AGRIBUSINESS SIMULATORS FOR MANAGEMENT TRAINING

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Abstract

This paper describes four agribusiness simulators which can be processed on a microcomputer for use in undergraduate and extension teaching. The simulators model the environment in which supermarket chains, farm supply centers, and cooperative and proprietary grain elevators compete for business. Instruction manuals, user's manuals, and a diskette are distributed for each simulator. Each diskette contains programs to enter and edit team decisions, to process decisions and print reports, and to create graphs of team performance. The simulators can be used to teach financial management concepts and techniques, as well as economic principles.

Key words: agribusiness, simulator, microcomputer, management game.

Simulators (management games) have been used for more than 25 years to teach economic and business topics to persons in collegiate, extension, and industrial training programs. In the past, the use of simulators was restricted to those who had access to a mainframe computer and required programmers or others who could install the software. Teaching was usually done at the location of the computer and simulator use had to conform with established processing procedures. With the widespread availability of microcomputers, simulators can now be used by a much broader group of teachers and in more flexible teaching frameworks.

Brief comments about the use of simulators are made here since reviews of early applications (Babb and Eisgruber) and contemporary evaluations (Siegfried and Fels) are available. Simulators represent an extension of case study methods of teaching. Students normally make a sequence of decisions where changing market conditions, competitors' behavior, and other factors must be considered. There is feedback from each set of information from earlier decisions. In contrast, case studies are usually static.

Simulators have generally been found to be effective for teaching (Wolfe), but their benefits must be considered in relation to additional student time requirements and costs (Schriesheim and Schriesheim). They have been used to teach concepts and practices of management, planning techniques, organization principles, and characteristics of an industry. Simulators can be used as a laboratory to reinforce abstract principles and concepts being taught. The purpose of this article is to describe four microcomputer software packages which can be used by agricultural economists in undergraduate and extension teaching.

COMPUTER PROGRAMS

The four software packages are: supermarket chain simulator, farm supply center simulator, and grain elevator simulator (cooperative and proprietary firm versions). Each simulator models the environment in which firms (teams of students) compete for business. Each software package consists of a notebook containing an instruction manual for students, a user's manual for the teacher and/or person inputting team decisions, a quick reference guide, a set of blank forms (decision form, cash budget, and profitability model), and a diskette.

The diskette for each simulator contains three programs which are accessed by the user, plus other programs which are linked to the primary programs that require no action on the part of the user. The first program is used for entering and editing decisions made by teams. The second program is used for processing decisions and printing results. The third program creates graphs of team performance which can be printed from the

screen and used to make transparencies. The supermarket chain simulator diskette contains an additional program which creates files for storing team performance data for graphing directly on a color plotter. The graphics programs provide the teacher with visuals which demonstrate the impacts of decisions made by teams. These software have a similar structure and were designed to operate much the same. Experience with the use of one simulator will carry over to another.

All computer programs are written in BASIC for an IBM personal computer with 64K of memory and two disk drives. Other computers that use software compatible with the IBM-PC may also be used. The IBM disk operating system (DOS) version 2.0 or 2.1 or equivalent for other DOS is required for use with the graphics programs. The supermarket chain simulator is distributed in compiled BASIC and requires 256K of memory.

Development

Information used to construct the simulators came from a variety of sources including: prior studies of demand and firm operating costs, reports published by trade associations, engineering departments of co-operating firms, and surveys and interviews of firm managers. The physical and cost relations should be representative of midwestern firms. For relationships such as advertising response, the judgments of persons in the industry were used. The market demand for commodities such as meat was based on prior research. There was no empirical basis for specifying the sales response to unilateral price changes by firms; e.g., one team reduces price while others make no change. Again, conventional wisdom of those in the industry was used. Demand relations in the simulators are somewhat like those in a prisoner's dilemma game. That is, the sales response for a firm to its unilateral price change is much greater than for the same price change by all firms. The price elasticity for a unilateral price change is greater than for joint action by all firms (market demand). Response coefficients and other relationships used in the simulator are described in the user's manual. In some cases, the teacher may modify the coefficients and/or the environment in which teams compete.

Testing

Each simulator has been tested extensively. The software was tested for ease of use by a variety of users including relatively naive subjects. The programs employ prompts and menus to guide the user through data entry and processing and contain many data entry and other checks. The supermarket chain simulator has been tested in about 30 seminars for over 1,000 persons from the food retailing industry and in two large undergraduate classes in financial management. The grain elevator simulator has been tested with about 90 grain elevator managers. The farm supply center simulator has been tested in two undergraduate classes and in extension workshops.

The simulators can be used to teach business planning techniques, economic and business principles, and characteristics of the industry and firms in it. They are especially designed to teach financial management and to demonstrate the impacts of different business strategies.

SUPERMARKET CHAIN SIMULATOR

The supermarket chain simulator models the market environment in which food retailing chains of six stores (can be varied) compete for sales (Babb and Leburg, 1984a). Each store is organized into six departments: grocery, meat, dairy, produce, frozen food, and general merchandise. There are 26 operating decisions for one supermarket for 1 week which involve margins, promotions, specials, orders, and people. There are six quarterly decisions for the chain concerning remodeling, opening new stores, investments, and loans. Financial results for all stores are projected on a quarterly basis.

Team decisions are recorded on a decision form for creation of data files using the editor program, Table 1. The editor prompts for each input and team decisions are entered directly from the decision form. When data entry is completed, decisions can be processed by the simulator. The results (simulator output) returned to teams consist of an operating statement, balance sheet, ratio analysis, report of inventory and stock turn, labor analysis, and a market report containing the shares of competing chains and margins, promotional activities, and other policies of competitors, Table 2. These results are used for

the next decision made by teams. The teacher may also request (optional) a report which summarizes key performance variables for all teams. This provides an overview of performance for the class and identifies teams which may need assistance. A report of the input data (team decisions) and values of response coefficients calculated for each team may also be requested. Graphs of team performance may be requested and consist of such items as comparative team sales, profits, net worth, gross margins, total expenses, wage expense, market share (line and pie graphs), and composite performance of individual teams.

FARM SUPPLY CENTER SIMULATOR

The farm supply center simulator models the environment in which firms sell feeds, fertilizers, and various services and purchase grain from farmers (Babb and Leburg, 1984b). Each team makes 41 decisions including price levels for products and services, quantity and quality discounts, hog and layer contracting, personnel, product orders, equipment purchases, facility expansions, loans, and investments. Decisions are made for a 1-year period. For each decision period, teams are given a market news sheet which contains information about cost of goods, grain market prices, and news items which are expected to influence their volume of business, prices, or profitability.

The results from decisions consist of an operating statement, balance sheet, ratio analysis, efficiency report, contracting report, inventory report, and market information relating to market shares, prices, and other policies of competitors. As in the case of the supermarket chain simulator, optional reports may be obtained for the teacher, including graphs of team performance.

GRAIN ELEVATOR SIMULATOR

The grain elevator simulator models the environment in which firms compete for the purchase of corn and soybeans from farmers (Babb and Leburg, 1984c). There are two version of this simulator with separate software packages. One version models competition among cooperative firms and embodies the unique financial and tax features of cooperatives. The other models competition among proprietary firms. Each team makes decisions concerning the purchase prices of grain at various times during the year, drying and storage charges, grain contracting at harvest and from farm storage, storage of company owned grain, discounts, facilities expansions (truck, dryer, and storage), investments, loans, and equity capital. Decisions are made for a 1-year period, but involve seasonal flows of grain and cash. For each decision period, teams are given a mar-

TABLE 1. SAMPLE INPUT FOR SUPERMARKET CHAIN SIMULATOR

SUPERMARKET CHAIN SIMULATOR DECISION FORM		
Market Area Number	1	
Firm (Team) Number	1	
Quarter Number	1	
MARGINS[a]		
Grocery (percent)	±4	1 7 • 0
Meat (percent)	±4	2 2 • 0
Dairy (percent)	±4	1 9 • 0
Produce (percent)	±4	3 4 • 5
Frozen food (percent)	±4	2 4 • 5
General merchandise (percent)	±4	3 4 • 0
PROMOTIONS		
Stamps (percent of sale)	0, 2.2 to 4.4	0 • 0
Double coupons	0=no, 1=yes	0
Advertising (dollars) ..		1 2 0 0
Store hour policy (number)	1,2,3	2
SPECIALS		
Grocery (number)	0 to 40	1 5
Meat (number)	0 to 20	_ 7
Dairy (number)	0 to 10	_ 4
Produce (number)	0 to 10	_ 4
Frozen food (number)	0 to 10	_ 4
General merchandise (number)	0 to 10	_ 4
ORDERS		
Grocery (dollars)		5 0 0 0 0
Meat (dollars)		2 1 0 0 0
Dairy (dollars)		1 1 0 0 0
Produce (dollars)		6 0 0 0
Frozen food (dollars)		6 0 0 0
General merchandise (dollars)		5 0 0 0
PEOPLE		
Persons in meat department (FTE's)	4 or more	8
Persons in rest of store (FTE's)	10 or more	1 7
Persons part-time (FTE's)	<60%	1 5
FACILITIES		
Remodel store (number)		0
Open new store (number)		0
MONEY		
Borrow money (dollars)[b]		_ _ _ _ _ 0
Repay loan (dollars) ..		_ _ _ _ _ 0
Make investment (dollars)		_ _ _ _ _ 0
Call investment (dollars)		_ _ _ _ _ 0

[a] Maximum and minimum margins for the next quarter are shown at the bottom of your market share report.
[b] The maximum amount which can be borrowed next quarter is shown at the bottom of your performance report.

TABLE 2. SAMPLE OUTPUT FOR SUPERMARKET CHAIN SIMULATOR

TRADE AREA 1 FIRM 1 QUARTER 1
OPERATING STATEMENT

	Week	Percent	Quarter
SALES—dollars			
Grocery	58,755	50.3	4,582,871
Meat	24,716	21.2	1,927,885
Dairy	12,990	11.1	1,013,195
Produce	8,263	7.1	644,510
Frozen food	6,056	5.2	472,332
General merchandise	5,928	5.1	462,396
Total	$116,708	100.0	$9,103,188
Cost of goods sold			
Grocery	49,682		3,875,232
Meat	20,650		1,610,678
Dairy	10,798		842,216
Produce	5,971		465,762
Frozen food	4,718		367,998
General merchandise	4,038		314,953
Total	$ 95,857	82.1	$7,476,839
Gross margin			
Grocery	9,072	15.4	707,638
Meat	4,067	16.5	317,207
Dairy	2,192	16.9	170,979
Produce	2,292	27.7	178,749
Frozen food	1,338	22.1	104,334
General merchandise	1,890	31.9	147,442
Total	$ 20,851	17.9	$1,626,349
Operating expenses			
Wages and fringes	11,673	10.0	910,492
Advertising expense	1,200	1.0	93,600
Stamp expense	0	0.0	0
Other expense	3,163	2.7	246,736
Non controllable	4,841	4.2	377,586
Total	$ 20,877	17.9	$1,628,413
Net operating profit	−26	−0.0	$ −2,064
Other income	575	0.5	44,861
Grand opening cost			0
Investment income			6,000
Interest cost			56,165
Total net profit bt	549	0.47	−7,368
Income tax			0
Total net profit at			−7,368
Total net profit at pct			−0.08

Sales per square feet ...	6.48	No. stores open	6
No. customers	7762		

BALANCE SHEET

ASSETS		LIABILITIES AND EQUITY	
Cash	763,770	Accounts payable	1,094,705
Market securities	300,000	Principal payable	30,000
Accounts receivable ...	494,705	Other debt	404,705
Inventory	1,398,859	Friendly finance	0
Current assets	2,957,333	Current liabilities	1,529,410
Fixtures and equip	2,060,004	Bank note	1,170,000
Other assets	74,705	Total liabilities	2,699,410
Non-current assets	2,134,709	Equity	2,392,632
Total assets	$5,092,043	Total Liab. + equity	$5,092,043

RATIO ANALYSIS (ANNUALIZED)

Current ratio	1.93	At return on total assets	−0.58
Debt to equity	1.13	Leverage factor	2.13
At profit pct	−0.08	At return on equity	−1.23
Asset turnover	7.15	At return on inv. cap	4.88

GENERAL INFORMATION—FOR REPRESENTATIVE WEEK AND STORE

Department	Shrink pct.	Stock-out	Inventory Average	Ending	Annual Stock turns
Grocery	0.51	0	148,899	149,058	17.4
Meat	4.18	0	26,615	26,790	40.3
Dairy	0.78	0	18,151	18,252	30.9
Produce	5.25	0	6,144	6,159	50.5
Frozen food	0.53	1057	7,391	8,032	33.2
Gen. merchandise	0.50	0	24,371	24,852	8.6
Total	1.68	$1057	$231,572	$233,143	$21.5
Total shrink dollars	$1960				

LABOR ANALYSIS REPORT—FOR REPRESENTATIVE WEEK AND STORE

	Sales	Sales per hour worked	Hours required	Hours available	Number of persons
Meat dept.	24,716	99.6	248	320	8
Rest of store	91,991	66.7	1,378	680	17
Part time				600	15
Total store	$116,708	71.8	1,626	1,600	40

	Hours paid Regular	Over-time	Labor Cost Regular	Over-time	Total labor cost	Labor pct. of total sales
Meat persons	320	0	2,880	0	2,880	2.5
Store persons	680	98	4,760	1,033	5,793	5.0
Part time	600		3,000		3,000	2.6
Total	1,600	98	10,640	1,033	11,673	10.0

Labor image factor	0.996	Promotional carryover factor	0.982
Tax loss carryover	1,326	Maximum borrowing next qtr.	$889,538

MARKET REPORT
TRADE AREA 1   QUARTER 1

	Firm 1	Firm 2
Share of market		
Grocery	50.0	50.0
Meat	50.0	50.0
Dairy	50.0	50.0
Produce	50.0	50.0
Frozen food	50.0	50.0
Gen. merchandise	50.0	50.0
Total	50.0	50.0
Initial margins		
Grocery	17.0	17.0
Meat	22.0	22.0
Dairy	19.0	19.0
Produce	34.5	34.5
Frozen food	24.5	24.5
Gen. merchandise	34.0	34.0
Number of specials		
Grocery	15.0	15.0
Meat	7.0	7.0
Dairy	4.0	4.0
Produce	4.0	4.0
Frozen food	4.0	4.0
Gen. merchandise	4.0	4.0
Other policies		
Advertising	1,200.0	1200.0
Double coupons	n	n
Stamps	0.0	0.0
Store hours	2.0	2.0
Remodel store	0.0	0.0
Stores open	6.0	6.0

Average initial margin levels for the market	Margin range for next quarter
Grocery	17.0	13.0 - 21.0
Meat	22.0	18.0 - 26.0
Dairy	19.0	15.0 - 23.0
Produce	34.5	30.5 - 38.5
Frozen food	24.5	20.5 - 28.5
General merchandise	34.0	30.0 - 38.0

ket news sheet which contains information about cash and futures prices at various times of the year and news items which might affect volume of grain, prices, and margins.

Output from the simulator consists of an operating statement, balance sheet, ratio analysis, detailed report of grain transactions and flows through the year, utilization report, finance report, and market information relating to market crop and price reports, market shares, and prices and policies of rivals. Optional reports and performance graphs may also be obtained.

AVAILABILITY

All of the programs and materials for the four simulators have been copyrighted by the Purdue Research Foundation and are being distributed to departments (units) of educational institutions under a license agreement which restricts use to classroom and extension teaching under the auspices of the institution. The cost of the software package for each simulator is $100 and should be ordered from: Publication Distribution, Department of Agricultural Economics, Purdue University, West Lafayette, IN 47907. Checks or purchase orders should be made to Purdue University.

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