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A STUDY OF THE CORRELATION BETWEEN STUDENTS' MATH APTITUDE AND THEIR ACHIEVEMENT IN PRINCIPLES OF ECONOMICS

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A STUDY OF THE CORRELATION BETWEEN STUDENTS' MATH APTITUDE AND THEIR ACHIEVEMENT IN PRINCIPLES OF ECONOMICS

Corlis McGee

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A STUDY OF THE CORRELATION BETWEEN STUDENTS' MATH APTTITUDE AND THEIR ACHIEVEMENT IN PRINCIPLES OF ECONOMICS

APPROVED:

Graduate Committee:

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ABSTRACT

A STUDY OF THE CORRELATION BETWEEN STUDENTS' MATH APTITUDE AND THEIR ACHIEVEMENT IN PRINCIPLES OF ECONOMICS

by Corlis McGee

The primary purpose of this study was to determine the relationship of math aptitude to achievement in Principles of Economics. This study sought answers to two major questions:

(1) What is the relationship between math aptitude and achievement in Principles of Economics?

(2) What is the relationship between overall aptitude and achievement in Principles of Economics?

Secondary areas examined included gender and classification as possible determinants of students' performance in Principles of Economics.

The study covered students taking Principles of Economics at Trevecca Nazarene College during the five quarters from Winter Quarter, 1985 through Spring Quarter, 1986. The sample included 82 students for Principles of Macroeconomics and 86 students for Principles of Microeconomics.

Corlis McGee

ACT scores were used to measure math aptitude and overall aptitude. Student achievement was measured by scores on the 1980 version of the Test of Understanding of College Economics and by course grade.

Math aptitude did prove to be a good predictor of achievement in Principles of Economics. However, overall aptitude as measured by the ACT Composite score was shown to be a much stronger predictor.

In addition, there appeared to be a stronger correlation between math aptitude and course grade than between math aptitude and TUCE achievement. Composite ACT score also emerged as a very good predictor of course grade in Principles of Economics.

It was concluded that: (1) Math aptitude is useful in predicting achievement in Principles of Economics. (2) Of the variables in the study, overall aptitude is the strongest predictor for achievement in Principles of Economics. (3) Class standing is useful for predicting achievement in Principles of Microeconomics, but it is not a good predictor of achievement for Principles of Macroeconomics. (4) Gender is not a good predictor of achievement in Principles of Economics.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

There is a strong feeling among instructors of Principles of Economics that students' performance in this subject is considerably affected by their background in mathematics. If a significant correlation does exist between the two variables, it is recommendable that advising faculty members in various disciplines be alerted about this phenomenon and that a minimum degree of proficiency in mathematics be made a pre-requisite to the beginning level economics. However, empirical research work to confirm the conjectured correlation has been relatively limited.

Statement of the Problem

This dissertation, which is based on a survey at Trevecca Nazarene College, attempts to contribute to the field by investigating the relationship between achievement in Principles of Economics, as measured by the TUCE (Test of Understanding of College Economics) score and course grade, and background in basic mathematics, as measured by the ACT (American College Test) math score. As a matter of secondary importance, this study examines such factors as gender and classification (i.e., freshman, sophomore, junior, or senior) as possible determinants of students' performance in Principles of Economics.

Hypotheses

The following research hypotheses are advanced:

Hypothesis 1: There is a significantly positive relationship between students' math aptitude as measured by their math ACT score and their achievement in Principles of Economics as measured by a post-test score on the TUCE.

Hypothesis 2: There is a significantly positive relationship between students' composite ACT scores and their post-test TUCE scores.

Hypothesis 3: There is a significantly positive relationship between students' math aptitude as measured by their math ACT scores and their final course grades in Principles of Economics.

Hypothesis 4: There is a significantly positive relationship between students' composite ACT scores and their final course grades in Principles of Economics.

Background and Significance of the Study

It has been commonly claimed by researchers in economic education that the principles of economics course during the 1930's provided students with a thorough introduction and overview of the discipline.[1] However, the content of basic economics has since undergone significant changes with the emergence of new theories and approaches. The trend has been to move away from teaching primarily economic thought and economic history toward teaching specific micro- and macro- economic principles that were earlier considered

[1] C. R. McConnell, "Some Reflections of the Introductory College-Level Course in Economics," In Larsen, A. F., and Nappi, A. (eds.), Goals and Objectives of the College-Level Course in Economics. Minneapolis: Federal Reserve Bank, 1979.

appropriate only for advanced courses. In addition, Principles of Economics courses and textbooks have incorporated more quantitative tools.

These changes, along with the increased burden on instructors who must cover an overwhelming amount of material within a limited period of time, have caused the development or reinforcement of a negative attitude toward economics on the part of many students. Horace Taylor stated in 1950 that "some teachers feel that the introductory course, instead of starting students on their way into more advanced study of economics, becomes for many students who might reasonably have gone much further a terminal course," and that "the introductory course is a basic difficulty in the whole enterprise of teaching economics."[2] These remarks seem to be more applicable to the condition today.

With the trend toward "open enrollment" in colleges and universities, there has been an increasing number of students with inadequate preparation in basic skills.[3] In the past few years, it has become apparent in my Principles of Economics classes at Trevecca Nazarene College that many students have deficient skills in the use of simple mathematics. This deficiency seems to make it difficult for them not only to understand equations and diagrams, but also to follow the logic of theories. The question has been whether this observation is supported by rigorous empirical studies, since any policy change recommendations should be based on objective data.

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[2]Horace Taylor, "On Teaching Undergraduate Economics," American Economic Review Supplememt, 1950, Volume 40, pp. 2-3.

[3]Stephen G. Buckles and Arthur L. Welsh, "The Use of Validated Tests in Teaching and Research," Research Papers in Economic Education, 1972, p. 31.

Unfortunately, past research dealing with the relationship between math aptitude and achievement in economics is not only very limited, but it also exhibits quite varied findings: George Dawson reported in 1976 that only 1.8 percent of the studies in economic education had been concerned with mathematics, econometrics, or statistics. According to him, some of these studies found no relationship between the student's previous training in mathematics and achievement in Principles of Economics, a few found a negative relationship, and the others found a positive relationship.[4] The most recent research dealing specifically with mathematics and Principles of Economics was conducted by Gery in 1969-70 using students in four sections of Principles of Economics taught by three different instructors at St. Olaf College. In this study, he found a marginal relationship between math aptitude and achievement in the introductory economics course.[5]

Because most of the studies have involved very limited samples, often confined to one or two classes at one school, Siegfried and Fels[6] and Becker,[7] along with several other researchers, have advocated replication. Replication will not only add to the sample size, but it will also increase the confidence

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[4]George G. Dawson, "Special Report: An Overview of Research in the Teaching of College Economics," The Journal of Economic Education, Spring, 1976, p. 114.

[5]Frank W. Gery, "Does Mathematics Matter?" Research Papers in Economic Education, 1972, p. 143.

[6]John J. Siegfried and Rendigs Fels, "Research on Teaching College Economics: A Survey," Journal of Economic Literature, Vol. XVII (September, 1979), p. 955.

[7]William E. Becker, Jr., "Economic Education Research: Part I, Issues and Questions," The Journal of Economic Education, Winter, 1983, p. 13.

attached to findings. This empirical study should make at least a modest contribution toward the goal of replication.

Definition of Terms

The following definitions apply to this study:

absolute achievement - post-test score reflecting the level of understanding at a point in time.

content validity - the extent to which a test instrument measures what it says it measures.

incentive structure - the incentive framework within which a student performs on a test instrument.

introductory economics course - the beginning level course, often referred to as Principles of Economics, in which elementary concepts and principles of micro- and macro-economics are presented in a one- or two-semester/quarter sequence.

OLS (ordinary least squares) - the sum of the squared deviations of the observed data points from the least-squares line is smaller than the sum of the squared deviations of the data points from any other straight line that can be drawn through the data points.

reliability - (1) internal consistency of a test instrument;
(2) stability of a test instrument, or test-retest reliability using a sample of students over a period of time without treatment;
(3) equivalent forms reliability, measuring the degree to which different forms of a test instrument are measuring the same aspect of behavior, or how well student scores on one form correlate with student scores on the parallel

form.[8]

t-statistic - the student t distribution is used when the sample is small and is characterized by a single parameter, the number of degrees of freedom. It allows us to make inferences about the mean when the population standard deviation is unknown.

TUCE - Test of Understanding in College Economics, prepared by the Joint Council of Economic Education.

ACT - American College Test, prepared by the American College Testing Service.

Limitations of the Study

The following limitations apply to this study:

(1) The study covers a particular college (Trevecca Nazarene College) during a particular period (1985 - 1986).

(2) Certain variables that may affect the learning process of students, such as class size, class hours, age-based motivation, major-minor standing, English-language proficiency, extracurricular activities, and the like, are not specifically incorporated into this study; they are assumed to not be systematically related to the performance measure.

(3) Additional training in mathematics which students may have received subsequent to the ACT but prior to the economics course is not incorporated into this study; this variable is also assumed to

[8] William B. Walstad and Stephen Buckles, "The New Economics Tests for the College and Pre-College Levels: A Comment," The Journal of Economic Education, Spring, 1983, p. 18.

not be systematically related to the performance measure.

(4) The materials covered by the specific instructor and textbook may somewhat differ from those coverd by the TUCE, thereby reducing the content validity of the test.

(5) Only the post-test package of the TUCE is used, as explained in Chapter 3.

Organization of the Study

Chapter 2 reviews relevant literature concerning the teaching of introductory economics at the college level especially as it relates to background in mathematics and achievement in economics.

Chapter 3 describes in detail the data collection process, experimental design employed, and the measurement instruments used along with the statistical techniques used in the evaluation and analysis of the data.

Chapter 4 presents the statistical results obtained in this experiment and the interpretations of these findings.

Chapter 5 contains the summary, conclusions, and policy implications recommended as a result of the study.

CHAPTER II

LITERATURE REVIEW

This chapter reviews literature on the the subject of the relationship between "student human capital" and learning achievement in economics. Student human capital in the present context refers to such elements as aptitude, knowledge, skill, experience, and the like that are variably embodied in all students. To be consistent with the purpose of this dissertation, literature containing mathematics background as one of such elements is given particular attention. It may be added that most analyses of the effect of student human capital on economics learning have appeared in literature as part of those studies which are primarily designed to evaluate new methods or media of instruction.

In their article, "Research on Teaching College Economics: A Survey" published in 1979, John J. Siegfried and Rendigs Fels reviewed the research in economics education up through 1978.[1] With respect to student human capital, they found the following tendencies among research findings:

(1) College entrance examination scores (SAT, ACT) are positively and significantly associated with learning achievement in economics; moreover, verbal SAT's seem to be more closely associated with TUCE scores than quantitative SAT's. This fact is substantiated by the usual non-significance of

[1]Siegfried and Fels, op. cit., pp. 937-938.

previous mathematics courses taken.

(2) Class rank in high school work has a positive relationship with collegiate performance in economics.

(3) Student maturity, measured by age, year in school, and number of accumulated college credit hours, usually shows no relationship with economics examination scores.

(4) Socioeconomic variables, such as family income and parents' educational background, are insignificant predictors of student cognitive achievement.

(5) Overall grade point average is usually positively related to economics test performance.

Siegfried and Fels concluded from their review that a student's general (particularly verbal) aptitude is the most important determinant of learning. Socioeconomic background, prior exposure to economics courses, mathematics preparation, class size, textbooks, and study effort were not found to be good predictors of achievement in Principles of Economics.[2]

In one of the few studies concerned primarily with the relationship between background in mathematics and achievement in economics, Frank Gery analyzed the case of students enrolled in four sections of Principles of Economics (taught by three different instructors) at St. Olaf College during the 1969-70 academic year.[3] In his study, the effect of mathematical aptitude and knowledge on performance in economics was found to be marginal in terms of absolute pre-TUCE scores and absolute post-TUCE scores. Gery found other

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[2] Ibid., p. 939.

[3] Gery, op. cit., p. 144.

critical variables, namely verbal aptitude and critical thinking skills to be more important predictors. However, quantitative aptitude emerged as the most important predictor when evaluated by the "gap-closing" procedure. The "gap-closing" method measures improvement from pre-TUCE to post-TUCE.[4] The relationship was particularly strong for those students with higher pre-TUCE scores.

The variables used in Gery's models fall into the following four categories: (1) dependent variables — scores on the TUCE and other student grades; (2) explanatory variables — aptitudes and achievements; (3) motivational variables — dummy variables for such things as interest, perceived importance of economics, quality of teaching and textbook, and reading habits; and (4) control variables — factors such as age, high school rank, and previous economics training.

The 33-question-hybrid version of the TUCE including both macro and micro questions was used for this experiment. Pre-TUCE, post-TUCE, gap-closing scores, and course grade were each used as dependent variables. High school economics training was expressed as a dummy variable ranging from 0 for 0-3 weeks of high school economics to 4 for more than 17 weeks.

It was also found that scores on the post-TUCE and ratings based on other evaluating yardsticks used in the economics course correlated reasonably well; students who did well on the post-TUCE also performed well on other measuring devices used by the instructor. However, the correlation was not

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[4]The gap-closing post-TUCE measure is formally defined by:

$$\text{gap closing} = \frac{\text{Posttest} - \text{Pretest}}{33 - \text{Pretest}}$$

high enough to warrant substitution of the TUCE score for all other evaluation instruments.

A corollary hypothesis that aptitude measures are more important than achievement measures for understanding economics was also tested by Gery. His findings supported this hypothesis. Verbal aptitude as measured by SAT scores was found to be more important than economics courses taken, overall rank, or nonmathematics courses taken in high school; quantitative aptitude as measured by SAT scores was more significant than mathematics courses taken in either high school or college.

Motivational factors in Gery's study were important explanatory variables at various points in the analysis. They were particularly helpful in explaining absolute improvement from pre-TUCE to post-TUCE, as well as course grade given by the instructor on the basis of non-TUCE score criteria.[5]

Based on questionnaire responses, the following motivational factors were incorporated:

INT = (0-5 scale) for degree of interest in economics

IMP = (0-5) for perceived importance of economics to informed citizenry

REQ = (0-5) for degree of agreement regarding whether economics should be a required course

QUAL of COURSE = (0-5) for overall reaction to the nature of the economics course

DIFF = (0-5) for relative difficulty of economics compared with other courses in college

TEXT = (0-5) for quality of textbook

[5] Ibid., pp. 150-152.

TIME = (0-5) for time spent on course relative to others

INSTR = (0-5) for quality of instructor compared with others in the college.[6]

In surveying the research in economic education in the Spring of 1976, Dawson found at least 700 studies dealing with economic education at the adult or college level. Approximately 10.9 percent of this total consisted of studies of an existing situation as compared with some sort of controlled experiment. His review showed that highly significant predictors of economics tests scores were student ability as measured by SAT scores and grade point averages. It also revealed that men tended to make significantly greater gains than women in learning economics.[7]

Laura S. Rubin used a sample of 129 sophomores in the College of Commerce and Finance at Villanova University to examine the socioeconomic and academic factors that influence college achievement of economics and business majors. Academic factors measured by verbal aptitude scores and hours of study were found to be significantly related to grade point average of students during their first three semesters in college. In her study, the link between socioeconomic variables and college scholastic success was much less clear.[8]

During the spring semester of 1974, the Center for Economic Education at Madison College initiated a study to test the effects on the statistical

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[6]Ibid., p. 153.

[7]Dawson, op. cit., p. 112.

[8]Laura S. Rubin, "Socioeconomic and Academic Factors Influencing College Achievement of Economics and Business Majors," Journal of Economic Education, Spring, 1977, pp. 124-125.

findings of using alternative forms for specifying TUCE scores as the dependent variable in the regression model,[9] since much of the criticism of past studies had centered around the specification models used. The four alternative forms used by the Center for specifying the TUCE were:

	TUCE Score Specification Form
(1) Absolute achievement	Post-test
(2) Absolute improvement	Post-test - Pre-test
(3) Percentage improvement	$\frac{\text{Post-test - Pre-test}}{\text{Pre-test}}$
(4) Gap-closing	$\frac{\text{Post-test - Pre-test}}{\text{Perfect score - Pre-test}}$

Covered by this study were all students enrolled in the one-semester introductory course in economics during spring semester, 1974. The sample included 138 students from five classes taught by two professors.

For explaining variation in TUCE scores, previous knowledge of the subject, both general and specific, (measured by pre-test, cumulative GPA, and CEEB total) appeared to be very important. The following variables were not identified to be statistically significant: high school rank, college hours completed, elective or requirement status of the course, pass/fail or letter grade assigned.

Although the four alternative models failed to yield completely consistent results with respect to identifying statistically significant explanatory variables, models 2 and 4 yielded the same pattern of results in seven of the

[9] Paul H. Kipps, Howard M. Wilhelm and Daniel R. Hall, "A Note on the Use of Multiple Regression Analysis in Studies of Achievement in Economics," Journal of Economic Education, Spring, 1976, pp. 130-132.

nine cases. As a most important conclusion, the findings supported the proposition that the model specification may introduce a systematic bias in the statistical findings with respect to identifying significant explanatory variables.

Lewis and Dahl conducted an experiment using 784 students at the University of Minnesota enrolled in an introductory macroeconomics course. These students, classified into 23 experimental and control sections, were subjected to questionnaires as well as TUCE pre- and post-tests and the Watson-Glaser Critical Thinking Appraisal.[10] Success in the study of Principles of Economics was found to be associated with a high level of prior ability in critical thinking.[11]

Lewis and Dahl later used this same research sample to reevaluate the factors influencing performance in the principles course.[12] This study revealed that class standing, ACT score, interest and whether or not the student feels the course is required were all significant as predictors of post-TUCE scores; the levels of significance for these variables essentially confirmed the results of many of the previous studies. However, student gender was not found to be a significant predictor, in contrast to opposite findings in many other studies.

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[10]Darrell R. Lewis and Tor Dahl, "Critical Thinking Skills in the Principles Course: An Experiment," Research Papers in Economic Education, Welsh, Arthur L., ed., 1972, p. 50.

[11]Ibid., p. 66.

[12]Darrell R. Lewis and Tor Dahl, "Factors Influencing Performance in the Principles Course Revisited," in Research Papers in Economic Education, Welsh, Arthur L., ed., 1972, p. 95.

In addition, "Time Spent" emerged in the regression equation with a negative sign, indicating that students who spent a larger amount of time on the course tended to make lower scores on the post-TUCE. This variable was positively correlated with "Subject Difficulty" and negatively correlated with "College Mathematics," implying that students who spent greater amounts of time on the course tended to find the subject difficult, generally had a limited quantitative background, and therefore did not do very well on the post-TUCE.[13] This observation may be partially explained by the general quantitative emphasis given in the economics coursework required by the Department of Economics at the University of Minnesota.[14]

According to John J. Siegfried, most of the studies of gender and performance in economics fail to consider explicitly whether it is the level of understanding at a point in time or the learning over a period of time that they expect gender to influence. Level of understanding is defined here as the stock of knowledge about economics and business at a point in time. Learning is defined as the flow of new knowledge that occurs over a period of time.

Studies examining the level of understanding generally report correlations between student performance on a final exam and student gender. Studies assessing the relationship between gender and learning either use a "value-added" measure of performance, or include a pretest control variable in their model. According to Siegfried, two-thirds of the studies dealing with the level of understanding found in terms of statistical significance that men

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[13] Ibid., p. 101.

[14] Ibid., p. 110.

performed better than women. On the other hand, only one-third of the studies examining the flow of students' learning during courses found that men did better than women. In general, empirical research suggests that by the time people reach college age, men are significantly ahead of women in understanding economics, but that both sexes progress at equivalent rates.[15]

It must be added that most of the studies from which these conclusions are drawn were designed for other purposes. In this sense, the conclusions are not definitive enough to resolve the issue of gender and achievement in Principles of Economics.

[15]John J. Siegfried, "Male-Female Differences in Economic Education: A Survey," Journal of Economic Education, Spring, 1979, pp. 1-11.

CHAPTER III

RESEARCH PROCEDURES AND METHODOLOGY

Procedures for Collecting Data

This study covers students taking Principles of Economics at Trevecca Nazarene College during the five quarters from Winter Quarter, 1985 through Spring Quarter, 1986. These Principles of Economics courses consist of four sections of Macroeconomics and four sections of Microeconomics. Six of the sections met twice per week on Tuesday and Thursday for 95 minutes each, and two sections met three times per week on Monday, Wednesday, and Friday for 65 minutes each. The enrollment in each section ranged from 35-50 students. All sections were taught by the same instructor using the same textbook and the same syllabus and course outline.

Given the availability of time and resources, this choice of sample conforms to the generally recommended approach. Research by Brown and Dubois indicates that a homogeneous group of students make the best subjects in predictive studies.[1] The homogeneity increases the accuracy of the prediction at that institution by eliminating the variance contributed by heterogeneous institutional arrangements. Additional research from Attiyeh, Bach,

[1]Frederick G. Brown and Thomas E. Dubois, "Correlates of Academic Success for High-Ability Freshman Men," Personnel and Guidance Journal, XLII (February, 1964), pp. 603-607.

and Lumsden[2] and studies by Chizmar[3] support these findings.

ACT scores are the most widely used and accepted measure of student ability. Moreover, they are considered to be one of the best predictors of cognitive achievement in college. This study uses the student's math aptitude score and overall aptitude score. These ACT scores were made available through cooperation of the Admissions Office of the College. Because ACT scores are not available for transfer students and foreign students, not all the students taking the introductory economics courses will be included in the survey. The total research sample is 82 students for Principles of Macroeconomics and 86 students for Principles of Microeconomics. This includes all students taking Principles of Economics during this period whose ACT scores are available.

Selection of Research Instrument

The primary instrument used by this study to measure student achievement in economics is the 1980 version of the TUCE (Test of Understanding of College Economics) which was originally developed by the Joint Council of Economic Education in 1968.[4] According to Walstad and Buckles, TUCE is the best measurement instrument currently available and represents a substantive improvement over previous instruments.[5] A review of the research in economics education indicates that TUCE is the most

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[2]Siegfried and Fels, op. cit., p. 958.

[3]Ibid.

[4]Ibid.

[5]Walstad and Buckles, op. cit., p. 17.

widely used measurement instrument.

Two forms of the TUCE macro exam and two forms of the TUCE micro exam are available. Each exam contains 30 multiple-choice questions and is designed to take 45 minutes. It was decided that use of a post-test would be sufficient. In the first place, this research is mainly concerned with the relationship between mathematical background and economics achievement, rather than the effects of different teaching treatments. Secondly, the approach which measures the gain from pre-test to post-test tends to over-emphasize the importance of the pre-test for the present purpose. Thirdly, use of a pre-test is administratively too expensive and cumbersome in view of its limited value.

K-R-20 (Kuder-Richardson 20) reliability estimates of the post-test are .81 for macro Form A, .76 for Macro Form B, .74 for Micro Form A, and .73 for Micro Form B according to the Revised Test of Understanding in College Economics—Interpretive Manual. Because of the higher reliability estimates and the recommendation by the TUCE revision committee that Macro Form A and Micro Form A be used when only a post-test is administered, these two forms have been selected as the measurement instrument.[6]

Administration of Research Instrument

The TUCE was administered in connection with a final comprehensive exam given in each class. Students were advised that the TUCE would count as extra-credit, but that it could in no way lower their grade on the final exam. In view of the problem of content validity mentioned earlier, this

[6]Phillip Saunders, Revised Test of Understanding in College Economics—Interpretive Manual, 1981, p. 3.

treatment seemed to be fairer to the student. It is also likely to cause more uniformity in incentive structure than asking the student to take the TUCE as a favor to the researching instructor.

A review of the literature indicates that the incentive structure used in administering the exam does make a difference in the motivation level of the students taking the exam. For example, the test manual indicates that having the test score count in determining the final course grade was positively and significantly associated with a difference of over two points in the pre-test score.[7] Similarly, William Wehrs found that counting the TUCE as a part of the course grade resulted in an upward bias in relation to the norms, and that nongraded structure resulted in a slight downward bias. According to him, the importance is not the type of incentive structure used, but rather the degree of uniformity of the incentive structure for all groups.[8]

Collection of other Data

Aside from the TUCE which is used as the primary instrument, student course grade, as evaluated by the instructor, will be used as a second instrument to measure student achievement in Principles of Economics. The evaluation is based on four tests counting 100 points each and a comprehensive final exam counting 150 points. The alphabetical grades of A, B, C, D, and F are converted to a numerical scale of A = 4, B = 3, C = 2, D = 1, and F = 0 for the purpose of this study.

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[7] Ibid., p. 9.

[8] William Wehrs, "Incentive Structure and the TUCE," The Journal of Economic Education, Spring, 1978, pp. 107-110.

Procedures of Treating Data

The relationship between the variables was analyzed with Ordinary Least Squares Regression analysis. The literature in economic education indicates that this is the most commonly used method of analysis. The t-statistic, in particular, was calculated and tested at the .05 and .01 levels of significance.

To test hypotheses (1) and (2) the model consisted of the following equations:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \varepsilon_i$$ [9]

$$Y_i = \beta_0 + \beta_1 X_{1i} + \varepsilon_i$$

$$Y_i = \beta_0 + \beta_2 X_{2i} + \varepsilon_i$$

$$Y_i = \beta_0 + \beta_2 X_{2i} + \varepsilon_i$$

where: Y_i = dependent variable = an accurately measured, continuous post-test score for the i^{th} subject, $i = 1 \ldots\ldots n$

X_{1i} = ACT math score

X_{2i} = ACT composite score

X_{3i} = gender

X_{4i} = classification

β = parameter to be estimated - reflects the impact of X on Y, holding all other variables constant

ε_i = an error resulting from the omission of variables, or some other random perturbation inherent in the study — ε_i is

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[9] William E. Becker, Jr., "Economic Education Research: Part III, Statistical Estimation Methods," The Journal of Economic Education, Summer, 1983, p. 4.

assume to be normally distributed, with a mean of zero, constant variance, zero covariance, and it is uncorrelated with the explanatory variables

To test hypotheses (3) and (4), the following equations were used:

$$Z_i = \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \alpha_3 X_{3i} + \alpha_4 X_{4i} + \varepsilon_i$$

$$Z_i = \alpha_0 + \alpha_1 X_{1i} + \varepsilon_i$$

$$Z_i = \alpha_0 + \alpha_2 X_{2i} + \varepsilon_i$$

where: Z_i = dependent variable = the final course grade in Principles of Economics

X_{1i} = ACT math score

X_{2i} = ACT composite score

X_{3i} = gender

X_{4i} = classification

α = parameter to be estimated - reflects the impact of X on Z, holding all other variables constant

CHAPTER IV

STATISTICAL FINDINGS AND INTERPRETATIONS

The data for this study, as described in Chapter III, were processed at the Academic Computing Department of Middle Tennessee State University by using the Statistical Package for the Social Sciences (SPSS). The results are presented in this chapter. More specifically, this chapter describes the quantitative relationship between the independent variables and the dependent variables, and adds interpretation of the regression analyses.

As had been hypothesized, a preliminary overview of the regression analyses indicated that there is a positive relationship between math aptitude as measured by the math ACT score and achievement in Principles of Economics as measured by a post-test TUCE score. However, overall aptitude as measured by the ACT composite score emerged as a much better predictor of achievement in Principles of Economics than did math aptitude. Secondary variables such as gender and class standing did not emerge as particularly good predictors of achievement in Principles of Economics. The findings are presented and discussed in the order of the hypotheses presented in Chapter I. Statistical details are given in Tables 1 - 6.

Major Findings

Test of Null Hypothesis 1: Effects of Math Aptitude on Achievement

Hypothesis 1: There is no significant relationship between students' math aptitude as measured by their math ACT score and their achievement in Principles of Economics as measured by a post-test score on the TUCE.

Alternatively, when a simple linear regression analysis (with ACT math score as independent variable and TUCE score as dependent variable) is used to test the research hypothesis that there is a significant positive relationship between students' math aptitude and their TUCE score, the research hypothesis proves to be valid for both macroeconomics and microeconomics categories of the Principles of Economics. For example, the regression equation for the macroeconomics category is

$$\text{Total TUCE Score} = 8.581 + .251\ \underset{(4.361)^{**}}{\text{ACT Math}}$$

The value in parenthesis is the "t" value which is significant at the .01 level. This tendency holds even when the 30 TUCE questions are subdivided into (1) recognition and understanding (RU), (2) explicit application (EA), and (3) implicit application (IA) questions of ten each; that is, students with higher ACT math scores do better in each of the three parts as shown in Table 3.

Similarly, the regression equation for the microeconomics category is

$$\text{Total TUCE Score} = 6.994 + .325\ \underset{(5.929)^{**}}{\text{ACT Math}}$$

and the value of "t" is significant at the .01 level. Moreover, students with

higher ACT math scores do better in each of the three parts as shown in Table 4.

However, when a multiple linear regression analysis (with ACT math score, ACT composite score, gender, and class standing as independent variables) is used, validity of the hypothesis does not appear conclusive. For example, although total TUCE scores for (1) macroeconomics and (2) microeconomics are positively associated with the ACT Math score,

(1) Total TUCE Score = 4.859 + .061 ACT Math + .342 ACT Comp
(.600) (2.408)**

+ .149 GEN + .369 CLASS
(.184) (.772)

(2) Total TUCE Score = 1.555 + .134 ACT Math + .355 ACT Comp
(1.490) (2.902)**

+ 1.013 GEN + .759 CLASS
(1.427) (2.087)

the regression coefficients are much smaller than those found under the simple regression analysis. Moreover, the "t" values are not significant at the .05 level.

Furthermore, breakdown of TUCE questions into the above-mentioned three parts produces mixed statistical results as presented in Tables 1 and 2.

These findings can be interpreted as follows. Math aptitude is a good predictor of achievement in Principles of Economics. In other words, students with higher ACT math scores will generally do better in introductory courses of economics. However, math aptitude is only a part of general aptitude that is even more important. Thus, as discussed further under the testing of the second hypothesis, ACT composite score appears to be a better predictor of student performance in introductory economics.

Test of Null Hypothesis 2: Effects of Overall Aptitude on Achievement

Hypothesis 2: There is no significant relationship between students' composite ACT scores and their post-test TUCE scores.

Again, the alternative hypothesis that there is a positive relationship between students' composite ACT scores and their post-test TUCE scores is tested. The multiple regression equations mentioned earlier are as follows for (1) macroeconomics and (2) microeconomics:

(1) Total TUCE Score = 4.859 + .061 ACT Math + .342 ACT Comp
(.600) (2.408)**

+ .149 GEN + .369 CLASS
(.184) (.772)

(2) Total TUCE Score = 1.555 + .134 ACT Math + .355 ACT Comp
(1.490) (2.902)**

+ 1.013 GEN + .759 CLASS
(1.427) (2.087)

They indicate that overall aptitude as measured by the composite ACT score is a stronger predictor of achievement in Principles of Economics as measured by TUCE scores than math aptitude. In both cases, the coefficient of ACT Comp is larger than that of ACT Math, and the value of "t" is significant at the .01 level.

Analyses with breakdown of TUCE questions into three parts (recognition and understanding, explicit application, and implicit application) reinforce the validity of the hypothesis. For both macroeconomics and microeconomics, TUCE score in every part is directly related to ACT composite score. Moreover, the "t" value is significant at least at the .05 level in all cases. These results are given in Tables 1 and 2.

Testing of the hypothesis with a simple linear regression analysis (with ACT composite score as independent variable and TUCE score as dependent variable) produces virtually the same result. The regression equations are as follows for (1) macroeconomics and (2) microeconomics:

(1) Total TUCE Score = 5.603 + .407 ACT Comp
(5.155)**

(2) Total TUCE Score = 3.918 + .486 ACT Comp
(6.748)**

All types of TUCE score are positively associated with ACT composite score, and the "t" values are all significant at the .01 level.

Test of Null Hypothesis 3: Effects of Math Aptitude on Course Grade

Hypothesis 3: There is no significant relationship between students' math aptitude as measured by their math ACT score and their final course grade in Principles of Economics.

The alternative hypothesis that there is a significant positive relationship between students' math aptitude and their final course grade proves to be valid. Course grade is positively associated with ACT Math score in both macroeconomics and microeconomics, whether the one-independent-variable equation or the four-independent-variable equation is used. The "t" value is significant at least at the .05 level in all cases. The equations for (1) macroeconomics and (2) microeconomics are as follows:

(1) GRADE = -.298 + .051 ACT Math + .079 ACT Comp
(2.274)* (2.524)**

-.173 GEN + .136 CLASS
(-.969) (1.293)

GRADE = .583 + .093 ACT Math
(7.198)**

(2) GRADE = -1.459 + .066 ACT Math + .084 ACT Comp
(2.911)** (2.740)**

+ .296 GEN + .290 CLASS
(1.665) (3.182)**

GRADE = .197 + .108 ACT Math
(7.634)**

Moreover, there appears to be a stronger correlation between math aptitude and course grade than between math aptitude and TUCE score as shown in Tables 1-4. The regression coefficient of ACT math is relatively larger in the former case than in the latter. The coefficient of determination, "R^2", is also higher in the former. A plausible explanation is that evaluation schemes used by the instructor of these courses to determine course grade contained more mathematical elements than TUCE questions did.

Test of Null Hypothesis 4: Effects of Overall Aptitude on Course Grade

Hypothesis 4: There is no significant relationship between students' composite ACT score and their final course grade in Principles of Economics.

Composite ACT score proves to be a very strong predictor of course grade in both Principles of Macroeconomics and Principles of Microeconomics when the research hypothesis is tested. The "t" values emerged as significant at the .01 level for the four variable equations as well as for the single

variable equations for (1) macroeconomics and (2) microeconomics:

(1) GRADE = -.298 + .051 ACT Math + .079 ACT Comp
(2.274)* (2.524)**

-.173 GEN + .136 CLASS
(-.969) (1.293)

GRADE = -.227 + .135 ACT Comp
(7.457)**

(2) GRADE = -1.459 + .066 ACT Math + .084 ACT Comp
(2.911)** (2.740)**

+ .296 GEN + .290 CLASS
(1.665) (3.182)**

GRADE = -.623 + 1.51 ACT Comp
(7.875)**

Again, the statistical analysis indicates that ACT composite score influences student performance in economics more than ACT math score.

These research findings correlate well with the findings of Siegfried and Fels in their survey of research in economics education up through 1978. They found that college entrance examination scores (SAT, ACT) are positively and significantly associated with learning achievement in economics; moreover verbal aptitude seems to be more closely associated with TUCE scores than quantitative aptitude. Siegfried and Fels concluded that a student's general aptitude is the most important determinant of learning.[1]

Notes Concerning Class Standing and Gender

In this research project, class standing as measured by the number of years in school proved to be a significant predictor of achievement for Principles of Microeconomics, but not for Principles of Macroeconomics.

[1]Siegfried and Fels, op. cit, pp. 937-939.

For Principles of Microeconomics, the "t" values of CLASS are significant at the .05 level for total TUCE score and partial TUCE score on explicit application questions, and implicit application questions. It is also significant for course grade at the .01 level. The only case that is not significant concerns the partial TUCE score on recognition and understanding questions. For Principles of Macroeconomics, all, except partial TUCE score on implicit application questions, show class standing to be a poor predictor of achievement.

Most of the prior research on class standing does not distinguish between microeconomics and macroeconomics. In their survey of research in economic education, Siegfried and Fels found that class standing usually shows no relationship with economics examination scores.[2] However, Lewis and Dahl found that class standing was a significant predictor of post-TUCE scores.[3] These conflicting findings in previous studies may possibly be explained by the significance of class standing for Principles of Microeconomics and the non- significance for Principles of Macroeconomics found by this study.

The regression equations generated by this study show that TUCE scores are not generally affected by gender. The "t" values are not found to be significant at the .05 level in either equation. Gender does show a "t" value significant at the .05 level for course grade in Principles of Microeconomics, but it is non-significant in Principles of Macroeconomics.

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[2] Ibid.

[3] Darrell R. Lewis and Tor Dahl, "Factors Influencing Performance in the Principles Course Revisited," in Research Papers in Economic Education, Welsh, Arthur L., ed., 1972, p. 95.

This evidence supports research by Lewis and Dahl which found gender not to be a significant predictor of achievement.[4] However, this is in opposition to many studies, including Dawson,[5] Siegfried,[6] and Allison[7] which revealed that men tended to make significantly greater gains than women in learning economics.

Elisabeth Allison developed the following account of the source of the differentials in a study conducted over a three-year period at Harvard on 2,400 students:

> Women enter the course with less "skill" in learning analytic material—less practice in that peculiar intellectual exercise of model building. Thus learning analytic material comes slowly; much of each hour spent studying is misdirected. Consequently, at the end of the semester they have learned relatively little economics per unit of time, and even less economic theory. Nor have they learned on the average analytic material as well as their male counterparts. Thus, in the second semester women are, given the cumulative nature of economics, doubly disadvantaged. Since (as revealed by other evidence in the study) they are more sensitive to grades than their male counterparts, they do not reduce their effort during the second semester. But as indicated in the second semester enjoyment equation, they ultimately find the experience relatively unsatisfying.[8]

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[4]Ibid.

[5]Dawson, op. cit., p. 112.

[6]Siegfried, op. cit.

[7]Elisabeth Allison, "Educational Production Function for an Introductory Economics Course," Research on Teaching College Economics, Rendigs Fels and John J. Siegfried, ed., 1982, p. 189.

[8]Ibid.

Notes Concerning Other Independent Variables

As stated earlier, the primary purpose of this study was to investigate the relationship between student's aptitude in mathematics and their learning achievement in introductory economics courses. The study incorporated four independent variables, namely, ACT math score, ACT composite score, class standing, and gender. Use of these four variables was more than adequate for the purpose of this study.

However, it must be stated that additional variables seem to be needed if the purpose is to develop a model to predict achievement in such courses accurately. This point is demonstrated by statistical results of this study in terms of the size of "R^2", or the coefficient of determination. In the following four major regression lines estimated for (1) macroeconomics and (2) microeconomics,

(1) Total TUCE Score = 4.859 + .061 ACT Math + .342 ACT Comp
+ .149 GEN + .369 CLASS
R^2 = .257

GRADE = -.298 + .051 ACT MATH + .079 ACT COMP
- .173 GEN + .136 CLASS
R^2 = .461

(2) Total TUCE Score = 1.555 + .134 ACT MATH + .355 ACT COMP
+ 1.013 GEN
R^2 = .406

GRADE = -1.459 + .066 ACT MATH + .084 ACT COMP
+ .296 GEN + .290 CLASS
R^2 = .531

the value of "R^2" ranged from .257 to .531, meaning that "goodness of fit" was not excellent. Apparently, such factors as students' interest, motivation, and industriousness considerably affect their achievement in economics.

LIST OF ABBREVIATIONS

CLASS - Class Standing

Freshman - 1
Sophomore - 2
Junior - 3
Senior - 4

GEN - Gender

Female - 0
Male - 1

GRADE - Final Course Grade in Principles of Economics

A - 4
B - 3
C - 2
D - 1
F - 0

ACT MATH - ACT Math Score (0-36)

ACT COMP - ACT Composite Score (0-36)

TOTAL - Total Score on TUCE (1-30)

RU - Recognition and Understanding - Total score on Recognition and Understanding Questions on the TUCE (1-10)

EA - Explicit Application - total score on Explicit Application Questions on TUCE (1-10)

IA - Implicit Application - Total score on Implicit Application Questions on TUCE (1-10)

TABLE 1

Regression Equations for Principles of Macroeconomics
(Four Independent Variables)

Total	= 4.859 +	.061 ACT MATH +	.342 ACT COMP +	.149 GEN +	.369 CLASS
(t)		(.600)	(2.408)**	(.184)	(.772)
	R^2 = .257	F = 6.67**	SEE = 3.63	n = 82	
RU	= 2.065 −	.018 ACT MATH +	.188 ACT COMP +	.178 GEN +	.186 CLASS
(t)		(−.388)	(2.921)**	(.485)	(.858)
	R^2 = .221	F = 5.449**	SEE = 1.646	n = 82	
EA	= 2.169 −	.033 ACT MATH +	.134 ACT COMP +	.017 GEN −	.231 CLASS
(t)		(−.709)	(2.020)*	(.044)	(−1.033)
	R^2 = .098	F = 2.100	SEE = 1.696	n = 82	
IA	= .626 +	.112 ACT MATH +	.019 ACT COMP −	.045 GEN +	.414 CLASS
(t)		(2.250)*	(.282)	(−.114)	(1.762)*
	R^2 = .209	F = 5.081**	SEE = 1.785	n = 82	
GRADE	= −.298 +	.051 ACT MATH +	.079 ACT COMP −	.173 GEN +	.136 CLASS
(t)		(2.274)*	(2.524)**	(−.969)	(1.293)
	R^2 = .461	F = 16.463**	SEE = .799	n = 82	

*significant at .05 level
**significant at .01 level

TABLE 2

Regression Equations for Principles of Microeconomics
(Four Independent Variables)

Total	= 1.555 +	.134 ACT MATH +	.355 ACT COMP +	1.013 GEN +	.759 CLASS
(t)		(1.490)	(2.902)**	(1.427)	(2.089)

R^2 = .406 F = 13.865** SEE = 3.282 n = 86

RU	= 2.021 +	.063 ACT MATH +	.029 ACT COMP +	.235 GEN +	.060 CLASS
(t)		(1.391)	(.471)	(.661)	(.330)

R^2 = .109 F = 2.501 SEE = 1.644 n = 86

EA	= -1.051 +	.054 ACT MATH +	.207 ACT COMP +	.528 GEN +	.337 CLASS
(t)		(1.153)	(3.255)	(1.436)	(1.787)*

R^2 = .409 F = 13.995** SEE = 1.701 n = 86

IA	= .585 +	.018 ACT MATH +	.119 ACT COMP +	.250 GEN +	.362 CLASS
(t)		(.412)	(2.063)	(.742)	(2.095)*

R^2 = .200 F = 5.078** SEE = 1.559 n = 86

GRADE	= -1.459 +	.066 ACT MATH +	.084 ACT COMP +	.296 GEN +	.290 CLASS
(t)		(2.911)**	(2.740)**	(1.665)	(3.182)**

R^2 = .531 F = 22.918** SEE = .823 n = 86

*significant at .05 level
**significant at .01 level

TABLE 3

Regression Equations for Principles of Macroeconomics
(One Independent Variable - ACT MATH)

Total	= 8.581 + .251 ACT MATH			
(t)	(4.361)**			
	R^2 = .192	F = 19.019**	SEE = 3.712	n = 82
RU	= 4.118 + .088 ACT MATH			
(t)	(3.299)**			
	R^2 = .119	F = 10.880**	SEE = 1.716	n = 82
EA	= 2.684 + .049 ACT MATH			
(t)	(1.853)*			
	R^2 = .041	F = 3.433**	SEE = 1.716	n = 82
IA	= 1.779 + .114 ACT MATH			
(t)	(4.109)**			
	R^2 = .174	F = 16.881**	SEE = 1.789	n = 82
GRADE	= .583 + .093 ACT MATH			
(t)	(7.198)**			
	R^2 = .393	F = 51.809**	SEE = .833	n = 82

*significant at .05 level
**significant at .01 level

TABLE 4

Regression Equations for Principles of Microeconomics
(One Independent Variable - ACT MATH)

Total	= 6.994 + .325 ACT MATH				
(t)	(5.929)**				
	R^2 = .295	F = 35.151**	SEE = 3.512	n = 86	
RU	= 2.539 + .078 ACT MATH				
(t)	(3.084)**				
	R^2 = .102	F = 9.512**	SEE = 1.622	n = 86	
EA	= 1.778 + .167 ACT MATH				
(t)	(5.863)**				
	R^2 = .290	F = 34.372**	SEE = 1.829	n = 86	
IA	= 2.676 + .079 ACT MATH				
(t)	(3.146)**				
	R^2 = .105	F = 9.895**	SEE = 1.619	n = 86	
GRADE	= .197 + .108 ACT MATH				
(t)	(7.634)**				
	R^2 = .409	F = 58.272**	SEE = .907	n = 86	

*significant at .01 level

TABLE 5

Regression Equations for Principles of Macroeconomics
(One Independent Variable - ACT COMP)

Total	= 5.603 + .407 ACT COMP			
(t)	(5.155)**			
	R^2 = .249	F = 26.569**	SEE = 3.578	n = 82
RU	= 2.653 + .165 ACT COMP			
(t)	(4.593)**			
	R^2 = .209	F = 21.091**	SEE = 1.627	n = 82
EA	= 1.739 + .099 ACT COMP			
(t)	(2.675)**			
	R^2 = .082	F = 7.156**	SEE = 1.679	n = 82
IA	= 1.209 + .143 ACT COMP			
(t)	(3.541)**			
	R^2 = .135	F = 12.537**	SEE = 1.830	n = 82
GRADE	= -.227 + .135 ACT COMP			
(t)	(7.457)**			
	R^2 = .410	F = 55.609**	SEE = .821	n = 82

*significant at .05 level
**significant at .01 level

TABLE 6

Regression Equations for Principles of Microeconomics
(One Independent Variable - ACT COMP)

Total	= 3.918 + .486 ACT COMP				
(t)	(6.748)**				
	R^2 = .352	F = 45.538**	SEE = 3.369	n = 86	
RU	= 2.168 + .097 ACT COMP				
(t)	(2.771)**				
	R^2 = .084	F = 7.677**	SEE = 1.638	n = 86	
EA	= .058 + .258 ACT COMP				
(t)	(6.970)**				
	R^2 = .366	F = 48.582**	SEE = 1.729	n = 86	
IA	= 1.692 + .131 ACT COMP				
(t)	(3.898)**				
	R^2 = .153	F = 15.196**	SEE = 1.576	n = 86	
GRADE	= -.623 + .151 ACT COMP				
(t)	(7.875)**				
	R^2 = .425	F = 62.023**	SEE = .895	n = 86	

**significant at .01 level

CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

The primary purpose of this study was to determine the relationship of math aptitude to achievement in Principles of Economics. This chapter summarizes the findings of this study, presents conclusions based upon these findings, and lists implications and recommendations.

Summary

This study sought answers to two major questions:

1. What is the relationship between math aptitude and achievement in Principles of Economics?

2. What is the relationship between overall aptitude and achievement in Principles of Economics?

Secondary areas examined included gender and classification as possible determinants of students' performance in Principles of Economics.

The study covered students taking Principles of Economics at Trevecca Nazarene College during the five quarters from Winter Quarter, 1985 through Spring Quarter, 1986. The sample included 82 students for Principles of Macroeconomics and 86 students for Principles of Microeconomics. This included all students taking Principles of Economics during this period whose ACT scores were available.

ACT scores were used to measure math aptitude and overall aptitude. These scores were made available through cooperation of the Admissions Office of the College. Student achievement was measured by scores on the 1980 version of the Test of Understanding of College Economics and by course grades.

The data were analyzed through the use of a multiple regression program available at the Academic Computing Department of Middle Tennessee State University.

Major Findings

Math aptitude as measured by the ACT math score did prove to be a good predictor of achievement in Principles of Economics. However, overall aptitude as measured by the ACT composite score was shown to be a much stronger predictor.

In addition, there appeared to be a stronger correlation between math aptitude and course grade than between math aptitude and TUCE achievement. Composite ACT score also emerged as a very good predictor of course grade in Principles of Economics.

Class standing as measured by the number of years in school proved to be a significant predictor of achievement for Principles of Microeconomics, but it did not prove to be a significant predictor of achievement for Principles of Macroeconomics.

Contrary to findings in most of the previous research studies, gender was not shown to be a good predictor of achievement in Principles of Economics.

Conclusions

1. It was concluded that math aptitude is useful in predicting achievement in Principles of Economics.

2. Of the variables tested in this study, overall aptitude is the strongest predictor for achievement in Principles of Economics.

3. Class standing is useful for predicting achievement in Principles of Microeconomics, but is not a good predictor of achievement for Principles of Macroeconomics.

4. Gender is not a good predictor of achievement in Principles of Economics.

Recommendations

1. It is recommended that advisors encourage students to take the general education mathematics requirement prior to enrolling in Principles of Economics.

2. It is recommended that further research be done to examine specific mathematics skills which contribute to achievement in Principles of Economics (i.e., elementary algebra, advanced algebra, etc.). This would aid economics departments in determining which mathematics class should meet the general education mathematics requirement for students of economics.

3. It is recommended that future studies consider using an instructor-modified form of the TUCE that conforms more closely to the content covered in the course. This would increase the content validity of the achievement instrument.

4. It is recommended that this study be replicated in many other college and university settings, since the conclusions in this study may only be applicable to Trevecca Nazarene College and very similar institutions.

5. It is recommended that additional variables be incorporated if the research objective is to develop a model to predict achievement in Principles of Economics.

APPENDICES

Appendix A

Pearson Correlation Coefficients

for

Principles of Macroeconomics

	GEN	CLASS	ACT Math	ACT Comp
GEN	1.000	-.1066 P = .170	.0377 P = .368	.0466 P = .339
CLASS	-.1066 P = .170	1.000	-.1784 P = .054	-.1040 P = .176
ACT Math	.0377 P = .368	-.1784 P = .054	1.000	.8245 P = .000
ACT Comp	.0466 P = .339	-.1040 P = .176	.8245 P = .000	1.000

P = Significance

Appendix B

Pearson Correlation Coefficients

for

Principles of Microeconomics

	GEN	CLASS	ACT Math	ACT Comp
GEN	1.000	-.0490 P = .327	-.0339 P = .378	-.0501 P = .323
CLASS	-.0490 P = .327	1.000	-.1762 P = .052	-.1007 P = .178
ACT MATH	-.0339 P = .378	-.1762 P = .052	1.000	.8180 P = .000
ACT COMP	-.0501 P = .323	-.1007 P = .178	.8180 P = .000	1.000

P = Significance

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