net Income					
	Periods 1-4	**Rank**	**Period 5 – 8**	**Rank**	**All periods**	**Rank**
Firm 1	$4,519	4	$4,893	3	$9,411	3
Firm 2	$5,032	3	$753	4	$5,785	4
Firm 3	$6,618	2	$3,677	2	$10,295	2
Firm 4	$7,901	1	$5,438	1	$12,259	1

Experiment 2 - Firm: Decreasing Returns
Industry: Increasing Returns

Parameters assigned to the advertising function in this experiment are shown in Table 5.

The net income results for experiment are shown in Chart 2:

In this experiment, Firm 4 again ranked first with a total net income of $14,863. Firm 1 ranked last. At the end of period 8, Firm 1's net income had declined from $1,863 to a loss of $1,735 in period 8. In order to maintain the starting net income of $1,863, Firm 1 must increase sales by 167 units ($1,000/6) each period to offset the increased advertising expense. In period 8, for Firm 1 to make $1,863, the firm needed for its share of allocated industry demand to be 1,563 ($1,863 + $7,500)/$6 . However, the actual allocated demand was 965—598 units short of making $1,863. In fact, Firm 1 showed losses in each of the last four periods.

Again, as in the case of experiment 1, Chart 2 shows that the specific advertising functions in this experiment did not support increasing advertising for any of the firms. Nevertheless, the strategy of following the leader allowed Firm 4 to be the industry leader in total net income. See Table 6 below.

Table 5

	Segment 1	Segment 2	Segment 3	Segment 4
Firm	.0008	.0004	.0002	.0001
Industry	.0001	.0002	.0004	.0008

Chart 2

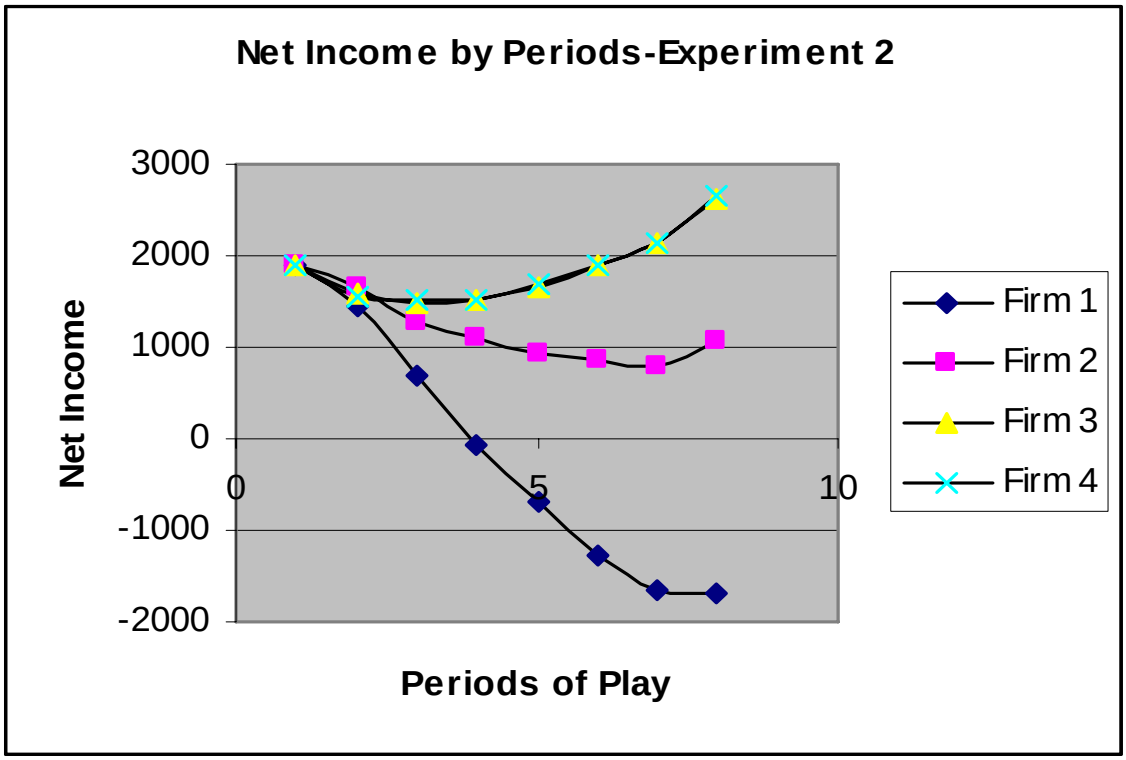


Table 6

	Net Income					
	Periods 1-4	**Rank**	**Period 5 - 8**	**Rank**	**All periods**	**Rank**
Firm 1	$3,950	4-	-$5,305	4	$1,355	4
Firm 2	$5,887	3	$3,681	3	$9,566	3
Firm 3	$6,416	2	$6,318	2	$14,374	2
Firm 4	$6,458	1	$8,405	1	$14,863	1

Experiment 3 **Firm:** **Increasing Returns**
Industry: **Decreasing Returns**

Parameters assigned to the advertising function in this experiment are shown in Table 7 below.

The net income results for experiment are shown in Chart 3:

In this experiment, Firm 1 ranked first with a total net income of $14,863. Firm 2 ranked last. Even though Firm 1 eventually prevailed as the income leader by the end of the 8th period, it was in second to Firm 4 place at the end of 4 periods. The decreasing returns in the industry advertising function starting in the 6th period caused all firms to experience a dramatic decline in net income from period 6 to period 8. Starting with period 6, Firm 1's net income declined from $3,650 to $1,657 per period. In order to maintain the starting net income of $2,650, Firm 1 must increase sales by 167 units each period to offset the increase in advertising expenses. However, in period 8, Firm 1's allocated demand only increased by 39 units causing period 8's net income to decline again.. In period 8, for Firm 1 to make $2,650, the firm needed for its share of allocated total industry demand to be 1,691 { ($2,650 + $7,500)/$6}. However, the actual allocated demand was 1,526—165 units short of making $1,883. Chart 3 clearly shows the declining net income for all firms.

In this experiment, Chart 3 shows that the specific advertising functions in this experiment did support increasing advertising in periods 1 through 4 but not in periods 5 – 8. Nevertheless, the strategy of following the leader allowed Firm 4 to rank second in total net income. See Table 8 below

Table 7

	Segment 1	Segment 2	Segment 3	Segment 4
Firm	.0001	.0002	.0004	.0008
Industry	.0008	.0004	.0002	.0001

Chart 3

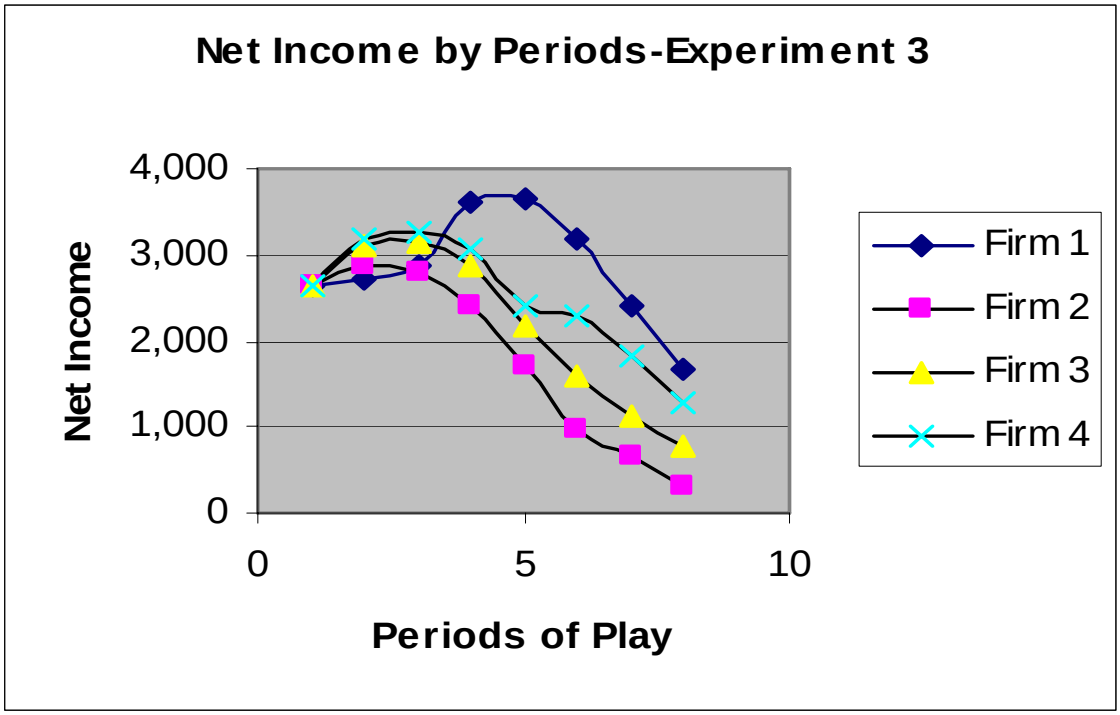


Table 8

	Net Income					
	Periods 1-4	**Rank**	**Period 5-8**	**Rank**	**All periods**	**Rank**
Firm 1	$11,849	2	$10,905	1	$22,754	1
Firm 2	$10,714	4	$3,685	4	$14,399	4
Firm 3	$11,763	3	$5,633	4	$17,396	3
Firm 4	$12,154	1	$7,812	2	$19,967	2

Experiment 4 **Firm:** **Decreasing Returns**
Industry: **Decreasing Returns**

Parameters assigned to the advertising function in this experiment were: see Table 9.

The net income results for experiment are shown in Chart 4:

In this experiment, Firm 4 again prevailed as the number 1 firm in total net income. For periods 1-4, Firm 4 was in second place to Firm 3 which eventually finished in second place. Firm 1's policy of very large increases in advertising proved to be disastrous as evident from Chart 4. In period 8, Firm 1 showed a net loss of $562. To maintain its period 1 level of income, Firm 1 required a minimum increase of 167 units to just earn the same net income as in the previous period.. But in period 8, for example, the increase in allocated industry demand for Firm 1 was just 35 units. Consequently, the net income of period 8 was considerably lower than in period 7.

In this experiment, Chart 4 shows that the specific advertising functions in this experiment did support increasing advertising in periods 1 through 4 for all firms and in periods 5 – 8 just for firms 2 and 3. It is evident that Firm 1 was on the wrong course in periods 5 – 8. In this experiment, the strategy of following the leader allowed Firm 4 to be number 1, but just barely over Firm 3. See Table 10 below.

Table 9

	Segment 1	Segment 2	Segment 3	Segment 4
Firm	.0008	.0004	.0002	.0001
Industry	.0008	.0004	.0002	.0001

Chart 4

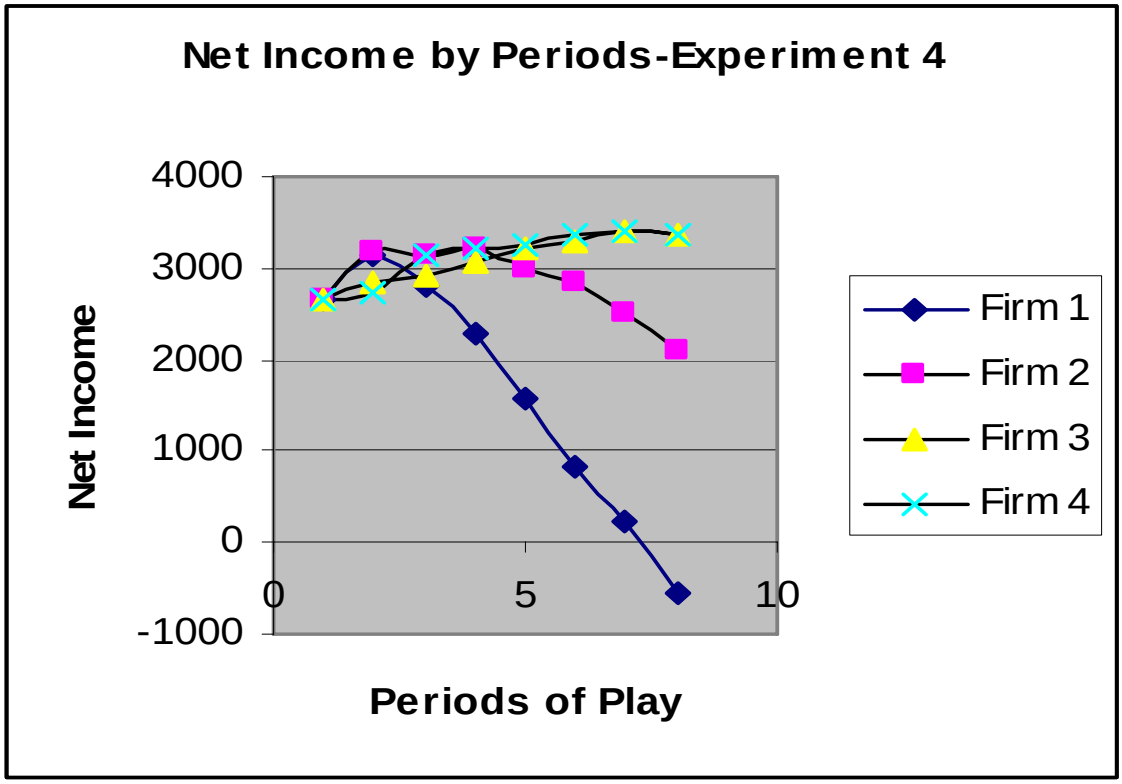


Table 10

	Net Income					
	Periods 1 -4	**Rank**	**Period 5 – 8**	**Rank**	**All periods**	**Rank**
Firm 1	$10,903	4	$2,076	4	$12,979	4
Firm 2	$12,154	1	$10,297	3	$22,451	3
Firm 3	$11,469	3	$13,279	2	$24,479	2
Firm 4	$12,754	2	$13,332	1	$25,086	1

Experiment 5 **Firm:** **Increasing/decreasing Returns**
Industry: **Increasing/decreasing Returns**

Parameters assigned to the advertising function in this experiment were: see table 11.

The net income results for experiment are shown in Chart 5:

In this experiment, Firm 4, the Follow the Leader Firm, is clearly the industry leader in total net income. However, at the end of period 4, Firm 4 was in second place to Firm 2. Starting in period 5, Firm 2's net income began to decline while Firm 4's net income held steady. Consequently, Firm 4 by the end of the 8th period became the overall net income leader. Firms 2, 3, and 4 in this experiment benefited by increasing advertising. Firm 1 did not. See Table 12 below.

Table 11

	Segment 1	Segment 2	Segment 3	Segment 4
Firm	.0004	.0008	.0002	.0001
Industry	.0004	.0008	.0002	.0001

Chart 5

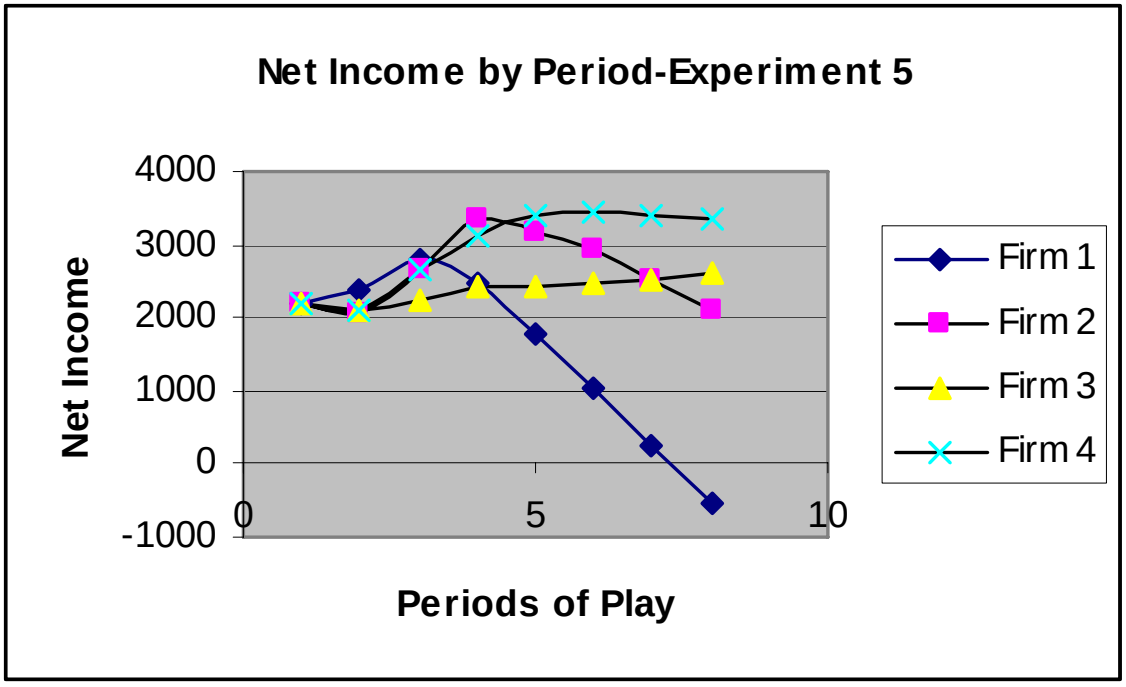


Table 12

	Net Income					
	Periods 1-4	**Rank**	**Period 5- 8**	**Rank**	**All periods**	**Rank**
Firm 1	$9,884	3	$2,525	4	$12,408	4
Firm 2	$10,253	1	$10,701	2	$20,954	2
Firm 3	$8,961	4	$10,044	3	$19,005	3
Firm 4	$10,063	2	$13,615	1	$23,678	1

Experiment 6 **Firm: Increasing/decreasing Returns**
Industry: Decreasing/increasing Returns

Parameters assigned to the advertising function in this experiment were: see table 13.

The net income results for this experiment are shown in Chart 6.

Firm 4 as in 4 out of the previous 5 experiments finished first again in total net income. Firm 1 led

only once and that was in period 2. After this period, the large increases in advertising caused the net income to quickly slide so that in the 8th period net income reached a low of $215. In the 8th period, the allocated demand of Firm 1 only increased by 72 units where a minimum a167 unit increase was required to keep income at the same level as in period 7. The advertising functions in this experiment, as in experiment 5, are considerably more complex than the functions used in experiments 1-4. For example, for a function first having increasing returns and then decreasing returns (a point of inflection) makes it difficult to determine the effect on demand of increasing advertising. Clearly for Firm 1, as the chart shows, dramatically increasing advertising was not a good decision.

See Table 14 below.

Table 13

	Segment 1	Segment 2	Segment 3	Segment 4
Firm	.0004	.0008	.0002	.0001
Industry	.0004	.0002	.0006	.0008

Chart 6

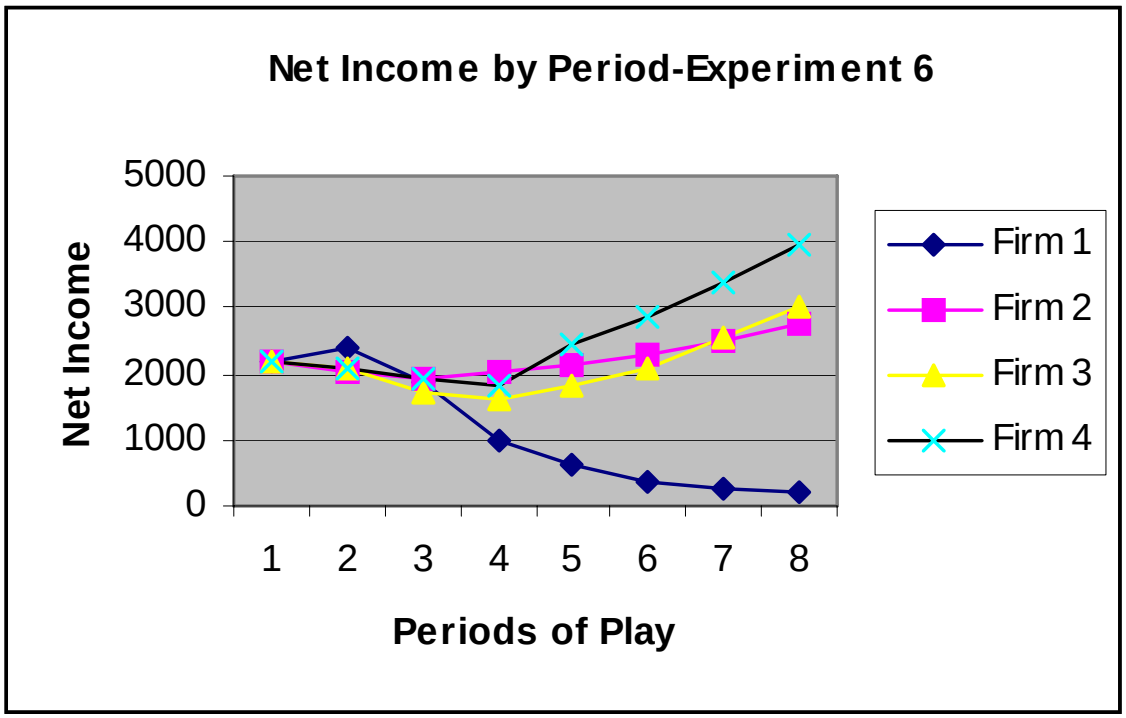


Table 14

	Periods 1 -4	Rank	Net Income Period 5 – 8	Rank	All periods	Rank
Firm 1	$7,472	4	$1,463	4	$8,935	4
Firm 2	$8,129	1	$9,722	2	$17,919	2
Firm 3	$7,645	3	$9,492	3	$17,136	3
Firm 4	$8,026	2	$12,653	1	$20,680	1

Experiment 7 **Firm:** **Decreasing/increasing Returns**
Industry: **Decreasing/increasing Returns**

Parameters assigned to the advertising function in this experiment are shown in Table 15.

The net income results for this experiment are shown in Chart 7.

Firm 4 prevailed in total net income in periods 1-4 while Firm 1 ranked third. However, in period 5 the assigned advertising parameters heavily shifted in favor of Firm 1 such that Firm 1 ranked first in periods 5-8 and also in overall net income. With large increases in advertising, net income for Firm 1 greatly increased such at the end of period 8 net income was nearly $5,000. Also, except for Firm 3, net income after period 4 increased for firms 2 and 4. Here is an example of an advertising function that initially seems to be unkind to increasing advertising and then later at a certain level of increased advertising, the effect on net income is substantial. See Table 16.

Table 15

	Segment 1	Segment 2	Segment 3	Segment 4
Firm	.0004	.0002	.0006	.0008
Industry	.0004	.0002	.0006	.0008

Chart 7

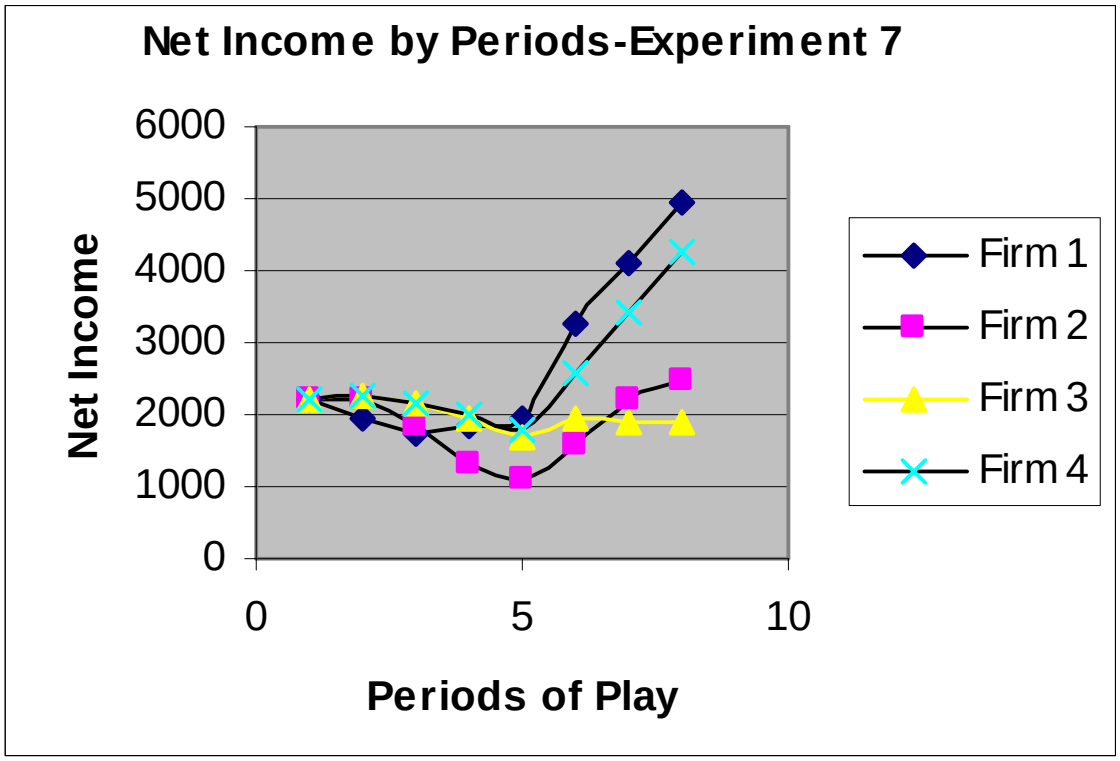


Table 16

	Net Income					
	Periods 1-4	**Rank**	**Period 5-8**	**Rank**	**All periods**	**Rank**
Firm 1	$1,938	3	$14,326	1	$22,072	1
Firm 2	$7,561	4	$7,179	4	$14,740	4
Firm 3	$8,525	2	$7,422	3	$15,947	3
Firm 4	$8,607	1	$12,054	2	$20,661	2

Experiment 8 **Firm:** **Decreasing/increasing Returns**
Industry: **Increasing/decreasing Returns**

Parameters assigned to the advertising function in this experiment are shown in Table 17

The net income results for experiment are shown in Chart 8:

As in the previous experiment, Firm 1 again ranked first in total net income. In this experiment Firm 1 ranked first also in periods 1-4 for total net income, although in periods 2 and 3 Firm 4 ranked first. This function demonstrates that for an advertising strategy to work, more than one period of play is required. The benefits of a particular strategy may not be immediate. It is also apparent from examining Chart 8 that all firms after period 5 are beginning to see a decrease in net income each period. The decreasing returns for the industry advertising function is beginning to have an affect. Although Firm 4, the Follow the Leader Firm, did not finish first, it did finish second, with net income considerably greater than firms 2 and 3. See Table 18.

Table 17

	Segment 1	Segment 2	Segment 3	Segment 4
Firm	.0004	.0002	.0006	.0008
Industry	.0004	.0008	.0006	.0002

Chart 8

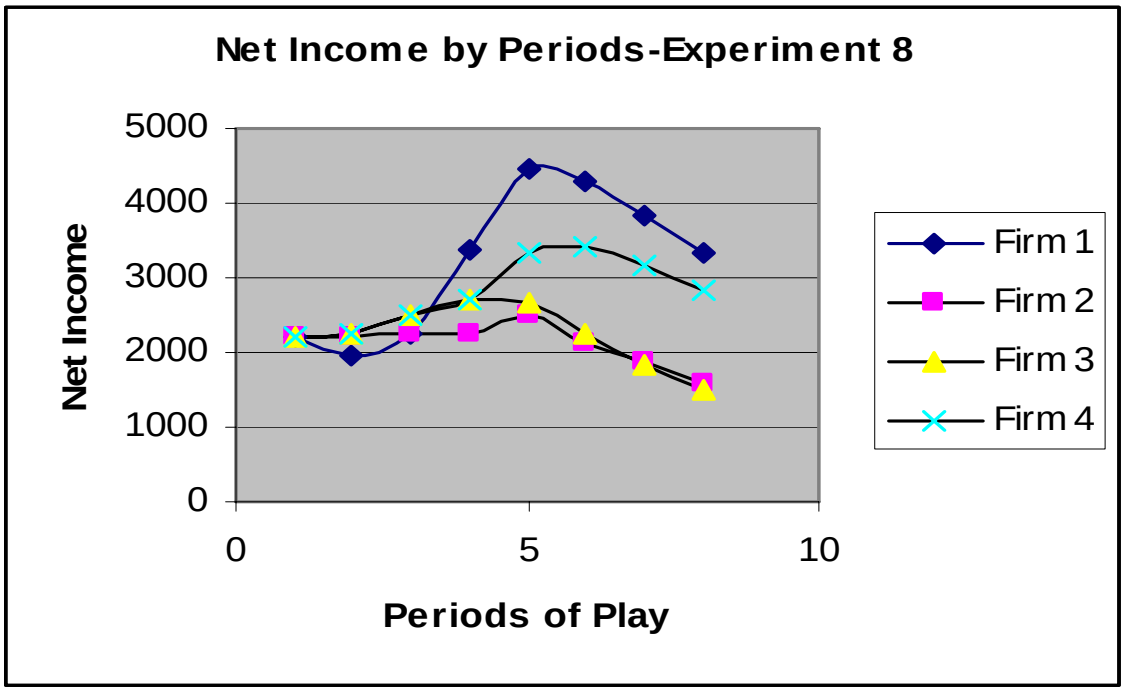


Table 18

	Net Income					
	Periods 1-4	**Rank**	**Period 5-8**	**Rank**	**All periods**	**Rank**
Firm 1	$9,790	1	$15,880	1	$25,670	1
Firm 2	$8,910	4	$8,093	4	$17,002	4
Firm 3	$9,649	3	$8,261	3	$17,910	3
Firm 4	$9,651	2	$12,766	2	$22,417	2

Experiment 9 **Firm:** **Constant returns**
Industry: **Constant Returns**

The net income results for experiment are shown in Chart 9:

A constant return function basically means that what happens in period 1, whether good or bad, will continue in each successive period. Clearly, Chart 9 shows this pattern. The constant return parameters assigned to this function do not at all in any period favor advertising increases. As can be seen in the Chart 9, Firm 1 was showing losses in periods 7 and 8. Firm 4 prevailed as the over-all net income leader strictly because in each period it had the lowest advertising and also never increased its advertising. Firm 4's net income remained constant each period at $1,975. Had Firm 4 not employed a Follow the Leader strategy and also increased advertising, its net income would also have decreased. The use of a constant returns advertising function in simulations seems to be undesirable. It either makes increases in advertising totally undesirable or it makes continual large increases desirable. See Table 20.

Table 19

	Segment 1	Segment 2	Segment 3	Segment 4
Firm	.0002	.0002	.0002	.0002
Industry	.0002	.0002	.0002	.0002

Chart 9

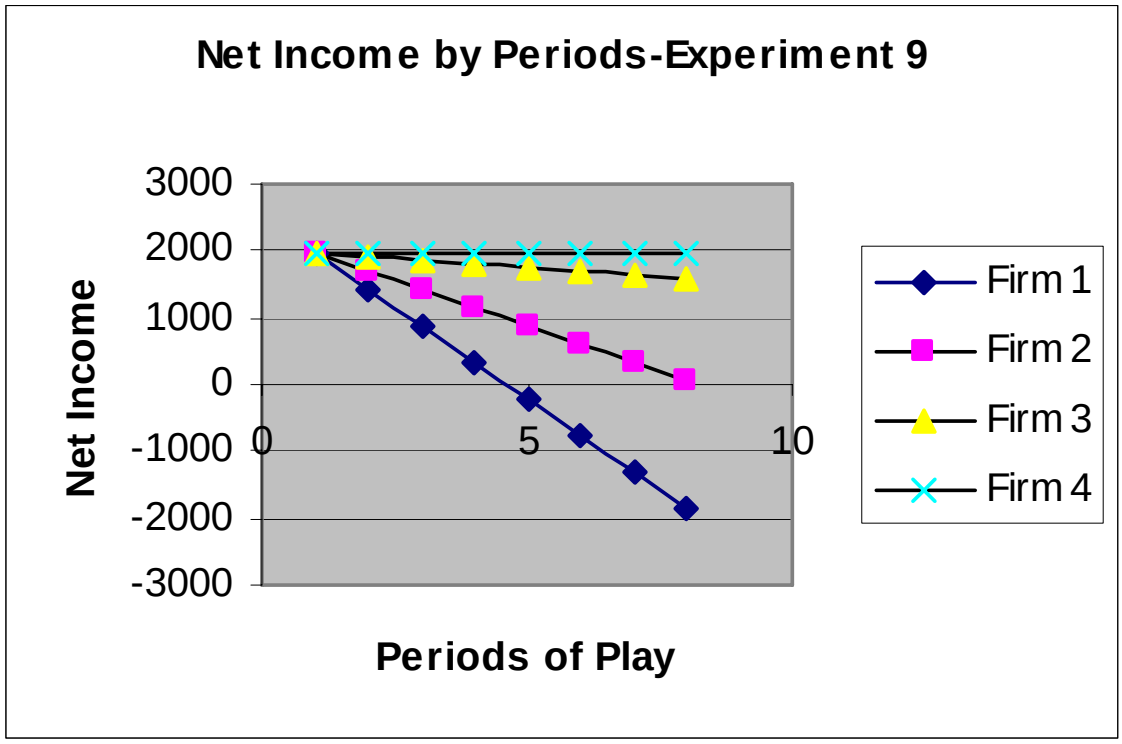


Table 20

	Net Income					
	Periods 1 -4	**Rank**	**Period 5 – 8**	**Rank**	**All periods**	**Rank**
Firm 1	$4,600	4	$-4,200	4	$ 400	4
Firm 2	$6,250	3	$1,850	3	$ 8,100	3
Firm 3	$7,570	2	$6,690	2	$14,260	2
Firm 4	$7,900	1	$7,900	1	$15,800	1

ANALYSIS OF EXPERIMENTS

For each experiment, the final rank or standing of each firm was noted. The standing results were as follows: See Table 21.

It is quite apparent that the Firm 1's strategy of substantially increasing advertising each period overall was not the best strategy. The strategy of Firm 3 proved on the average to be better than Firm 1. The least effective strategy was the advertising strategy of Firm 2. Firm 4 finished first in net income in six of the nine experiments and never less than second. Firm 1 finished first 3 times and last 5 times.

How a firm finishes is actually predetermined by the invisible firm and industry advertising functions. Because of the great uncertainty of the right strategy, the best approach indicated by the nine above experiments is to Follow the Leader. Since this strategy is flexible and adjusts to what appears to be working for another firm, the flexibility of this strategy has a great advantage.

When a strategy should end is difficult to know before it has gone one or two periods too far. When discovered that it is not working, the only alternative left it appears is for the once leading firm to also adopt a follow the leader strategy. The Follow the Leader firm has an advantage in knowing when a strategy has gone too far.

To step back and look at the above findings, the following observations may be made.

1. The determination of a good advertising appears to be a matter of luck. It is impossible to know what the best strategy will be without some experimenting. Finding a workable strategy might require 8 to 10 periods of play or even more.
2. The existence of increasing and decreasing returns complicates finding the right (winning) strategy. What strategy might work for periods 1-4 may not work for the remaining periods. When to decide that a strategy is not working is not easy. Because a strategy did not work very well in the early periods does not mean that it will work in the later periods. The question of when to abandon a strategy is not self evident.
3. The reason the Follow the Leader strategy worked so effectively in this experiment is because the Follow the Leader strategy observes the strategy of the other firms. In essence, the other firms are also experimenting for the Follow the Leader firm and when one firm prevails over others, it is on the whole best to adopt that strategy. By observing the advertising strategy of other firms, the number of trail and error attempts to find a good strategy is greatly reduced. However, adopting the strategy of Firm 2, for example, does not mean that the Firm 2 will do the best the next period. If in the next period Firm 3 prevails, then the desired action of the FTL firm would be to adopt the advertising strategy of Firm 3.
4. Even if the advertising functions and assigned parameter values were provided to students, understanding how the functions work and performing what-if analysis is still a tricky business. Whether a firm can capture market share or how much industry demand will change in large part also depends on the decisions of other teams. For example, if team 1 believes doubling its advertising budget will increase market share by 10%, then this may not happen when the other firms also double their advertising. To some degree, whether a strategy works depends on the assumptions about other firms advertising decisions being correct.
5. It must be pointed out that the Follow the Leader strategy works best if only one firm is using this strategy. In the experiments here, if all firms adopted this strategy, then there would never be a change in the amount of advertising. Standing up at a football game may give a visual advantage, but if all the fans stand up at the same time, there is no longer any advantage.
6. The strategy that works initially may not work as well later. In these nine experiments, the firms that finished first in periods 1- 4 only finished first four times in periods 5 - 8. Also, the firms that finished 4th in periods 1- 4 only finished 4th five times in periods 5-8.

Table 21

Average Rank - Total Net Income (Periods 1 – 8)

Experiment	Firm 1	Firm 2	Firm 3	Firm 4
1	3	4	2	1
2	4	3	2	1
3	1	4	3	2
4	4	3	2	1
5	4	2	3	1
6	4	2	3	1
7	1	4	3	2
8	1	4	3	2
9	4	3	2	1
Total	26	29	23	12
Average	2.88	3.22	2.45	1.33

Average Rank - Total Net Income (Periods 1 – 8)

SUMMARY AND CONCLUSION

Because simulation parameters are hidden within the simulation model and not known to the student participants, the response to increases or decreases in advertising are virtually impossible initially to predict. Only over a period of time (8 to 12 periods of play in some instances) can an effective strategy be found that has a reasonable chance of being effective in terms of net income. The firm that eventually prevails in terms of net income may have done so only by accident. As this study has clearly revealed, the firm with the largest advertising budget will not necessarily lead the industry in total net income. In this study, Firm 1 prevailed as the net income leader 3 times and finished last 5 times.

If chance or luck is the dominant factor in price or advertising strategy as has been made clear here now in the advertising experiments reported in this paper, then the use of net income as a measure of learning is likely to be highly misleading. As this study has demonstrated, the element of chance or luck can be greatly reduced by using the Follow the Leader strategy. The Follow the Leader strategy is more likely than not to result in a first place finish given that the simulation is basically simple. The number of times that the Follow the Leader strategy prevailed in this study was surprising. It was expected that the follow the leader strategy might prevail on the average as the number two firm, but to be the dominant first place finisher in 6 of the 9 experiments was not expected.

The follow the leader strategy theoretically has been proven in this study and also in the previous study involving price to be a winning strategy. However, some actual studies need to be made where in simulation play some real student participants have agreed to use strictly a follow the leader strategy. The theory presented in this paper concerning a Follow the Leader strategy needs to be tested.

REFERENCES

Goosen, Kenneth R. (1995) An Analytical Advertising Model Approach to the Determination of Market Demand, Developments in Business Simulations and Experiential Exercises,

Goosen, Kenneth R. (2008) Do Price Strategies Work in Business Simulations, Developments in Business Simulations and Experiential Learning

Goosen, Kenneth R. (2007) An Analysis of the Interaction between Firm Demand and Industry Demand in Business Simulations, Developments in Business Simulations and Experiential Learning, 2007

Gold, Steven and Pray (1983), Thomas, Simulating Market and Firm Demand–A Robust Demand System, Development in Business Simulations and Experiential Exercises

Gold, Steven and Pray (1984) Thomas, Modeling Non-Price Factors in the Demand Function of Business Simulations, Developments in Business Simulations and Experiential Exercises,1984

Kotler, Philip (1967) Marketing Management, Prentice-Hall