the students realize that an oligopoly setting discourages price competition – but encourages non-price competitive practices such as sales promotion through advertising, trading stamps, etc.

Another feature of simulation games is their role in broadening the student's myopic view of marketing. Many students may view the marketing system as extending only to the local elevator or processing plant. Some computer games can increase the student's awareness of the continuous chain of interrelated activities throughout the entire agricultural production and marketing systems.

Computer simulation games also provide the opportunity for a sensitivity analysis by which the student can evaluate the effect of a certain competitive practice when all other forms of competition or market variables are held constant. An example is allowing one firm the opportunity to vary its advertising level while all other variables are held constant by all firms. Similarly, the effect on the market process of varying the number of participating firms can also be seen, which in turn helps demonstrate important economic principles.

Finally, a few comments regarding administration of computer games. While such games seem to be useful teaching and learning devices for marketing courses, certain methods or procedures in administering them can increase their effectiveness. Game administrators should be aware of the amount of course time which should be devoted to a game. Devoting regularly scheduled class meetings for both critiquing game results and completing team decisions is highly desirable. This is crucial to maintaining and stimulating interest and in promoting a sense of competition among teams. In addition, this provides an opportunity for the administrator to point out the application of a principle or specific aspect of the course. Naturally, the amount of class time required is correlated with the frequency with which game decisions are submitted.

Submitting one set of decisions per week seems optimal. Submitting decisions on a less frequent basis tends to create difficulty for the students in recalling past game results and hence may contribute to a loss of interest. More frequent decisions may not allow enough time for a sufficiently detailed analysis of game results by each participant prior to submission of each set of decisions. In this connection, the administrator should strive to minimize time lags wherever possible – especially the time between submitting decisions and receiving results. Thus, access to on-campus computing facilities is essential.

Conclusion

Babb and Eisgruber have outlined some ideas or concepts that can be taught through business management games[5]. These include concepts and practices of management, suboptimization, and long run and short run planning. This paper has attempted to point out one additional concept which can be taught with computer simulation games, that is, a greater understanding of the complexities of today's agricultural market system and the existing competitive relationships. In a market system as complex as found in the U.S., this becomes crucial. Perhaps too often we graduate our students in an agri-business curriculum without a proper appreciation for the competitive jungle within which they will be expected to perform. This is particularly crucial for some students who hold a rather myopic view of the market system. Computer simulation games can add breadth as well as some reality to our marketing courses. While most of these games tend to have a management orientation, it is relatively easy to adapt them to a marketing situation. Some procedural or logistical requirements must be reckoned with in implementing the games, but the games do offer considerable potential as a teaching and learning device in a study of agricultural marketing problems.

NOTES

1 The investigation reported in this paper (No. 72-1-93) is in connection with a project of the Kentucky Agricultural Experiment Station and is published with approval of the Director.

2 Assistant and Associate Professors of Agricultural Economics, respectively, University of Kentucky.

3 For example, see Joe S. Bain, INDUSTRIAL ORGANIZATION (New York; John Wiley & Sons) 1968 (second edition) and Willard F. Mueller and Robert Clodius, "Market Structure as an Orientation for Agricultural Economics Research," JOURNAL OF FARM ECONOMICS, August 1961, pp. 515-533.

4 For more detail about these games and their use see:
E. M. Babb and L. M. Eisgruber, "Manual-Purdue Dairy Management Game", "Manual-Purdue Supermarket Management Game", and MANAGEMENT GAMES FOR TEACHING AND RESEARCH, Chicago: Educational Methods, Inc., 1966.

5 Babb and Eisgruber, MANAGEMENT GAMES, op. cit. p. 26.

AN UNDERGRADUATE HOG MARKETING GAME*

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INTRODUCTION

This paper reports some experience in the use of a simple hog marketing game as a teaching aid, and to study the feasibility of simulating alternative hog informational/bargaining arrangements in a behavioral laboratory.

The hog marketing game was designed for teaching purposes to dramatize, and to make students aware of, the alternative marketing strategies available to hog farmers.

A secondary purpose was the use of the game as a pilot to pre-test the potential of this technique in market structure research, and to examine the degree of abstraction which is compatible with realism and involvement.

The first section of this paper introduces the main components of the game. This is followed by a discussion of the game play by the students. An optimal solution to the game play is then discussed.

GAME COMPONENTS

The final version of the hog marketing game allows for:

1) The purchase of two weights (40 and 60 lbs.) and two grades (A and B) of feeder pigs,
2) The sale of finished hogs at two weights (210# and 230#) and four grades (#1, 2, 3, and 4).
3) Sale to two packers (I and II),
4) Sale through several marketing channels including terminal, country, grade and yield markets, and eastern shippers, and
5) Alternative farmer bargaining arrangements.

Each of the two packers maintained, in addition to a head hog buyer, a representative at the terminal, a country market (packer-operated), and a grade and yield buying agency at the packing plant.

At each play of the game, the farmers decided what feeder pigs to buy and how to sell the finished hogs.

GAME PLAY

In the spring and fall of 1969, an advanced livestock marketing class was used in a pilot simulation of finished hog marketing to packers.

Design

The participants in this exercise were members of the Ag. Econ. 521 class, a dual level course in livestock marketing. They were divided into two groups, "farmers" and "packers." The simulation centered on four alternative hog marketing-hog buying alternatives: terminal, country, grade and yield, and contractual.

In the spring class, Version I of the game was introduced gradually over a period of four class sessions, beginning simply and increasing in complexity. In the fall class, the total complexity of Version II was presented to the student in the first session.

In both the spring and the fall, however, the first day of exposure consisted of a "walk through" which allowed the student

to become accustomed to the format and the procedures of the exercise. The difference was that in the spring, only one option was described at each stage. As the students learned, the rules were embellished, which made the game more complex.

Game Procedure

Each simulated marketing session was divided into three parts. First, both the farmers and the packers, planned. Secondly, they interacted. Third, they calculated results.

For the farmers, the planning stage involved the purchase of feeder pigs. This decision had four alternatives. The farmer could purchase two grades and two weights of feeder pigs. He had complete information on the feed efficiency and the probability of carcass quality of all four weight-grades. What he did not know was the quality price differential on weight and grade which would exist at the alternative live hog marketing channels.

For the packer, the planning stage involved setting up price guidelines in each channel which he operated. This meant that the packer had to consider the various channel costs in addition to his total overhead cost to arrive at an initial price bid for his buyer(s) on the terminal, country, grade and yield markets.

The price of feeder pigs was given exogenously to the "farmers," and the wholesale value of the alternative weight-grades of market hogs was given to the "packer." Packers were also assigned fixed cost, so that if no hogs were bought they lost money.

Thus, the stage was set. The farmers knew their costs, and the packers knew their potential revenue. The question was, "At what price and in what channel will the exchange of hogs occur?" Of course, much of the result depended upon the cost structures built into the simulation.

For example, the farmer's cost information on feeder pigs was very important. He could buy feeder pig grade A or feeder pig grade B. Regardless of the grade he selected, he could buy either 40# or 60# animals. The higher grade feeder pig cost more, but had a better feed conversion and a better carcass grade profile than the lower grade feeder pig.

The vital information available to the packer-buyers pertained to potential revenue from alternative carcass qualities. Generally speaking, the higher quality hogs were more valuable than the lower quality hogs just as the lower weight hogs were more valuable than the higher weight hogs, on a per-pound basis.

While the cost structures were most important to the price discovery process, some of the result was wholly unique to the participants role-playing the packers and farmers. In the quest for the same goal farmers sold to different channels at different prices, the same channel at different prices, and even to the same packer in the same channel at different prices.

In the fall the students' grades were affected (slightly) by their calculated profits, and there was little doubt as to their involvement in the game. The participants were under a severe time constraint (about half an hour) to simultaneously calculate the outcomes of alternative marketing strategies and haggle for a better price.

Example of Involvement

On the third play of the fall simulation, an interesting situation developed. Several students role-playing farmers had approached those students role-playing packers and asked for a price bid for a volume of 1000 hogs (10 farmers with one lot of 100 hogs each). The packer said it would pay $18.00/cwt. for such a supply.

Later the "farmer-organizers" came back, but with only 700 hogs (or 7 farmers) committed to them. The packer-buyer was not happy about the loss of 300 head. The farmer-organizers pressured the packer-buyer to either take the 700 head for $18.00 or forget about it. The packer-buyer reluctantly agreed, and asked the farmer-organizers to deliver the hogs (by indicating the names of the farmers who were part of the group). In the meantime, one of the farmers decided to sell his hogs elsewhere. Thus, the farmer-organizers could only deliver 600 head of hogs. At this point, the packer-buyer yelled, "foul play."

So, in a meeting of the group, it was decided that the farmer-organizers were responsible for delivery of all hogs specifically contracted – namely 700 head. The 1000 quantity has been mentioned, but only as "around 1000" and not in exact terms. The 700 figure was judged to be a specific contract and only 600 head had been delivered, 100 short of the agreement. Thus, damages received by the packer, which consisted of the profit opportunity loss on the 7th lot of hogs, were paid by the farmer-organizers who, in turn, allocated the cost among their group. The group then pondered whether they had any recourse to the lone farmer who had reversed his decision in the last stages of negotiation. Because this kind of event had not been anticipated, they did not.

In the next session, each farmer wanting to bargain collectively had to sign a permanent commitment, one which would allow recourse for damages in a similar situation. This event was taken very seriously by all the students involved.

This event illustrates how the simulation brings to life some of the very real conflicts which might exist in the real world livestock marketing environment, with respect to farmer bargaining: individual vs. group action; group bargaining power vs. individual bargaining power; packer cohesiveness vs. farmer cohesiveness, and the like.

This event, in some degree, is a microcosm of the real world. Although most of the complexity is abstracted away, it is felt that much of the alternative perspectives and basic attitudes of the packer and the farmer were created in this simulated environment.

Another example of participant involvement is provided by one country buyer whose reputation caught up with him. In the first round of the spring game, he bought a large quantity of hogs. His technique was to lower price each time a farmer returned to ask for his bid. As a consequence, he bought hogs at a low price which resulted in a good profit for him and a poor profit for the farmers with whom he dealt. His fame as a shrewd buyer spread through the group.

On the second round, his reputation apparently caught up with him for he bought no hogs at all. His attitude was that it did not pay to build up a good reputation in a two-period game. This illustrates that the reputation-building aspect of the buying process could be very important in a game of longer duration as it is in the actual livestock marketing environment.

Student Observation

The students were more concerned with general price level than with specific prices for specific weight-grades of hogs. Getting top price was given high priority. Low priority seemed to be given to varying price discount schedules by the packers or predicting discount schedules by the farmers. For example, in the third session, the group bargaining which occurred emphasized price, not quality. The buyers seemed to be more concerned with covering their overhead costs than in obtaining a specific grade of hog. This is not dissimilar to the pressure which packers are under to keep their volume high.

A disappointing aspect of the game was that many of the students did not delve deeply into the various discount schedules and the implications they had on the weight-grade feeder pig purchases. The feeder pig purchase decision was based primarily on feeder pig price, feed efficiency, and carcass quality data, but not on the price discounts expected for market hogs. On the other hand, it is somewhat understandable that this factor was not included since the students role-playing farmers had no way of predicting what it would be other than knowing the wholesale value of various weight-grades. Also, the complexity of even this relatively single game was a hinder to vigorous analysis of discount schedules. On the other hand, perhaps the frustration of search for needed information made the game seem like a real market.

THE SEARCH FOR INFORMATION

Here is a brief description of behavior by market channel:

Terminal Marketing

The most noticeable behavior was the almost complete dependence on

the terminal market for price comparisons and the almost total lack of actual sales in that market. In part this can be attributed to the fact that the students were told that once they entered the terminal market, they could leave only under a stiff penalty for backhauling the hogs.

Country Marketing

The marketing of hogs in the country markets was a popular means of selling for the farmers, particularly due to a zero marketing charge, borne by the farmer. (It was assumed that a typical farmer has negligible cost in delivering his hogs locally in his own trucks.)

Grade and Yield Marketing

The students had difficulty using the grade and yield channel in the marketing system. For example, in the first play, only one sale in the grade and yield market was executed correctly – priced on a carcass basis, by grade. Other sales were consummated in the grade and yield channel, but these sales were made at either a single-price basis or a live-price basis, or both, but not at a multiple-carcass price basis, as the students were instructed to do. One student, in a later session, sold grade and yield, but misinterpreted the carcass price as a live price and ended up with a loss on his hogs.

Contractual Marketing

As a result of the "hog shortage incident" (described earlier), the penultimate play of the fall game included the rule that all farmers selling as a group will be liable to a packet for any price and quantity contracted and any farmer who signs his name to a group action will be liable to deliver his hogs. This rule was designed to overcome the previous situation where one farmer signed with two farmer bargaining groups.

In the play that followed, every single one of the farmers signed up in the same farmer bargaining group. This group then played one packer against the other until they achieved their price objective. They then sold all hogs to one packer and left the other with no hogs at all.

A Systems Approach

There was a noticeable change in the sophistication of the participants in successive plays of the game as shown in Table 1.

The students started out marketing in every channel. The farmers purchased different weight-grades of feeder pigs and the packers bought all hogs regardless of weight-grade. (Play IIA)

However, as the students became more familiar with the cost/revenue structure of the game and as they became more acquainted with each other, group selling of homogeneous lots of hogs became more common. (Play IIB)

In the final play of the game structure was changed to permit even more coordination between groups of farmers and the two packers. (Play IIC) The game structure was changed to eliminate price. Profit-sharing could be negotiated, but not price. Farmers were split into two groups and assigned to a specific packer. They had to either negotiate with that packer or become deadlocked. It was interesting how the students reacted to this changed structure.

All of them were familiar with the magnitude of the systems profit (farmers' profit plus packers' profit) which was available under optimal conditions. They had been asked to calculate this systems profit prior to the session. For this play, maximum potential systems profit was the same for both groups.

Table 1. Market Structures Used

Market Rules	Free Market (Play IIA)	Contractual (Play IIB)	Joint Venture (Play IIC)
Individual Selling Permitted	Yes	Yes	No
Farmer Must Sell With Group Once Committed	No	Yes	Yes
Live Hog Price Has Basis For Exchange	Yes	Yes	No
Profit Sharing Negotiated	No	No	Yes
Farmer-Producers Free to Approach Competing Packers	Yes	Yes	No

The final outcome of the two groups was: Packer A and their farmer group split the systems profit 30% and 70%, respectively; and Packer B and their farmer group split the systems profit 20% and 80%, respectively. The Packer A group purchased the lower priced B feeder pigs exclusively and the Packer B group purchased the higher priced A feeder pigs exclusively.

In comparing profits from the various groups, an interesting fact became apparent. The farmers who achieved the higher percentage of profits (80%) actually obtained less absolute profits than the farmers who achieved a lower percentage of profits (70%). The reason was that the second group had a higher systems profit due to a wiser feeder pig decision, as can be seen from Table 2.

Table 2. Profit Comparison by Dollar & Percentage

	Systems Profit	Profit Per 100 Hogs	
		Packer Share	Farmer Share
Packer A Group	$1306	$391 (30%)	$914 (70%)
Packer B Group	$1117	$223 (20%)	$893 (80%)

The students bargaining discussions first centered on price (even though they were instructed to not discuss price, they could not avoid it), and subsequently on percentage of total profit to be received by each party (farmers vs. packers). Little attention was given to physical product coordination strategies which would maximize total profits.

OPTIMAL VS. ACTUAL PERFORMANCE

In Version I of the hog marketing game, the two packer price sets were different, but Version II price sets were the same. Packer "price sets" are those exogenous prices at which the packers can sell their wholesale pork cuts derived from the hogs they buy. Demand is assumed to be perfectly elastic at these prices.

The marketing game was not explicitly designed for analysis by linear programming, but despite this it was susceptible to analysis by linear programming. The appropriate analyses are now discussed.

Two weights and grades of feeder pigs were assumed to be available in unlimited amounts at fixed prices. The appropriate technical coefficients are given in Table 3. The quality of finished hogs available for sale next period was assumed to depend solely on the quality of feeder pigs bought in this period. The farmers' feeding costs were assumed to be fixed for each weight-grade of feeder pig as in Table 3. Farmers were allowed to split their lots, that is to sell, say, their U.S. #4 to one packer and all other hogs to the other.

Table 3. Feeder Pig Purchase Options

Grade	A		B	
Weight (lbs.)	40	60	40	60
Cost $/Hog	10	13	7	11
Total Feed Cost	15.94	16.15	18.06	18.27
Finished Weight	210	230	210	230
Finished Grades:				
U.S. No.1 (%)	85	74	29	15
U.S. No.2 (%)	8	11	44	14
U.S. No.3 (%)	5	8	20	44
U.S. No.4 (%)	2	7	7	27

The costs of selling finished hogs for each type of market are recorded in Table 4. The cost record in Table 4 was taken to be a net drain on the system; the costs did not reappear as components in anyone's profit function.

Table 4. Marketing Costs and Charges by Type of Market

Type of Market	Terminal	Country	Packer	
			Station	Grade Yield
Cost Item (Per Head)				
Producer	$.75	$.00	$.30	$.30
Packer	.00	.40	.20	.20
Total	$.75	$.40	$.50	$.50

Each of the two packers was assumed to have overhead of $300 per period (totally unrelated to volume), and to have an infinite demand for hogs at the prices given in Table 5. That is, Table 5 is taken to reflect the "true" variable cost break-even value of hogs to the packer. If Packer A has to pay more than $19.00 for U.S. # 1's, he is better off, all things considered, not to buy. To break even for his whole operation a packer has to

have $300 of contribution to overhead by buying his hogs below the price given in Table 5.

Table 5. Value of Hogs to Packers ($/Head)

Packer Revenue Per Cwt.	A	B
210 lb. Weight		
U.S. No. 1	19.00	19.25
U.S. No. 2	18.75	19.00
U.S. No. 3	18.75	18.75
U.S. No. 4	18.50	18.10
230 lb. Weight		
U.S. No. 1	18.75	18.50
U.S. No. 2	18.00	18.25
U.S. No. 3	18.25	18.00
U.S. No. 4	18.00	17.75

A linear programming problem can be formulated from the above information, and an optimal plan is given in Table 6. This solution generated a "systems" profit (including both farmers and packers) of $12,618. The hogs purchased were B, 40 lb. feeder pigs and they were marketed to both Packer A (Grades 3 and 4) and Packer B (Grades 1 and 2).

Table 6. Optimum Plan – First Session, Version I

Activity	Quantity	Unit	Cost/Revenue
Buy B, 40 lb. Feeder Pigs	900	Head	$ 7.00
Feed	16254	Dollars	1.00
Sell 210, No. 1	544.5	Cwt.	19.25
210, No. 2	828.5	Cwt.	19.00
210, No. 3	364.3	Cwt.	18.75
210, No. 4	135.5	Cwt.	18.50
Country Marketing	900	Head	.40

The "systems" profit under the optimum plan can be traced in the aggregate, as follows:

Revenue			$35,532
Cost:	Feed	$16254	
	Pigs	6300	
	Marketing	360	
			$22,914
			$12,618
Per Head			$ 14.02
Per Cwt.			$ 6.67

Now, a comparison is made between the profits generated by the optimal plan and those produced by the participants in the behavioral experiments. The behavioral outcome generated a "systems" profit of $12,172.

The profit figures can be traced in the aggregate under the behavioral approach, as follows:

Revenue			$35,844.
Cost:	Feed	$15,082.	
	Pigs	8,100.	
	Marketing	490.	
			$23,672.
			$12,172.
Per Head			$ 13.52
Per Cwt.			$ 6.43

Table 7. Behavioral Plan – First Session, Version I

Activity	Quantity	Unit	Cost/Revenue
Buy A, 40 lb. Feeder pigs	600	Head	$10.00
Buy B, 40 lb. Feeder pigs	300	Head	7.00
Feed A, 40 lb. Feeder pigs	9564	Dollars	1.00
Feed B, 40 lb. Feeder pigs	5418	Dollars	1.00
Sell 210, No. 1, Packer I	117.6	Cwt.	19.00
Sell 210, No. 2, Packer I	184.8	Cwt.	18.75
Sell 210, No. 3, Packer I	84.0	Cwt.	18.75
Sell 210, No. 4, Packer I	33.6	Cwt.	18.50
Sell 210, No. 1, Packer II	411.6	Cwt.	19.25
Sell 210, No. 2, Packer II	646.8	Cwt.	19.00
Sell 210, No. 3, Packer II	294.0	Cwt.	18.75
Sell 210, No. 4, Packer II	117.6	Cwt.	18.10
Country Marketing	100	Head	.40
Terminal Marketing	200	Head	.75
Direct Packer Marketing	600	Head	.50
Grade/Yield Marketing	0	Head	.50

The comparison shown in Table 7 resulted from the first session of the spring experiment. A similar difference in optimal and behavioral "system" profit per head occurred in the fall experiment.

The optimal plan as shown in Table 8 generated a "systems" profit of $7.34 per head compared to a "systems" profit of $6.00 per head for the behavioral experiment as shown in Table 9.

Table 8. Optimum Plan – First Session, Version II

Activity	Quantity	Unit Cost/Revenue	
Buy B, 40 lb. Feeder pigs	1600.	Head	$ 7.00
Feed	28896.	Dollars	1.00
Sell 210, No. 1	940.	Cwt.	19.25
Sell 210, No. 2	1478.	Cwt.	19.00
Sell 210, No. 3	672.	Cwt.	18.75
Sell 210, No. 4	268.	Cwt.	18.50
Farmer Direct Bargaining	1600.	Head	.30

Table 9. Behavioral Plan – First Session, Version II.

Activity	Quantity	Unit	Cost/Revenue
Buy A, 40 lb. Feeder pig	1000	Head	$11.00
Buy A, 60 lb. Feeder pig	400	Head	13.00
Buy B, 40 lb. Feeder pig	200	Head	7.00
Feed A, 40 lb. Feeder pig	15940.	Dollars	1.00
Feed A, 60 lb. Feeder pig	7224.	Dollars	1.00
Feed B, 40 lb. Feeder pig	3230.	Dollars	1.00
Sell 210 No. 1	823.	Cwt.	19.25
Sell 210 No. 2	1293.	Cwt.	19.00
Sell 210 No. 3	588.	Cwt.	18.75
Sell 210 No. 4	235.	Cwt.	18.50
Sell 230 No. 1	128.	Cwt.	18.50
Sell 230 No. 2	202.	Cwt.	18.25
Sell 230 No. 3	92.	Cwt.	18.00
Sell 230 No. 4	36.	Cwt.	17.75
Country Market	800	Head	.40
Terminal Market	0	Head	.75
Farmers Direct Bargaining	0	Head	.30
Grade/Yield Market	800	Head	.50

The profit figures can be traced in the aggregate for the optimal plan and the behavioral approach, as follows:

		Optimal		Behavioral	
Revenue:			$63,735		$64,130
Cost:	Feed	$28,896		$26,394	
	Pigs	11,200		17,600	
	Mktg.	480		720	
			$40,576		$44,714
			$23,159		$19,416
Per Head			14.47		12.13
Per Cwt.			6.80		5.70

Although grossly abstracted from reality, this comparison between optimal and simulated performance in finished hog marketing illustrates the nature of the inefficiency which can exist even when "farmers" know in advance how much packers can afford to pay for specific carcass weight-grades, and "packers" know production costs associated with an alternative weight-grade of feeder pigs. This pilot simulation comparison between optimal and behavioral patterns, simple though it may be, illustrates how easy and natural it is for the transfer process from feeder pig to hanging carcass to be suboptimized.

EVALUATION

As a teaching exercise, there can be little doubt that this game stimulated interest and awareness on the part of students in the hog marketing process.

Post-game questionnaires were given, which quizzed the participants about game mechanics (forms and calculations), competition and organizational conflicts, and usefulness and possible improvements to the game.

The response to the questionnaires was encouraging. In answer to the question, "Is the game sufficiently worthwhile as a learning device to warrant further development," 26 out of 28 students in the spring class and 25 out of 27 in the fall class responded, "Yes."