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TRADEGAME : A COMMODITY TRADING SIMULATION EXERCISE

Volume I
Description and Use of the Game

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THE TRADEGAME PROGRAM REQUIRES A MINIMUM OF 48 K, ONE DISK DRIVE & A PRINTER TO BE CONNECTED AND "ON LINE".

1. INTRODUCTION

Tradegame is a computer-based commodity trading simulation exercise for up to 31 'players' (or teams of players). The programme is written in BASIC for the Apple micro computer. Tradegame is designed to be a realistic simulation of a commodity trading environment, incorporating an 'exchange', off-market trading and provision for forward contracting. This paper describes the game, suggests potential uses for teaching and research, and outlines our experience in operating the game with academics, students and agribusiness representatives. A second volume provides detailed operating instructions for the game controller and players together with the programme documentation and listing.

2. ECONOMIC AND MANAGEMENT GAMES

Management games are now well established in the teaching of all aspects of management; marketing, financial management, farm management, human relations skills. According to French, "They are proved, available, flexible and motivational".[1] Management games usually involve a repeating decision→result→decision ... sequence as illustrated in Figure 1.

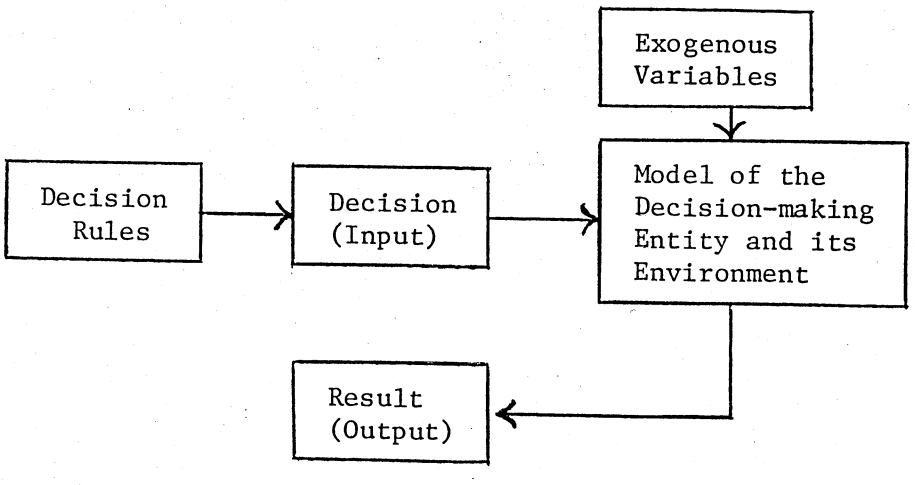

Figure 1: Diagrammatic Illustration of a Management Game

1 French, Charles E., "Selected Alternative Programmes for Bringing the Real World into the Undergraduate Classroom", American Journal of Agricultural Economics, 56: (5), December 1974, pages 1163-1175.

To facilitate computation and rapid feedback to the game participants, the model of the decision making entity is usually computer based.

While the simulation of price formation under various transaction environments is well established as an experimental technique in micro-economics,[2] the use of 'economic games' as a method of teaching economic principles appears to be less widely adopted than the use of management games in teaching management. However, illustrating the price formation process by assigning students buying and/or selling roles in a simulated market is a useful teaching approach, both for stage one students and in more advanced courses where the objective may be to show the impact of different transactional environments in price formation (for example an auction as compared with an exchange). For some experimental and teaching purposes, it may be desirable to simplify transactions, sometimes to the extent that it is difficult for players to relate their participation in the game to the real world. There is a tradeoff between simplifying to illustrate a limited number of abstract principles and the learning and motivational aspects of simulating the complexities of the real world.[3]

Tradegame combines economic and managerial aspects. The bidding/transaction section of the game illustrates price formation under alternative transaction rules and the game incorporates provision for forward contracting, illustrating the principles of a futures market. The basic financial objective of trading is usually to maximize the yield on capital employed and to minimize the risks taken in achieving

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2 Two surveys are: Smith, Vernon L., "Reflections on Some Experimental Market Mechanisms for Classical Environments", Proceedings of a Conference on Choice Theory, School of Business Administration, University of Washington, Seattle Washington, September 1980; and Burns, J.P.A., "Economic Games for Fun and Profit". Paper presented to the 50th Jubilee ANZAAS Congress, Adelaide, 1980.

3 Babb, E.M. and Eisgruber, L.M., Management Games for Teaching and Research, Educational Methods Inc., 1966, Chapter II.

this objective. Tradegame incorporates most aspects of a realistic trading environment; players can adopt risk-reducing measures such as back-to-back contracts and hedging, and the cost of stockholding is identified in terms of direct costs such as storage and insurance, and interest costs on borrowed funds. Brokerage charges have a fixed and variable component showing that per unit transaction costs decrease with the volume traded per transaction. There are penalties for non-delivery (the 'out of stock' cost in inventory management terms) and non-receipt for players whose stock or financial position does not allow them to comply to the terms of an established contract. Finally, players have, at the discretion of the game controller, the option of buying information on such aspects as stock levels, forecasted harvest and offtake, and the financial position of competitors.

It should be emphasized that Tradegame is not a marketing management game - it is a trading management game. The decision variables in Tradegame are only the quantity and price of sales and purchases on the spot and forward markets and whether or not to purchase market intelligence. Marketing mix variables relating to advertising, sales force, market segmentation etc are not incorporated as these are irrelevant in a commodity trading situation. This distinction between a commodity and a branded product can be used as a teaching point.

3. DESCRIPTION OF THE GAME

3.1 The Trading Environment

The hypothetical commodity traded in Tradegame is called 'grommetts', (although, having adopted this name, we discovered that it is, in fact, a plumbing term. Other users of the game may wish to use another name). Grommetts are normally harvested over the period April to June. The final demand for grommetts by processors is relatively evenly distributed over the year. This pattern of harvest and processing corresponds approximately to southern hemisphere feedgrain such as maize. Clearly it may be varied - for example, by introducing a seasonal pattern of demand.

Starting stocks, harvest and processor requirements are the physical parameters of the game. Prices and volumes traded are established by the players themselves during the course of the game.

The programme allows for up to 31 players, or teams of players. Teams may be classified as 'producers', 'traders' or 'end-users'. The number of teams in each category may be varied from one upwards and various restrictions may be placed on the activities of different categories of players.[4] For example, producers may be restricted to selling only from their own stocks and only to traders. Alternatively producers may be allowed to buy as well as sell and deal directly with end users.

Players may establish contracts[5] for either the 'spot' (current) month or in two permitted forward contract months. For example, if the current month is January, forward contracts may be established for April and July. Forward contracts may be made up to a month prior to the maturity of the contract. The forward contracting provision of the game thus provides a restricted type of futures market and players may hedge or speculate.

Regardless of how the contract is established, it is assumed that an 'Exchange' operates as an intermediary between the contracting parties. For example, even if a contract is established by private negotiation, it is still recorded through the exchange and brokerage fees are paid. In the case of default by either party to a contract, the exchange guarantees delivery or payment to the other party. For example, if Producer Number 2 contracts privately in January to supply Trader Number 10 with 100 tonnes in April and has insufficient stock to supply, Producer 2 is penalized for non-delivery, but the contract is executed in full (for 100 tonnes) in the books of Trader 10.

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4 Operationally, the one player required in each category can be made inactive by not entering any bids or contracts for him. Thus, it is possible to run the game with one or two categories of players (e.g. Producers and End Users.

5 Contracts are established under transaction rules established by the Game Controller. See Section 3.3.

3.2 Trading Management

The basic objective for all three classes of player is maximize 'net worth' at the end of the game. Net worth is defined as Stock at current market valuation plus cash in Bank (or less overdraft). This differs from the conventional accounting use of the term in that stock values are in current market terms rather than historic values. Other measures of performance could be used; for example, yield on average capital employed.

The components of trading performance are:

(a) The gross margin on trading; i.e. the average difference between buying and selling price;

(b) The volume traded;

(c) Trading expenses, including brokerage, storage and insurance, interest, penalties for non-compliance with the terms of established contracts, and the cost of obtaining market information.

Gross margin, stockturn and selling expenses represent the basic components of profitability for any trading operation, whether it be commodity trading, wholesaling or retailing. Tradegame can be used to illustrate the fact that different combinations of these variables can yield the same financial return - for example, low stockturn/high margin compared with high stockturn/low margin. The differences between different types of trading can also be illustrated.

In inventory management terms, Tradegame incorporates the three components of inventory cost:

- stock holding cost, including storage, insurance and interest on borrowed funds;

- fixed order costs, represented by the fixed component in the brokerage charge;

- 'out-of-stock' costs represented by the penalty charge for non delivery.

The main type of risk in commodity trading is that associated with being in an 'open position'; that is, where the trader has made a commitment to deliver or receive a specified quantity of the commodity at a specified price, without a 'back-to-back' contract which ensures the profitability of the deal. Appropriate risk-reducing measures can easily be adopted by Tradegame players. Players can also hedge their commitments using the forward contracting provisions of the game. For example, an end user who forecasts in January that he requires 2000 tonnes of grommetts for processing in March, can hedge his January purchases (or stocks) against a price fall by forward contracting to supply 2000 tonnes for July delivery, cancelling this commitment by contracting in March to receive 2000 tonnes for July delivery. This is, of course, a classic hedging operation. Players may learn to use the 'futures market' in more subtle ways.[6]

3.3 Price Formation

The concept of an equilibrium price is fundamental to economic analysis and one which is introduced to students at an early stage. The more perceptive students may observe that even for a homogeneous 'commodity' such as company shares, prices vary from minute to minute in a way which is not obviously explained by movements of supply and/or demand curves. Further consideration of this question may lead the student to the idea that such variation is determined at least in part, by the transaction rules governing the operations of the participants in the market.

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6 Although our limited experience to date suggests that, without prior explanation, they are unlikely to learn even elementary hedging techniques over the course of, say, 10 rounds of the game.

Tradegame specifically incorporates two alternative transaction systems, an 'exchange' and a 'private contract' market, but other types of transactions can be accommodated (for example, sealed bid offers, auctions, or 'take it or leave it' pricing).

The operation of the exchange requires the presence of an auctioneer who begins the bidding by announcing a set of 16 permitted prices[7] and calling for buying or selling bids at each price. The bidding opens with potential sellers offering high prices and potential buyers offering low prices. Players are told that they may change their bid and that bids do not become binding until the bidding closes, the closure point being determined by time and/or a maximum number of bids allowed per player.[8] After each new bid, the potential surplus or deficit at each price is displayed on the monitor screen. An example of the pattern of bids established after one and four minutes of bidding with a student group is given in Table 1.

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7 The Game Controller chooses the lowest permitted price and the price interval (for example $100/tonne to $175/tonne at $5 intervals). The limitation on the number of permitted prices is imposed by the capacity of the Apple computer and could be increased with a larger computer. In practice, this limitation is not serious as the Game Controller can allow a wide range of prices by choosing a wide price interval. Players can establish contracts at intermediate prices by an appropriate mix of permitted prices; for example, if permitted prices were at $10 intervals, a player could effectively purchase 1000 tonnes at $176 per tonne by a mixture of 600 tonnes at $180 and 400 tonnes at $170.

8 The computer will not accept bids once this maximum has been reached.

Table 1: Pattern of Bids after One, and Four Minutes of Bidding

Price	Buying bids (tonnes) After:		Selling bids (tonnes) After:		Surplus (Deficit)* (tonnes) After:	
	1 minute	4 min.	1 min.	4 min.	1 min.	4 min.
150	100	0	0	0	(100)	0
155	1500	0	0	0	(1500)	0
160	4400	3500	0	0	(4400)	(3500)
165	6700	5900	1000	500	(5700)	(5400)
170	4647	5700	2450	3800	(2197)	(1900)
175	0	2500	3150	4700	3150	2200
180	0	0	2000	5100	2000	5100
185	0	0	3700	1700	3700	1700
190	0	0	250	0	250	0
195	0	0	1400	1100	1400	1100
200	0	0	0	0	0	0
205	0	0	0	0	0	0
210	0	0	0	0	0	0
215	0	0	0	0	0	0
220	0	0	0	0	0	0
225	0	0	0	0	0	0

* Figures in parentheses are deficits.

The bid pattern shows some convergence to equilibrium over time.

The operation of the exchange in this way illustrates the tâtonnement process which is assumed to underly the economic abstraction of supply/demand equilibrium. The important assumptions are that recontracting is allowed (i.e. initial bids can be changed) and that participants are willing to spend the time required to reach convergence.

In a real market situation, participants may rationally decide to accept the possibility of buying (selling) at slightly more (less) than the theoretical equilibrium price for the sake of saving time. In a classroom situation with a simulated market, the practical problem arises that the class time allocated to playing the game may simply be insufficient for convergence to equilibrium to occur. Tradegame incorporates a routine for 'matching' bids and establishing contracts when the bidding is stopped at any stage. The procedure is somewhat arbitrary but essentially is designed to trade the maximum volume while ensuring that no player pays a higher price, or receives a lower price than his final bid. The details are given in the Operator's Manual. If the bidding was stopped after 4 minutes, the bids in Table 1 would result in contracts being established as shown in Table 2 below (as displayed by the computer).

Table 2: Market Report - Period 2 (February)

	OFFERED(TONNES)		TRADED(SPOT)	
PRICE($)	BUY	SELL	TONNES	VALUE
160	3500	0	0	0
165	5900	500	0	0
170	5700	3800	4300	731000
175	2500	4700	2500	437500
180	0	5100	0	0
185	0	1700	0	0
195	0	1100	0	0
TOTALS	17600	16900	6800	1168500

AVERAGE PRICE = 171.84

Table 2 shows that while 16,900 tonnes were offered for sale and 17,600 tonnes were bid for by buyers, only 6800 tonnes were traded. Sellers may receive more than their offering selling price (for example the 500 tonnes offered at $165 per tonne is sold at $170 per tonne) and buyers may pay less, in the case of a surplus situation. If purchase

offers exceed selling offers at, or less than, the buying offer price, the total quantity traded is allocated to buyers in proportion to their original bid. For example, buying offers at $170 totalled 5700 tonnes but only 4300 tonnes was traded at this price. The 5700 tonnes buying offer comprised two bids, player 5, 3000 tonnes; and player 7, 2700 tonnes. Contracts are established as follows:

$$\text{Player 5: } \frac{3000}{5700} \times 4300 = 2263 \text{ tonnes}$$

$$\text{Player 7: } \frac{2700}{5700} \times 4300 = \underline{2037} \text{ tonnes}$$

$$4300.$$

This heuristic bid matching procedure has been tested in a variety of situations and appears to perform satisfactorily.

Operating experience with Tradegame suggests that it is necessary to allow about 10 minutes for bidding if there are 30 players in the game. After this time, offer prices range within three or four bid intervals. The convergence process would be speeded up if bids were entered electronically rather than manually.

Operating the exchange is valuable for illustrating the tâtonnement process and for making the point that an exchange involves maximum exchange of information between participants in the market - as compared with, for example, sealed tenders or private negotiation. It is, however, time-consuming. Depending on the teaching objectives underlying the use of the game, the game controller may decide to adopt less time-consuming contracting procedures such as private negotiation.

3.3.2 Price formation under private negotiation

The computer programme allows privately negotiated contracts to be established, in addition to, or instead of, the exchange. A realistic rule is to allow private contracts after the players have seen the outcome of their bids. The easiest alternative administratively is to allow private contracts only.

Introducing private contracts following a period of operating the exchange illustrates the market information impact of market decentralization. Some student players commented that they preferred the exchange because, under private negotiation, they "never knew whether or not they were being ripped off". A partial solution to this problem is for the player to buy a market information report - illustrating the point that a reliable market intelligence service becomes more necessary as the marketing system becomes more decentralized.

3.2.3 Sealed bid offers

These can be called for by the game controller and matched using the routine described in Section 3.2.1, or in some other way. It is a useful exercise to compare the range of offer prices with sealed bids, the exchange, and private negotiation.

3.2.4 Other transaction rules

Other possible transaction systems are auctions (English or Dutch) and 'take it or leave it' pricing. These can be easily incorporated into Tradegame. For example, rules may be established under which producers sell to traders at auction and traders sell to end users by private negotiation (the channel by which most wool is sold). Auction rules may, or may not, allow reserve prices. As far as the operation of the game is concerned, auction sales would be entered as established private contracts.

4. OPERATING TRADEGAME

At the time of writing, Tradegame has been operating for about a year, although, over the course of the year, several modifications have been made to the programme. The game has been run with academics, students and Stock and Station Industry personnel. We have not formally evaluated the game as a teaching method, either by means of questionnaires distributed to participants or by experimental comparison of learning by game participants as compared with a control

group. Neither have we conducted formal experiments comparing alternative transaction systems, market structures etc. The following represents our impressions from the year's experience, combined with the views of other users of management games as reported in the literature.

4.1 User Objectives

It is important for the user to establish exactly what objectives, experimental or teaching, that the use of Tradegame is designed to achieve. If the game is being used for teaching purposes, the teaching cost effectiveness of the game should be compared with other teaching methods. Without experimentation with different teaching methods such a comparison is necessarily of an ad hoc nature. Babb and Eisgruber argue on a priori grounds that business games "... possess a high degree of accordance with the principles of learning, possibly higher than any other teaching tools presently available for the teaching of management".[9]

In considering using Tradegame for teaching purposes the first question is what specific concepts can be learned through the experience of playing the game? The following is a list of such concepts:

- the forces influencing short term commodity price formation:
  - changes in end user demand and supply ex farm;
  - changes in marketing costs such as storage;
  - expectations, and the influence of market information on these;
  - speculation;
  - the way in which prices converge towards an 'equilibrium' during the bidding process;[10]

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9. Op.cit. page 24.

10 The market environment simulated in Tradegame is too complex for the game controller to calculate the theoretical equilibrium price. (Compare with experimental studies based on known supply and demand schedules, for example, Smith V.L., "An Experimental Study of Market Behaviour", Jnl.Pol.Econ. 70: 1962, pp.111-137). There is, however, a relatively narrow price range that prices converge to in the operation of Tradegame.

- the effect of different transaction rules on price formation;
- the operation of a futures market;
- aspects of trading management including:
    - negotiating skills,
    - use of market information,
    - costs of holding stock,
    - risk reducing strategies.

If a course has teaching objectives corresponding to one or more of the above, Tradegame may be a suitable teaching method. Clearly, the greater the correspondence, the more useful Tradegame will be.

However, even if a teacher can see limited use for Tradegame for specific teaching purposes, there is no doubt that Tradegame, along with other business games, is stimulating to the participants and allows them to experience group decision making. It is good for group morale and is a change of pace from lecturing. Its use facilitates student/lecturer interaction - players always try to obtain free information from the game controller!

4.2 Size of Teams

As the number of players (or teams of players) is restricted to 31, 'teams' of greater than one participant will be required if the size of the group is greater than 31. There is a trade-off between the desirability of providing group decision-making experience and the logistics problems associated with getting the group together and also the problem that the group can be dominated by one or two players. Logistics are a particular problem with students who live off-campus and are enrolled in a variety of degrees. It may be very difficult for them to organise a time and place for group meetings.[11]

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11 Wright, Parminter and Ward report that group organisation difficulties were the major limitation in using a farm management game with agricultural science degree students. "Management Games and the Teaching of Farm Management: A Case Study", New Zealand Agricultural Science 12 (2): 1978, pp. 62-66.

This problem would be less with High School students and participants at residential extension courses. If logistics are expected to be a problem, it is probably best to restrict teams to one player or to organise teams with the problem in mind.

4.3 Briefing Players

At the beginning of the game, players are provided with relevant technical and financial information relating to their particular role in the game. To 'set the scene', they are given a 12-24 month history of production, offtake and prices. There are different points of view as to how much further information should be supplied. One extreme point of view is that no briefing should be given on strategies for playing the game and students should 'learn by doing'. The other extreme is that lectures should be given prior to starting the game on all concepts to be covered by the game. In using the game to date, we have provided very limited guidance prior to the game and lectures on relevant concepts were mostly given after the game was completed. Experience with this approach suggests that a more detailed pre-game briefing, more help for the players from the game controller, and more integration of the game with lectures would have been a better strategy. Several teams made obviously silly decisions - like consistently buying at a higher price than their selling price. Like most business games, it is possible for a team ot get itself in an irretrievable position (effectively bankruptcy). This is obviously bad for morale, is not likely to result in much learning and, if a team's position deteriorates irretrievably, they are likely to make frivolous or 'desperate' decisions. Counselling during the course of the game should help to avoid this situation.

4.4 Trading Roles and Transaction Rules

The game controller must decide how many teams to be allocated to each category; producers, traders and end-users. Different market structures can be simulated from the extreme of a monopolist producer, a monoposonist end user or a monopolist/monopsonist trader. For most purposes, however, a relatively even distribution of players into each category is best - perhaps with slightly more traders than the other two categories.

If there is no restriction on buying and selling between categories of players, there is a tendency for producers and end users to 'bypass the middleman' and deal directly with each other. The game, as presently structured, does not fully take into account the economic benefits provided by intermediaries in the marketing system. Storage charges, interest costs and brokerage rates are the same for all classes of player. The most obvious way around this problem is to arbitrarily restrict trading so that producers may only sell to, and end users may only buy from, traders. Variables that can be varied by class of player are starting stock, starting cash and the overdraft limit, and traders can be advantaged by being given a significantly larger initial cash sum and/or overdraft limit.

4.5 Rewards

Cash rewards or other prizes can be given to the 'best' team (in terms of net worth or some other measure of performance) or a cash sum can be apportioned among teams according to closing net worth. It is however very difficult to establish initial conditions so that all three classes of player are treated equally and it is probably fairer to give rewards by class of player. For student groups, performance in the game can be incorporated in the final grade.