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SYSTEMS DEVELOPMENT FOR AN EXPERIMENTAL ECONOMICS LABORATORY

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ABSTRACT

This paper presents the results of the Systems Development for an Experimental Economics Laboratory project. This project, sponsored under the IBM Advanced Education Project, developed the methodology and software required to run experimental markets on an IBM Token-Ring Network of personal computers.

The goal was to develop an innovative method for teaching principles of economic markets: the use of computerized markets. The power of the computer network coupled with student participation in an active market brings a realism to the teaching of economics that can augment and supplement traditional methods of instruction.

The paper is organized into sections: section 1 introduces the project and presents an overview of experimental economics and markets, section 2 presents the goals and structure of the project, section 3 describes how the computerized experimental markets function, section 4 presents the educational value of computerized economic markets and a final section presents conclusions and a summary.

1. INTRODUCTION

Experimental markets are controlled laboratory procedures in which human participants are given resources and allowed to trade. By manipulating the allocation of resources and the information available, researchers and participants can gain an understanding of market forces.

Conducting experiments to test economic theory has been used by researchers for the last 30 years. In the last few years the amount of research using experimental economics has grown greatly. However, experimental economics has not been widely implemented as a method of teaching business or economics.

Most economic markets are run manually. Students (traders) are assigned to be sellers or buyers. Sellers hold assets; buyers hold cash. They are given incentives to trade. Different market rules may be established. For example, a double oral auction allows buyers to BID for assets and sellers to ASK for assets. A BID is an offer by a buyer to purchase an asset for a stated price; an ASK is an offer by a seller to sell for a stated price. A TAKE occurs when either a buyer or seller accepts an outstanding offer. Figure 1 summarizes these options:

SELLERS	BUYERS
Hold assets. Desire cash. May ASK a price for an asset. May TAKE a BID.	Hold cash. Desire assets. May BID a price for an asset. May TAKE an ASK.

Figure 1. Summary of traders' options

Students must keep track of large amounts of information and complete complex accounting functions. Chalkboards are used to keep track of asks and bids. Bingo cages are used to generate random numbers. All the difficulties associated with conducting a manual experiment make experiments an impractical tool for classroom use.

One solution to the difficulties of manual experiments is a computerized experiment. By running experiments on computers much of the information processing task is placed on the computer, allowing more time for the students to observe the workings of the theories. The computer can also quickly summarize and present the data at the end of the experiment so students can compare their behavior to theoretical predictions.

Attempts have been made to conduct experiments on mainframe computers, but these programs were too slow, cumbersome and inflexible. However, a network of personal computers provides a feasible way to run experiments. The programs to run experiments on a network of personal computers can be written in higher level languages. Networks meet the speed requirement necessary to run experiments. And the network can be kept under complete control by the experimenter.

2. THE GOAL OF THE PROJECT

The goal of this project was to develop an innovative method for teaching principles of economic markets. The method is to use computerized markets to demonstrate principles of economic theory. The power of the computer network coupled with student participation in an active market brings a realism to the teaching of economics that can augment and supplement traditional methods of instruction.

Specifically, the project was to develop software tools that would allow instructors and researchers to easily use networked personal computers for conducting experimental economics markets. The software would be written in a compiled language (Pascal) so that users could easily change the program to meet the specifications of their particular experiment.

Speed and presentation of information are important in conducting experiments, therefore the software has to have control over network communications and the output screens of the subject terminals. The NETBIOS Token–Ring interface provided the necessary control over then network. Pascal provided an interface with NETBIOS and allowed complete control over the experiment.

The software was developed and tested in a 4 station Token–Ring lab, provided through IBM's Project Woksape. Once the software was developed it was taken to the Carlson School of Management's 16 station lab (provided by an IBM Management of Information grant) where three test markets have been run.

First, standard routines were developed for controlling the network in Pascal. Then software was developed for controlling the screen output, and processing information used in various experiments. Most of the programs written operate on a simple algorithm where the computer listens for input from the trader or for messages incoming on the network. If data is entered, the computer processes it and sends it across the network. If a message is received from the network, the program processes the information received.

The software was developed in Pascal routines so that changing the code for a particular experiment could easily be done. Presently there are programs for sending and receiving verbal message, conducting various auction markets, and conducting various game theory experiments.

3. DESCRIPTION OF THE MARKETS

The computerized economic markets developed by this project are real–time interactive multiplayer games. A trader sits at a workstation and makes buy, sell or hold decisions by pressing keys on the keyboard. All of the information to which the trader has access is presented on the computer screen in separate windows.

For the double oral auction market, there is a window which displays ASKS and one which displays BIDS. These scroll up with the most recent offer being on the bottom row. There is a window for accounting data such as cash, number of assets, reservation prices and profit. A graphical window plots prices at which exchanges take place. And there is an input and directions window. Figure 2 presents the trading display window:

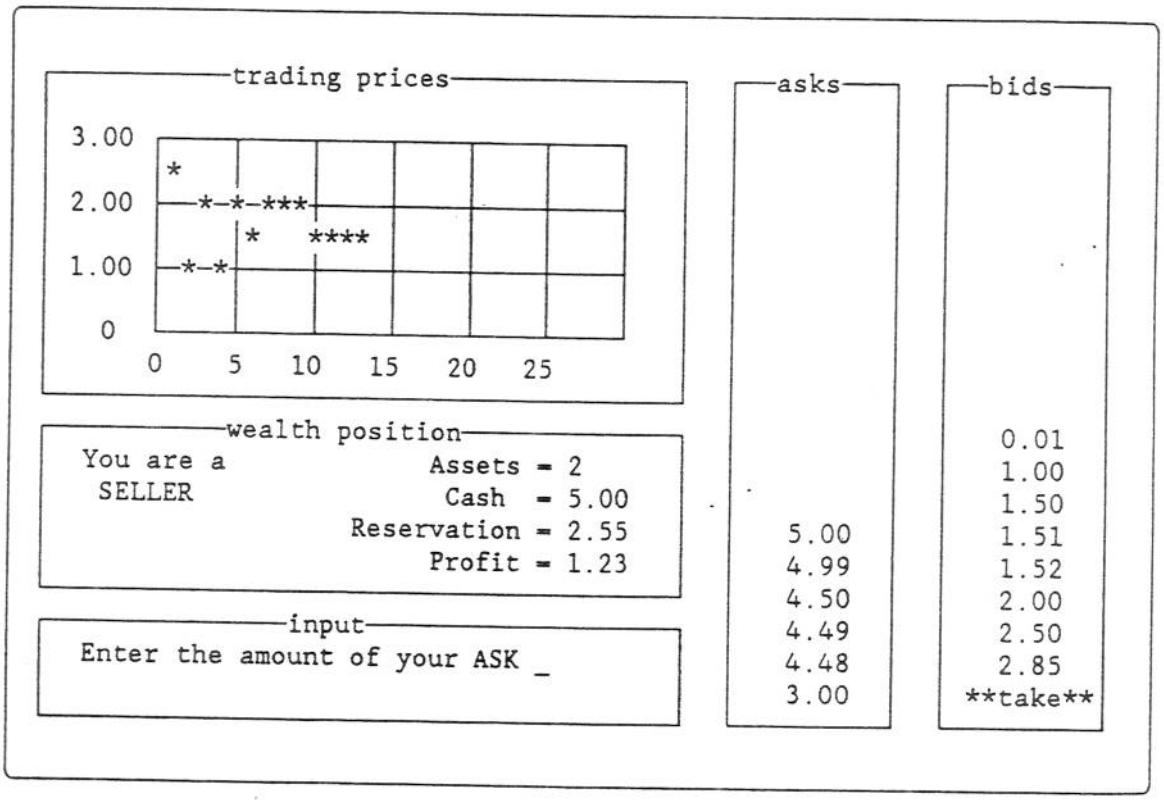

Figure 2. Display for double oral auction market

When traders make offers, they enter the amount at the keyboard and then the amount is immediately posted to the screens of all other traders. When a trade is consummated or TAKEN, the amount is displayed and is also plotted in the graphics window. In this manner, relevant market data is made available to all traders almost immediately. By carefully following the market and making sound trading decisions, individuals may make

a trading profit. More importantly, this active participation demonstrates how markets function.

4. EDUCATIONAL VALUE OF COMPUTERIZED ECONOMIC MARKETS

Traditional methods of teaching economics include lecture and mathematical analysis based on models of market forces such as supply and demand. Economic markets place students in a market and allow them to actively participate in that market. This participation allows students to experience the market forces at work. Any insights the students may gain from such participation can be compared or contrasted with economic theory.

Students may experience the effect of different market rules on market behavior. A market in which negotiations are conducted in secret behaves differently from one in which negotiations are conducted in public. One way to understand the differences is to participate in both markets.

Lecture and mathematical analysis may follow such demonstrations. Having participated in the markets, students are better able to comprehend the theory. In this manner, computerized economic markets may augment and supplement traditional methods of teaching economics.

5. SUMMARY AND CONCLUSION

The goal of the Systems Development for an Experimental Economics Laboratory project was to develop an innovative method for teaching principles of economic markets. The method is to use computerized markets to demonstrate principles of economic theory. The power of the computer network coupled with student participation in an active market brings a realism to the teaching of economics that can augment and supplement traditional methods of instruction.

The project developed tools necessary for conducting experimental economics markets on a network of personal computers. The software developed is a set of standard Pascal routines that allow control over the IBM Token-Ring Network through the use of the NETBIOS Interface.

Three test markets have been run on a 16 station network using graduate economics student, graduate business students and business faculty. These test markets have demonstrated the advantages of presenting economic theory by computerized markets. Traders quickly see how market forces work. Trading prices have in general been consistent with economic theory.

The next phase of the project is to expand the set of markets that are available for education. Different markets using different market rules will be built that illustrate economic concepts. These markets will be coordinated with an introductory class in microeconomics.