farm depends on successful operation through time. These conditions provide a fair approximation of the "real world" decision making environment facing farm managers. The computerized farm simulation allows this approximation without excessive expenditures of capital or time.

Summary and Conclusion

A computerized farm simulation has proven to be an effective means of teaching decision making skills required to be a successful farm manager. The instructor can direct the decisions to emphasize various economic principles. Students receive rapid feedback to relate outcomes to decisions made.

Specific advantages of the farm simulation include:

1. repeated use of the decision making process in farm management scenarios;
2. exposure to a wide variety of farm management decisions in a fairly realistic framework;
3. experience in making farm management decisions in a risky environment;
4. experience in making farm management decisions in a multi-period framework;
5. rapid feedback relating outcomes to decisions to reinforce learning;
6. development of oral persuasive skills and written communication skills; and
7. experience in small group (committee) mechanics and politics.

The author has found the farm simulation to be a valuable addition to the traditional lecture format commonly found in farm management courses. In conclusion, the farm simulation provides many of the same benefits that could be derived from the management of an operating farm as described by Honeyman (1985 p. 12) with the additional benefits of rapid feedback on decision results and limited capital investment and financial risk.

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A QUANTITATIVE COUNSELLING APPROACH

Course Prerequisites and Undergraduate Student Performance

Marshall A. Martin

Introduction

Upper division undergraduate agricultural courses normally build on skills and knowledge acquired in previous courses. These advanced courses in the various agricultural disciplines often require the development of quantitative skills in mathematics and statistics. Also these advanced courses frequently draw on a student's analytical skills in the core area of the discipline e.g., economic theory for agricultural economics majors or biology and chemistry for majors in agronomy, animal science, biochemistry, forestry, or botany and plant pathology.

Counsellors often are uncertain as to a student's potential for success in an advanced course. Grade point averages are the most widely used indicator of a student's academic ability. For example, Krockover, Mortlock, and Johnson found that SAT scores, high school rank, and freshman grade point averages were highly correlated with the final grade point average of graduating college seniors.

In most disciplines one or more prerequisite courses are required before a student is allowed to enroll in an advanced course. Sometimes diagnostic tests are available to determine if a student has the appropriate background to master successfully a subject area. Royer, Abranovic, and Sinatra found that while a grade point index was a good predictor of course performance, they also found that a student's reading comprehension and subject matter knowledge were useful predictors of course performance. They used a minitest at the beginning of the semester to determine students' potential performance in courses in business statistics and educational psychology. They also found that scores on the minitests and grade point averages were highly correlated.

This article illustrates a quantitative approach used in the Department of Agriculture Economics at Purdue University to determine those factors which might be the most appropriate indicators of a student's successful completion of a senior-level, elective course in agricultural price analysis. While the empirical results are specific to an agricultural economics course taught at Purdue University, the conceptual framework and methodology are appropriate for any academic discipline.

Course and Student Description

As taught at Purdue University, about one-fourth of the agricultural price analysis course is devoted to a review of the appropriate microeconomic economic theory for agricultural pric analysis, one-half covers the statistical theory and application of regression analysis to applied price analysis problems using microcomputers, and the remainder of the course treats several

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Table 1. Class Characteristics[a]

Variables	Year One	Year Two	Pooled Data
Agricultural Economics Major	75%	83%	79%
	(0.44)	(0.38)	(0.41)
Completed Agricultural Marketing	70%	83%	78%
	(0.47)	(0.39)	(0.43)
Completed Introductory Microeconomic Theory	80%	87%	84%
	(0.41)	(0.34)	(0.37)
Completed Introductory Statistics	45%	78%	63%
	(0.51)	(0.42)	(0.49)
Completed One Semester of Calculus	35%	39%	37%
	(0.49)	(0.50)	(0.49)
Economics IQ Test Score[b]	14.7	14.6	14.6
	(3.17)	(3.15)	(3.12)
Grade Point Index[c]	4.52	4.94	4.75
	(0.57)	(0.62)	(0.62)
Points Earned in Agriculture Price Analysis Course	458	529	496
	(100.6)	(63.5)	(89.2)

[a]The numbers in parentheses are the standard deviations.
[b]This was a 20 point multiple choice test on basic microeconomic and macroeconomic theory questions normally presented in a general introductory economics course.
[c]Purdue University employs a 6.0 grade point scale.

applications of price theory to agricultural policy and marketing questions. The course textbook by Tomek and Robinson reviews microeconomic theory, summarizes basic agricultural marketing concepts, and explains how regression analysis can be used to estimate agricultural supply and demand functions. The course is an elective selected by about one-fourth of the students in agricultural economics. About four-fifths of the students in the course are majoring in agricultural economics. The others are from other agricultural disciplines or the business school. (Table 1).

Data for this article were drawn from two class years. (Table 1) There were 20 students in the class in year one and 23 in year two. Due to the sensitive nature of including student grade point averages in the empirical analysis, the actual years are not mentioned to preserve complete anonymity of the students given the relatively small sample size each year.

During year one of this study the faculty specified three prerequisite courses for the agricultural price analysis course. They were: (1) a sophomore course in microeconomic theory, (2) an introductory course in agricultural marketing, and (3) an introductory statistics course. Of the students enrolled in the agricultural price analysis course in year one, 80 percent had completed the introductory microeconomic theory course, 70 percent had completed the course in agricultural marketing, and 45 percent had taken the introductory course in statistics. (Table 1).

In year two, through counselling, the number of students who had satisfied the prerequisite courses increased to 87 percent who had completed a course in microeconomic theory, 83 percent who had taken the agricultural marketing course, and 78 percent who had completed the introductory statistics course. For the two years combined about four-fifths of the students had completed the courses in microeconomic theory and agricultural marketing and about two-thirds had taken the basic statistics course. (Table 1)

Success in economics courses appears to be closely related to a student's analytical and mathematical skills. Hadjimatheou and Rendall reported that undergraduate students with more preparation in mathematics and satistics performed better in economics courses.

Although many of the economic and satistical concepts in the agricultural price analysis course at Purdue University are taught graphically, college algebra and calculus often are used to derive the normal equations for linear regression analysis or to derive the elasticities for a nonlinear demand or supply function. Thus, a strong mathematical background is useful. At the same time that the faculty changed the prerequisites for the price analysis course, they also added the requirement of one semester of calculus to the curriculum. However, since some students had matriculated into the program before the calculus requirement was imposed, they were allowed to continue in the program without taking calculus. During each year studied about one-third of the students in the course had completed one semester of calculus. (Table 1)

Diagnostic examinations can offer an indication of a student's basic understanding of subject matter in a specific area (Royer, Abranovic, and Sinatra). At the first class meeting each semester, a general economic theory test was administered to the students enrolled in the agricultural price analysis course at Purdue University. The test contained 20 multiple choice questions drawn from an introductory, freshman-level general economics course. About one-half the questions covered microeconomic theory issues related to business, firm behavior, and marketing. The others related to macroeconomic concepts such as inflation, federal budgets, and employment. The average Economics IQ Test score was 14.6 out of 20 with a range from a perfect score of 20 to a low of 7. (Table 1)

The average grade point index was higher in year two than in year one. Improved student counselling, based on better knowledge of the course content and teaching objectives, plus greater adherence to the course prerequisites probably contributed to a selection of students in the second year with slightly higher academic ability. In the first year the average grade index was 4.52 with a range of 3.7 to 5.9. In the second year the average was 4.94 with a range of 4.0 to 5.9. Purdue University uses a 6.0 grade point scale.

Total points earned in the agricultural price analysis course are based on two, one-hour examinations (30 percent), a final examination (30 percent), homework assignments (15 percent), and a term paper (25 percent). Although the average score in the second year was 15 percent higher and the standard deviation was smaller than in the first year, the top score earned in each year was the same. (Table 1) Again the improved counselling and selection of students in the second year probably contributed to the improvement in points earned in the course.

Results

A multiple regression equation was estimated separately for each year as well as for a pooled data set. Binary variables (0-1) were used to represent whether a student was an agricultural economics major (1), had completed an introductory microeconomics theory course (1), had taken a statistics course (1), had completed the introductory course in agricultural marketing (1), and had completed at least one semester of calculus (1). College algebra is a prerequisite for calculus. The other explanatory variables were the Economics IQ Test scores and the cumulative grade point average earned at the end of the sophomore year. Since several students take the agricultural price analysis course during their junior year, the grade index at the end of the sophomore rather than at the end of the junior year was selected.

Based on the R^2 and F-statistics, the regression equations for both the first and second years are acceptable. Both equations were statistically significant at the one percent level. (Table 2) Since forcing the regression equation through the origin would distort the regression coefficients, an intercept was included in each equation. The intercepts are statistically significant for years one and two. The intercept is a measure of the average performance of all students in the class after accounting for the variation explained by the independent variables. Other variables not included would be study habits, class attendance, writing skills, or test taking ability.

None of the three prerequisite courses for the agricultural price analysis course has a statistically significant regression coefficient for either the first or second year. (Table 2) Furthermore, the fact that a student was an agricultural economics major taking an advanced agricultural economics course had no bearing on the student's performance. The regression coefficient for the binary variable for agricultural economics major was not statistically significant for either year. This was not totally unexpected since about four-fifths of the students were agricultural economics majors and had completed the prerequisite courses in agricultural marketing and microeconomic theory. (Table 1) As discussed further below, the situation is somewhat less clear for the prerequisite statistics course.

Mathematical skills were very important in the first year as suggested by the regression coefficient for the calculus variable which is statistically significant at the 5 percent level. (Table 2) This is not the case for the second year, but the regression coefficient is almost significant at the 10 percent level. In the first year, students who had completed a calculus course on the average earned 69 more points in the agricultural price analysis course. In the second year, students who had completed a calculus course earned about 22 more points.

Table 2. Quantitative Analysis of Student Performance[a]

Independent Variables	Year One	Year Two	Pooled Data[b]
Intercept	-190.575*	120.831**	-46.181
	(-1.508)	(1.647)	(0.676)
Agricultural Economics Major	-21.562	-16.988	-21.487
	(-0.469)	(-0.629)	(-0.863)
Introductory Agricultural Marketing	-2.914	-19.768	-15.843
	(-0.063)	(-0.446)	(-0.637)
Introductory Microeconomic Theory	39.699	-16.516	0.808
	(0.829)	(-0.263)	(0.029)
Introductory Statistics	24.944	19.348	29.426*
	(0.578)	(0.812)	(1.408)
Calculus	69.077**	21.968	42.676**
	(2.094)	(1.140)	(2.398)
Economics IQ Test	9.671**	3.135	3.522
	(1.777)	(0.798)	(1.196)
Grade Point Index	101.104***	77.472***	101.992***
	(3.416)	(4.894)	(7.154)
R^2	0.78	0.72	0.72
F-statistic	6.055***	5.632***	12.572***

[a]The dependent variable is the total points earned in the agricultural price analysis course from midterm and final examinations, a term paper, and homework assignments. The Student-t statistic is in parentheses below the corresponding regression coefficient. Statistical significance at the one, five, and ten percent levels is indicated by ***, **, and *, respectively.

[b]Using a Chow test, it was determined that there is no structural difference between the equations for years one and two. The F-statistic (8,35) is 1.42. Thus, the data from the two years may be pooled for further analysis.

The students' performance on the Economics IQ Test was a good indicator of success in the first year but not in the second year. In the first year the regression coefficient is statistically significant at the 5 percent level. (Table 2) However, the regression coefficient for the Economics IQ Test suggests that each additional question answered correctly on the Economics IQ Test corresponds to only 1.5 more points earned in the course. (This is calculated by converting the regression coefficient to an elasticity and multipling by the number of possible points on the Economics IQ Test.) In the second year the regression coefficient is not statistically different from zero and thus performance on the Economics IQ Test was not a good indicator of student performance in the price analysis course.

As expected, a student's grade index as an underclassman was a strong indicator of performance in the senior-level agricultural price analysis course. (Table 2) The regression coefficient for the grade point

average is statistically significant at the 1 percent level for both years. Converting the regression coefficient to an elasticity (percentage change in total points earned in the course relative to a percentage change in a student's grade index) provides a measure of how many additional points a student might earn in the course for each percentage increase in a student's grade index relative to the class average grade index. For example, in the case of the first year, each 1 percent increase in a given student's sophomore cumulative grade index relative to the class average grade index corresponds to an equal percentage increase in total points earned in the agricultural price analysis course.

To test the generality of the results from the two years of data, the data were pooled and a Chow test was conducted. The pooled data contained both time-series and cross-sectional data. Using an F-statistic, the equations for years one and two were found not to be statistically different. Thus, it is appropriate to draw statistical inferences from the pooled data.

The regression equation for the pooled data offers similar results to those for each year separately. (Table 2) As before, the regression coefficients for agricultural economics major and for the course prerequisites in agricultural marketing and microeconomic theory are not statistically significant. Furthermore, for the pooled data the regression coefficient for the Economics IQ Test is not statistically significant at the 10 percent level but does have a positive sign. However, the regression coefficient for the introductory statistics course is statistically significant at the 10 percent level. It appears that some background in statistics may be helpful, even though basic statistical methods such as hypothesis testing and use of probability tables are taught in the agricultural price analysis course.

The two key explanatory variables for success in the agricultural price analysis course are calculus experience and grade point index. The regression coefficients for both variables are statistically significant at the one percent level. As has been realized by educators for many years (Royer, Abranovic, and Sinatra; Krockover, Mortlock and Johnson), a grade point index usually provides a strong indication of an undergraduate student's innate abilities and application through study habits, class attendance, and note taking skills.

Table 3. Correlation Matrix, Pooled Data

	AGEC	Market	Micro	Stat	Cal	IQ	GPA	Total
Agricultural Economics Major (AGEC)	1.00							
Introductory Agricultural Marketing (Market)	0.13	1.00						
Introductory Microeconomics (Micro)	0.58	-.05	1.00					
Introductory Statistics (Stat)	0.52	0.59	0.20	1.00				
Calculus (Cal)	-.14	0.35	0.10	-.24	1.00			
Economics IQ Test (IQ)	-.06	-.43	-.30	0.00	0.02	1.00		
Grade Point Index (GPA)	0.11	-.10	0.35	0.11	0.32	0.15	1.00	
Total Points Earned (Total)	0.06	-.06	0.27	0.09	0.52	0.35	0.78	1.00

Mathematical skills also are an important indicator of performance in economics courses (Hadjimatheou and Rendall). Based on the pooled data, **everything else equal,** those students in the agricultural price analysis course at Purdue University who had completed one semester of calculus earned 43 more points in the course. Completion of the calculus course is probably not only an indicator of knowledge of basic mathematical skills but also a student's ability to use logic and reasoning. Also the understanding and application of economic theory to price analysis problems plus the ability to evaluate regression results on computer print-outs require such skills.

Multicollinearity was not a problem with the pooled data. (Table 3) Furthermore, the correlation coefficients provide some additional insights into the econometric results. There was a negative relationship between the scores on the Economics IQ Test and the variables for agricultural economics major and completion of the agricultural marketing and introductory microeconomic theory courses. This is somewhat surprising. However, there was a positive correlation between agricultural economics majors and completion of the statistics and introductory microeconomics courses. This is consistent with the data in Table 1 which indicate that most students in class were agricultural economics majors and had completed the prerequisite courses. Perhaps most revealing are the positive correlation coefficients for points earned in the agricultural price analysis course and grade point index ($r=0.78$), completion of calculus ($r=0.52$), Economics IQ Test ($r=0.35$), and completion of the introductory microeconomic theory course ($r=0.27$).

Hence, the correlation matrix offers some information that reinforces the conclusions drawn from the analysis of the regression coefficients. Namely, grade point index, understanding of basic economic concepts, and statistical and mathematical skills are essential if a student is to excel in the agricultural price analysis course taught at Purdue University.

Conclusions

The purpose of this article was to demonstrate a potentially useful means of counselling undergraduate students using an econometric approach. In an agricultural price analysis course taught at Purdue University those students with a high grade index and solid background in statistics and mathematics were more successful in the course. It is especially important for a student with a below average grade point index to have taken the statistics and calculus prerequisites. A general understanding of introductory economics also may be helpful. However, since most students had completed the course prerequisites and were

agricultural economics majors, these variables were not useful predicators of class performance.

Students often rely on the "grapevine" and academic counsellors to select undergraduate courses. An error in course selection may result in failing a course, dropping a course during the semester, or not having sufficient background to perform to a student's potential. Any such errors may harm a student's self-image, increase the time required to complete a degree, and/or increase financial costs to the student, parents, or the public.

Any procedure that can minimize course selection errors should be encouraged. The approach described in this article shows promise as a technique to use information readily available in most students' counselling files plus some easily administered diagnostic tests that could reduce course selection errors and improve students' academic performance. While some of the explanatory variables selected in this article are unique to a price analysis course in agricultural economics at Purdue University, several of the variables such as major and grade point index could be applied to any course. To apply this approach to another course in another discipline or university, other appropriate explanatory variables would need to be selected. To perfect this approach to give students and counsellors more confidence in the method, it should be tested for several years, i.e., use pooled cross-sectional and time-series data. It would likely be a better predictor for courses with a larger number of students.

A word of caution. This approach should not be viewed from a strictly fatalistic nor deterministic perspective. Some students who have course and grade point problems in their first few semesters in college sometimes "find themselves" and through improved study/learning habits and increased motivation perform better as upper classmen. Occasionally other students do not perform as well as upper classmen if they lose interest in school or encounter personal problems or distractions. Thus, any quantitative technique for counselling is only a guide and should be tempered with other information that a counsellor knows about a student before giving advice on course selection.

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A REPORT

Microcomputer Use for Agricultural Mechanics

W. Forrest Bear

Introduction

Public schools have used the microcomputer for more than twelve years. Future high school graduates will be able to do limited programming, use word processing software and spreadsheets, and operate menu-driven programs. Students attending post-secondary schools, two or four-year institutions, already possess a variety of these computer skills.

Purpose

The goal of this study was to determine if instructors of agricultural mechanics classes at the collegiate level capitalize on their students' computer skills by using computers in agricultural mechanics classes.

Procedure

Two forms of data collection were used for this study. Interviews were conducted at the American Society of Agricultural Engineers meetings, the National FFA Agricultural Mechanics Contest, and on-site visits to campuses. To achieve a better geographic distribution of respondents, a limited number of questionnaires were sent to other members of the National FFA Agricultural Mechanics Contest Committee. Note, Figure 1 for the state location of respondents.

Figure 1. Respondents by State Location

Findings

Study participants totaled 114; 71 (62.3 percent), had primary appointments in agricultural engineering departments, and 43 (37.7 percent), had agriculture-education appointments. There were 50 agricultural engineers and 64 non-engineers. Computer usage was determined for instructional and non-instructional applications. Computers were used for student instructional purposes by 71.0 percent and for non-

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