AN EXAMPLE

Using Microcomputers for Student Problem Sets

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Abstract

An example describes student use of microcomputers for solving class take-home problems sets. Each student receives individualized problem sets as the input data are randomized. This assures reasonable independence among the students in completing the exercise and offers an improved learning experience. The computer also grades the exercise, eliminating grader errors and time. Calculations demonstrate that computerizing problem sets can result in long-run cost savings to the department. The procedure is inexpensive, easy to use and educationally effective.

Introduction

Take-home problem sets are valuable educational tools which instructors use to reinforce conceptual material presented in class. Problem sets assist students in understanding the logic and practical application of concepts. Learning-by-doing has considerable appeal and long-lasting educational effect. However, in a class with growing enrollments the instructor is faced with a difficult choice of whether to continually assign problem sets because of the time commitment to grading. The hiring of graders or teaching assistants is possible, but for a large class such employment can become expensive as well as boring for those involved. Another difficulty with take-home problems is assuring that each student obtains the maximum learning experience and is not utilizing a friend as a crutch while working together. A reasonable alternative with respect to time, money and educational (learning) experience is to make the problem sets available for solving on microcomputers.

This article describes the utilization of the microcomputer for take-home problem sets in a class dealing with commodity futures markets. Each problem is individualized to the student. The procedure is effective, relatively inexpensive, easy to use, and has the side benefit of giving students some computer awareness.

Procedure and Uniqueness

The College of Agriculture at the University of Illinois has a microcomputer laboratory containing several personal microcomputers. Classes are offered on the operation and use of microcomputers, and the lab is available to all instructors in the college for use in conjunction with their regularly scheduled classes. The lab has regular posted hours with a person responsible for its operation, maintenance and teaching function. Also, monitors are available to assist student users and to check out disks for the appropriate classes, much like a library. Students can reserve a time for using a computer if desired.

The problem sets described here are written for the IBM personal computer. Instructions for each problem set are distributed in class, along with a deadline date. Students go to the microcomputer lab on their own time, check out the appropriate disk and complete the exercise. The student generates a printed output of the questions, student answer, correct answer, and overall numerical grade which is handed in for the posting of credit.

Each of the assigned problem sets utilizes prices, either cash or futures, as input information into the exercise. These prices are randomized so that each student is assured of having an individualized problem set. Students can still work together in the lab if desired, but they cannot copy each other's answers as they have different input prices. Actually, students tend to work independently in the lab and at their own speed.

The scenario for the problem set is available on both the screen and hard copy, or described in the class handout. Each question is asked on the screen, and as soon as the student enters an answer, the correct answer is shown immediately. This allows students to monitor their potential final score as they progress through the exercise. In the event that the student is doing poorly, he or she can return to the beginning and start again, but of course with new randomized input prices. This allows the student to continue to work the exercise until a desired grade has been reached.

In reality, many students first run through the exercise entering zero for each answer. This gives the student a hard copy of all the questions and correct answers for a particular set of input prices. After studying this output and learning how the answers are derived, they do the problem set again on the computer for credit, but of course with new input prices. The randomizing of the prices assures that there is an individualized problem set for each student and each time an exercise is initiated.

As mentioned above, the computer indicates the correct answer after each student answer is entered. The computer tabulates the number of correct answers recorded, and upon completion, all student and correct answers are printed out as well as the student's numerical grade. The instructor can weigh the individual question in any manner desired. This procedure eliminates the need for a grader as only the final score needs posting.

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The computer programs are written so that the instructor, even one without programming skills, can change basic input information. For example, the instructor can change price levels to correspond with the current market situation, change the range over which random prices can be selected, and change other input information such as dates and futures contract months. This makes it easy to adjust the problem sets from semester to semester for each class operating in a new environment.

Types of Problems

In this section, four different problem sets used in a commodity futures market class are described. In each case, information is distributed in class and/or initially printed out by the computer for the student to use in solving the problem set. A worksheet can even be provided by the computer.

The first problem set allows students to monitor the position value, capital and equity of a speculator's trading account. A speculator is assumed to be long one contract of soybenas, and the student is given values for the initial and maintenance margins. The program proceeds through time daily, each day with a new closing price chosen randomly. The student must determine his or her position value, capital and equity in the trading account at the end of each day. Also margin calls may occur for which the student must adjust the account, and the student is allowed to withdraw money if the equity exceeds a particular value. At the end, the long trading position is liquidated and a commission paid, after which the student computes the gains or losses and remaining money in the account.

The second problem set is a series of hedging problems, both long and short hedges. The student is given randomly selected prices and required to answer a series of questions concerning gains and losses on the cash side and futures side of the transactions as well as compute basis changes.[1] The different problems emphasize different basis relationships, such as cash price discounted to futures price and vice-versa, and alternative scenarios of widening and narrowing bases.

In the third problem set the computer initially presents a series of cash and futures prices for a grain commodity for four different dates and for several futures contract delivery months. A class handout describes several potential hedging scenarios or real-world problem situations in grain marketing. To answer each problem correctly, the student must select the prices for the correct delivery months and calendar dates as well as determine whether the situation calls for the trader to be a long or short hedger. The computer asks a series of questions for each problem concerning the outcome of the cash side and futures side of the transactions as well as the overall outcome of the hedge. The questions can also involve rolling the hedges forward or backward from one future contract to another and calculating those results.

The last problem set is much like the third problem set except the hedging is done with financial instruments rather than with an agricultural commodity. Long-term and short-term government securities are used in the examples, with emphasis on getting the student to recognize that fluctuations in interest rates and instrument prices are inversely related.

Evaluations and Conclusions

For a class of no less than 150 students, an efficient grader takes at least 25 hours per problem set to grade and add the scores, amounting to at least 100 hours per semester for four problem sets. For a master's student working for $5.00 per hour this is a cost of at least $500 per semester. If this student were hired as a teaching or research assistant and paid monthly, the hourly rate is more like $8.00 per hour, or a cost of $800 per semester. The programming for these problems was done by a master's student in agricultural economics who was familiar with Basic. It took approximately 400 hours of programming time at $5.00 per hour for a cost of about $2,000. It is possible that a computer science student could have completed the task more quickly and efficiently.

Thus, in four semesters the cost of the programmer is recouped in saved grading time. Larger classes would recover the programming cost even faster. Obviously, using the problem sets beyond four semesters generates savings to the department. In these calculations, no cost is attached to the microcomputers since they were made available to instructors by the college. Certainly, completing the exercises on microcomputers is much cheaper than paying fees for access to a mainframe computer. Instructor time is not necessarily increased, providing that the problems are required assignments, regardless of their means of completion.

Besides the above cost advantage, there are several educational advantages to putting problem sets on the microcomputer. One of these is the opportunity for students to obtain computer awareness and literacy. Many undergraduate students are still reluctant to learn about computers, and these exercises are simple enough that even inexperienced students can interact with the computer to solve the problems. A second advantage is that each student has an individualized problem set. Students can still work together in the lab, but eliminated is the potential for copying another student's answers. Such copying is very tempting when students have identical input prices.

In addition, if while working the problem set the student is missing too many questions, he or she can rework it, but with new input prices. This can continue until the desired grade or level of understanding is achieved. This option is not available to students with noncomputerized take-home problems. As expected,

[1]The basis is the arithmetic difference between a cash price and a futures price. Since a hedger is essentially arbitraging between cash and futures markets, the change in the basis reflects the financial outcome of the hedge.

scores will increase. The average score on these problems sets increased from 91.8 for the last two years prior to computerizing them to an average of 94.8 for the first two years after they were computerized. Students are also free to go back to the lab at any time and rework problem sets in preparation for examinations. Finally, potential errors by the grader either in grading or in adding scores are eliminated because the computer performs these functions. This virtually eliminates grading complaints by the students.

Thus, the cost and educational advantages overwhelmingly favor microcomputerizing student take-home problems for a large class where problems will be required regardless of the class size. Students often give favorable comments about them in class evaluations. Instructors should give this teaching technique serious consideration; it can be very economical and educationally effective.

Microcomputer Simulation of Plant Growth

John Ball

Abstract

Many instructors are examining the use of computers as a means of utilizing simulations. This is especially applicable to horticulture due to the time length required to grow real plants. To increase students' understanding of environmental influences on plant growth, a plant simulation game was developed. Game players can alter light intensity, light duration, day temperature, night temperature, atmospheric carbon dioxide level and soil moisture content in their attempt to grow a taller plant.

Introduction

Most horticulture students are able to enumerate the environmental factors effecting plant growth. However, few are able to comprehend the effect these factors and their interaction can have on plant growth. Understanding environmental factors and their interaction is critical for horticulture workers. It is especially important for greenhouse growers since almost all environmental factors including atmospheric carbon dioxide concentrations, can be under grower control.

Computers are ideal tools for presenting these concepts. Computer simulations can be effective in increasing a student's problem-solving ability (Small and Edwards, 1979). By working with situations involving multiple variables and many acceptable results, a student must reason to obtain the desired outcome. A computer can also compress time, and this ability is useful in teaching biological concepts where time horizons can stretch into months or years (Lehman, 1983). In addition, computer modeling is now being used by the greenhouse industry (Carlson, 1986), and the students should become familiar with its practical application.

To promote a better understanding of envionmental influences on plant growth a computer game was developed. The simulation game permits student teams to set the values for the environmental factors and observe how the plant performs under these conditions. The game's basic assumption is that the plant is in a pot placed in a closed room. Students can adjust light intensity and duration. They can alter the day and night air temperature, atmospheric carbon dioxide content and soil moisture. Values for all factors are selected at the beginning of the game then the total plant growth is computed. No alteration of the values is posible after this point.

Students work out a strategy for producing the maximum growth, type in the value for each of the factors, read the total growth produced from the run, determine how they could improve upon it then try again. To add some additional competitivee interest to the simulation game, when the computer displays the plant height achieved during the last execution it also displays the maximum height achieved during the day.

The computer simulation game is introduced to the students after they complete the lectures on environmental influences of plant growth. Students must have a basic understanding of the environmental factors and how they influence plant growth to fully utilize this sumulation game. In the next lecture period the purpose and rules of the game are explained to the students. Working in small groups of three or four, students discuss strategies and decide the values they will utilize. They may not run the simulation until they explain to the instructor what they are goint to try and why. This procedure is a vital part of the simulation game. It requires students to plan a course of action and predict its outcome rather than just randomly select values and see what happens.

The effectiveness of the game in promoting a better understanding of environmental influences was examined through the use of a randomized control group. Twenty-eight students were given a pretest after the initial lectures on environmental influences. The students were then randomly assigned to two groups, one group utilized the computer simulation, the other continued with just lecture. The following lecture period all students were given a post-test. The scores of the two groups of tests were compared by use of the students's t-test. There was no significant difference between the two groups pretest scores. However, there was a significant difference (p►0.05) between the two group's post-test scores (Table 1). The group utilizing the simulation game demonstrated a better understanding of environmental influences.

In addition, student surveys have showed that most students enjoyed this particular portion of the class. They preferred examining plant growth in an

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