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Predicting Success in College Mathematics from High School Mathematics Preparation

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PREDICTING SUCCESS IN COLLEGE MATHEMATICS FROM HIGH SCHOOL MATHEMATICS PREPARATION

by

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Richard A. Shepley

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Predicting Success in College Mathematics From

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by

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The purpose of this study was to develop a model to predict the college mathematics courses a freshman could expect to pass by considering their high school mathematics preparation. The high school information that was used consisted of the student's sex, the student's grade point average in mathematics, the highest level of high school mathematics courses taken, and the number of mathematics courses taken in high school.

The high school sample was drawn from graduated Seniors in the State of Utah for 1979. The college sample was drawn from the fall semester 1980 at Utah State University, Weber State College, University of Utah, Westminster College, and Brigham Young University. The model was developed using ACT Scores as the dependent variable with the high school data in one equation and the college data in another equation and then predicting from high school to college using the ACT Scores as the bridge.

The results showed that those students that had courses in the higher levels of mathematics in high school, were significantly more successfull in college mathematics. The level of mathematics was more significant than the grades received in mathematics.

Females who had had higher levels of mathematics in high school were as successfull as males on that level.

(101 pages)

CHAPTER I

INTRODUCTION

The Problem

The prediction of college success for high school graduates has had a long history of attempts and applications. Colleges desire score-cut-offs on standardized tests and other criteria to determine entrance levels. College athletic directors desire criteria to determine which high school athletes to recruit for their schools. State Educational Agencies desire prediction criteria to assess high school curricula and state graduation requirements. High school counselors desire prediction criteria for college success to help advise high school seniors who plan to attend college, in which courses they might experience the best success.

The problem of this study was that there were not suitable prediction criteria in the area of mathematics to assist in predicting college mathematics success.

Background of the Problem

There have been many attempts at predicting college success in general from many different independent variables. Some independent variables that have been used in the literature are: parent and student attitudes by Burbank (1968), high school grade point average and vocabulary reading comprehension by Matchler (1978), high school grade point average, and ACT scores by Passons (1967), high school grades and CEEB scores by Wilson (1976), and by Price and Kim (1977), college entrance standardized examinations by Ebel (1978).

The most common predictors used with the best results in the literature, seem to be standardized test scores from college boards and/or high school classwork and high school grade point average as shown by Siegelman (1971), Judy (1975), Troutman (1977), and Demas (1977).

With so many independent variables, how valid are these predictions? Chesson (1974) found that the predictability of performance was not uniform for students in different colleges taking the same courses. Demas (1977) also found this variation of predictability, but found the difference not significant in the student population if high school curriculum were used as one of the independent variables. He found that a single regression equation could be used and the results showed no significant difference at the $\alpha = .05$ level.

In summary, there have been many models used to predict college success. The most effective models used some form of the standardized test scores from college entrance examinations and/or high school classwork with grade point averages.

Purpose of the Study

This study was aimed at determining how great a correlation there is between high school preparation in mathematics, the courses taken and grades received, and the first mathematics course taken and grade received as a college freshman in 1979-1980. The questions to be answered were:

1. What high school mathematics courses had the 1979 graduates in the State of Utah completed?

2. What courses did 1979-1980 incoming freshmen in Utah, take as their first college mathematics course?

3. What is the percentage of freshmen in each course, considering the student's sex as a variable?

4. What ACT Scores did entering Freshmen in Utah in 1979-80 receive in mathematics and composite scores compared by level of high school mathematics courses completed?

5. What ACT Scores would a freshman need to receive a grade of "C" or better in each mathematics course available to them in college?

6. What high school mathematics preparation would be advisable for a college freshman to receive a grade of "C" or better in each mathematics course available to them in college?

7. What effect does the student's sex have on the predicted ACT Scores for success in each college mathematics course?

Importance of the Study

A model using high school preparation to predict college mathematics success would be an asset for the advising of high school students and graduates that wish to attend college. The model in this study uses ACT Scores as the connector between high school data and college success.

A comparison of ACT Scores and high school mathematics preparation, and ACT Scores and success in certain freshman college mathematics courses could be used to assist high school students in better preparing for college success. They could also be used in counseling high school students as to which college mathematics courses they might expect to succeed in. This comparison could be used by the State Board of Education, or local boards of education to change or improve their mathematics curriculum.

In this study, college mathematics success was predicted by looking at high school mathematics preparation and ACT scores. While other studies looked at all high school courses or predicted over-all college success, this one focused on mathematics success. Different abilities needed for different courses, as defined as a level of difficulty, were considered as a means to predict success rather than simply looking at total number of classes taken and cumulative grades.

Summary

The models in this study used the high school mathematics preparation and predicted ACT Scores from them. It also used college freshmen mathematics courses and grades received and predicted ACT Scores from them. The study then combined these two models using ACT Scores as the connector to predict college mathematics success using high school mathematics preparation.

Research Design

Linear Regression Equations for the prediction of Mathematics ACT Scores and Composite ACT Scores using; college course level, sex of the student, and grade received in the course as the independent variables, and using high school mathematics GPA, sex of the student, highest level of mathematics course taken in high school, number of mathematics courses taken in high school and length of time since last high school mathematics course as the independent variables had to be developed.

The Survey Research format was used to obtain the information used to develop these equations. That is, information was collected by examining the records of the subjects. The information was "time-bound associated", in other words, events that are considered to be at the same point in time were looked at. The high school students' ACT Scores and College Freshmen ACT Scores are for the same year.

The target population was all college freshmen in the State of Utah in the year 1980. The accessible population was the college freshmen attending Wasatch Front colleges for the school year 1979-1980.

The sampling procedure for the college mathematics courses taken, was a census of all college mathematics courses taken by freshmen at Utah State University, University of Utah, Weber State College, Westminster College, and Brigham Young University. This sample was then used to get the course percentages and to develop regression formulas for the college courses and grades to ACT Scores. The information was also used to obtain correlation coefficients for ACT Scores with course level, ACT Scores with course grade, and ACT Scores with the sex of the student.

The sampling precedure for the high school mathematics information was a systematic random sampling of five selected high schools. The five high schools were selected because of their socioeconomic and urban/rural populations. They were considered to be a representative sample of the major population center of the State of Utah.

Systematic random samplings of 75 students each, who took the ACT Test, were obtained from Logan High School, Skyview High School, Roy High School, Weber High School, and Olympus High School. The samples were obtained by taking the total number of seniors at each school and dividing each total by 75, then using those numbers to count between the selected students from an alphabetical listing of all seniors at that school. Example: Since Logan High School had 316 seniors then 316/75=4.20, thus every fourth senior would be used in the sample, the first one chosen was by random selection from 1, 2, 3 and 4. This produced a sample of approximately 400 seniors from the 1979 graduating classes. This sample was then used to construct the regression formulas for ACT Scores with the high school course levels, sex, grades, and time as the independent variables.

Delimitations

There was a possibility of a wide difference in course content and method of instruction for courses with the same names at different colleges. No attempt was made to compensate for these differences as no attempt was made to judge the quality of courses at the different institutions.

Since Brigham Young University required all entering freshmen either to register for Math 100 or pass a comprehensive mathematics examination, this institution was analyzed separately to prevent biasing the study.

Because of limited numbers of accessible data from smaller rural high schools, no students from remote areas were included in the study, and results may not be applicable to these areas.

Definitions

ACT - American College Testing Program

ACT-C - American College Testing Composite Score

ACT-M - American College Testing Mathematics Score

CAT - California Achievement Test

CEEB - College Entrance Examination Board Test

GPA - Grade Point Average

Remedial Mathematics - Any college mathematics course below the level of Introductory Algebra or Trigonometry

SAT - Scholastic Aptitude Test

General Mathematics - Any high school mathematics course below the level of Algebra I

College course success - Obtaining a grade of "C" or better in the course

CHAPTER II

LITERATURE REVIEW

General Prediction

The literature is replete with studies on prediction. There seem to be studies on prediction about students from kindergarten to graduate school, using predictors that vary from aptitude to socialization. The area that is related to this study is academic achievement in mathematics of college freshmen, which pares the numerous studies down to a manageable number.

In academic achievement, or college performance, Chesson (1974) found, in his study in North Carolina, that predictability of performance from past performance was not uniform for students in different colleges who took the same courses. Demas (1977) found, in Michigan, that the student population was sufficiently similar that he could use a single multiple regression equation for predicting success if he used class standings and standard test scores. He did, however, acknowledge these differences given by Chesson. Both of these studies used as independent variables high school rank, scores on standardized mathematics examinations, I.Q. test scores, and standardized test composite scores. Matchler (1978) looked at reading comprehension, vocabulary, and high school GPA as the independent variables to predict college success, and obtained a correlation of

R=0.34. Sherman and Hoffmann (1978) found no applicable correlation between Locus of Control, socioeconomic status, and sex, with college achievement. Funche (1967) found a multiple R=0.652 for the correlation between secondary transcript average and ACT Scores with freshmen college GPA. Price and Kim (1977) indicated a multiple R=0.731 for the effects of high school grades and college entrance examination scores on college achievement. Wilson (1978) found that intellectual variables (high school GPA, I.Q. scores, and standardized test scores) correlated much higher than non-intellectual variables (sex, sibling position, and socioeconomic status) in predicting academic success. Pedrini and Pedrini (1974) reported a multiple R=0.593 using high school grades and aptitude test scores as the independent variables. Bean and Covert (1973) used SAT Composite Scores and Mathematics Scores as their independent variables and obtained a Multiple R=0.722.

All of the above studies reported in differing degrees results similar to those presented by Ford and Campos (1977, p. 18.).

> The high school grades (class rank) ... are the best predictors of college grades; aptitude test scores ... add appreciably to the accuracy of that prediction, and scores on tests in specific subject areas add only a modest amount of predictive power to the combination of high school grades and aptitude test scores.

Ferguson and Brennan (1979), in their study, considered the issue of Predictive Validity of College Admissions Test Scores and high school curriculum. They reported that standard test scores on high school data are valid predictors of college achievement. Passons (1967), in his study, showed strong support for the predictive validity of ACT, SAT, and high school grades toward college success. A study by the Educational Testing Service (1968) supports this validity claim of standardized test scores, by studying the effects of coaching students before they take standardized tests the SAT in this study). They reported that with a score range of from 200 to 800 possible points coaching produced a net effect of only 10 points per student score change, regardless of the coaching technique used or level of student ability.

To discover how reliable high school grades and college board scores are, Fishman and Pasanelle (1960) reported a mean Pearson Product Moment Correlation Coefficient of r=0.50 between high school GPA and First year college grades, from 263 college admissions studies they did over a 10 year period. They also reported a mean product moment correlation coefficient of r=0.47 between Standardized College Board Test Scores and First year college GPA. Austin (1971) found a slight difference in the predictions for males and females. He found the correlation coefficient between high school GPA and college grades for women was r=0.51, but for men it was r=0.50. Other studies report similar results.

Mathematics Prediction

High school GPA and/or College Board Test Scores have been used by many mathematics departments for the placement of entering freshmen in the appropriate mathematics classes in hopes of making their first college mathematics experience a successful one.

Bickford (1979) in her study, discussed "Native Intelligence" as measured by high school GPA, SAT Scores, Mathematics Aptitude Tests, and I.Q. Tests and college mathematics experience. Tobias (1978) discussed the negative effects of "math anxiety" on mathematics achievement, Gough (1954) used the phrase "Mathephobia" in her article to describe this same fear as Tobias. Cauthen (1979) takes this one step further in looking at Demographic and Personality variables related to mathematics achievement in men and women. She used a sixteen personality factor questionnaire, the Rokeach Dogmatism Scale, and the Rotter Internal-External Locus of Control Scale. Mathematics achievement was determined by the mathematics section of the Cooperative Examination, the sample was 1045 males and 372 females. The factors she found that correlated directly were, for women: reserved, more intelligent, timid, and self sufficient. The significant factors that correlated directly for men were: more intelligent and self control. The Demographic factors were, for both, SAT Scores, high school mathematics curriculum, and high school GPA. Innema (1977) studied the effects of a student's sex on mathematics achievement, and found most of the results were tied to factors studied by Tobias or Cauthen. Burbank (1968) showed a high relationship between parent mathematics attitude, student attitude and student mathematics achievement. Carmen (1975) found a significant effect of tutuoring and mathematics achievement, Howard Fehr (1973) discussed the importance of good teacher pedagogy for better student achievement. Miller (1974) showed no significance in the correlation between method of instruction and student achievement.

In the area of Standardized Test Scores and mathematics, studies have shown differing results on the correlation between college mathematics achievement and standardized college test scores. Gussett (1974) reported a Pearson Product Moment Correlation Coefficient of r=0.62 (n=142) between SAT Scores and college mathematics achievement, Troutman (1977) reported a correlation coefficient of r=0.50 (n=123) between SAT-M and college mathematics grades. Larson and Scontrino (1976) found correlation coefficients varying from as low as r=0.22 up to r=0.54 in eight different studies of standardized test scores and college mathematics achievement (n=200 for each). Chissom and Lanier (1975) supported the lower correlation in their reporting of a correlation coefficient of r=0.39.

In using high school GPA to predict college success, Troutman (1977) reported a correlation coefficient of r=0.40. Larson and Scontrino (1976) found correlation coefficients varying from r=0.58 ro r=0.72 in their studies.

To improve these predictions other studies have used both high school GPA and College Board Test Scores in a Multiple Regression Equation. Using high school GPA and College Board Test Scores as the independent variables and college mathematics as the dependent variable, Price and Kim (1977) reported a multiple correlation coefficient of r=0.73, and Kenneth Wilson (1976) found a correlation coefficient of r=0.81 using weighted values of high school GPA, SAT-V, and SAT-M Scores.

In summary, the literature supported the concept of using high school grades and achievement in conjunction with standardized test scores to predict college achievement. The use of ACT Scores and high school achievement information are valid predictors of college success. There is a high correlation between high school achievement with standard test scores and college mathematics achievement.

Mathematics Preparation

Stephen Doblin (1977) in a study at the University of Southern Mississippi (USM), ACT Scores indicated 66% of its incoming freshmen (n=969) had a weakness in mathematics skills, 54% had taken less than 4 years of high school mathematics, 18% had taken no mathematics in which they had received a grade higher than a D. For Fall 1975, 36% of the entering freshmen at USM had taken no mathematics beyond Algebra I in high school (n=1130).

Since there is such a high correlation between high school grades and courses in mathematics with college mathematics success, why does this weakness in mathematics preparation still exist? Is there an attitude that mathematics is of less importance than other subjects in american schools today? Is this information simply not understood? Are there other priorities in education? A final quote by an official of The National Education Association shows the prevalent view. David Darland is trying to stress the creative subjects in high school and excusing the national dropping standardized test scores. (David Darland, 1975, p. 60.)

> If the skills demanded by these tests are what it takes to get through college, then maybe it is the colleges that ought to change.

The skills demanded" were mathematics, and science ability at the 9th grade level, General Science and Algebra I.

Summary

The literature indicates a high validity and a moderately high reliability in predicting college achievement from high school records and College Board Test Scores. Many variables showed a correlation coefficient above r=0.40, but the literature indicates the better predictors to be both high school GPA and either ACT or SAT Scores.

The literature indicates that using just high school GPA could account for, or precict, 40% of the college mathematics achievement. It also indicates college board test scores could predict up to 36% of college mathematics achievement. A composite of high school GPA and College Board Test Scores can predict as high as 64% of college mathematics achievement, if appropriate weights are given to the variables.

CHAPTER III

RESEARCH METHODS

Survey Design

The research design used a survey format to collect student information on high school preparation and college success. This method was selected because of the necessity of examining student records, collecting information from them, and analyzing the information. The research information was collected from two different sources. The first was the records of college freshmen enrolled in Utah for the Fall Semester of 1979-1980. The second, was the high school records of seniors that graduated in 1979 in Utah.

The information collected from the high school records consisted of (a) the student's sex, (b) the student's ACT-Composite Score, (c) the student's ACT-Mathematics Score, and (d) a list of all mathematics courses taken in high school and the grades received in each.

The information collected from the colleges consisted of (a) the student's sex, (b) the student's ACT-Composite Score, (c) the student's ACT-Mathematics Score, (d) the student's GPA for the first semester, and (e) the first college mathematics course taken and grade received in it. ACT Scores were used because of the high relationship (Pearson Product r=0.81) between high school course work, high school GPA, and ACT Scores, on the one hand, and the high predictability of college success from high school grades and ACT Scores on the other (Price and Kim, 1977).

Statistical Design

The analysis of the information collected required the design of linear regression equations. The first set of equations had to correlate Mathematics ACT Scores, and Composite ACT Scores with high school mathematics GPA, sex of the student, highest level of mathematics course taken in high school, and the number of mathematics courses taken in high school. The second set of equations had to correlate Mathematics ACT Scores with college mathematics course level, grade received in the course, and sex of the student. This was done using the computer program Statistical Package for the Social Sciences (SPSS) Multiple Correlations, which gave the Pearson Product Moment Correlations for each variable with each of the others. It also used the stepwise-in method of developing a multiple correlation model. That is, the independent variables were each used to figure which order of introduction of the variables would produce the largest change in the correlation as each new variable was added. This guaranteed the most important variable (highest correlation) was entered first, and the least important (the lowest overall multiple correlation change) was entered last. These linear regression equations were then used to predict the ACT Scores for the different values of the independent variables listed above.

Sampling

Running a census of all high school Seniors in Utah in 1979 and all college freshmen in Utah in 1979-1980 would have been prohibitive. Because of this fact, a sample of college freshmen and a sample of high school seniors were selected to provide an indication of trends.

The target population for the study was all freshmen in Utah, the available population was the college freshmen attending Utah State University, Weber State College, the University of Utah, Westminster College, and Brigham Young University. A census was taken of all freshmen attending each institution, using the computer records at the respective institutions. The high school target population was all high school seniors in Utah. The accessible population was all seniors attending each of the following high schools: Logan high School, Skyview High School, Weber High School, Roy High School, and Olympus High School. These schools were selected because they are a representative sample of the high schools in the major population centers in Utah. Since these high schools do not have computerized records, a census of all of the seniors was prohibitive. A systematic random sample was taken from each high school. The selection of this sample was done by taking the number of students in the 1979 graduating class and dividing by

75, the result was the number that was skipped between each element of the sample of student records that were used. For example, since Logan High School had 316 seniors then 316/75=4.20, so every fourth senior was used in the sample. The first student was chosen by random selection between 1, 2, 3 and 4. If 2 was chosen then seniors numbered 2, 5, 8, 11, 14, etc., would have had their records used for the survey.

The information was transferred from each student's records to a data sheet (see appendix D). The information from these sheets was then recorded on computer cards for analysis.

Procedure

The steps that were used in this survey were as follows:

1. A letter was sent to each Mathematics Department Chairman of the colleges used in the study (see Appendix A) explaining the nature of the study and asking for their suggestions and assistance in gaining access to the Student Data Base information at their college.

2. A letter was sent to each college's administrator in charge of student records (see appendix B), to explain the nature of the study and asking for their permission to access the Student Data Base at their college and ask for their suggestions on the study.

3. Mr. Dale McEntire, assistant in charge of computer center records at Utah State Univerisy, was requested to write a Cobol computer program to retrive the desired information from the Student Data Base and design the format used to store the information on magnetic tape to match the information from the other universities and colleges for the final analysis.

4. The computer center assistant in charge of records at each of the other colleges was asked to give the information desired from the computer records, have it transferred to magnetic tape for transportation to Utah State University where the final analysis was made.

5. Upon arrival of all of the tapes at Utah State University, a program was written to use the SPSS Program from the computer library to run the two Multiple Regression Equations with the ACT Scores.

6. The percentage of freshmen in each course, and the mean ACT-scores for the student records were calculated.

7. A letter was sent to the Principal of each of the high schools used in the study (see appendix C), explaining the nature of the study and asking for permission to gain access to the student's records and solicit additional suggestions on the study.

8. Some of the high school Principals required a contact with the school district office to obtain permission

to gain access to the student's records, this permission was obtained.

9. A student data sheet (see appendix D) was constructed to collect the information from the high school records.

10. Information from each high school was obtained and transcribed by the researcher.

11. An SPSS Multiple Correlation Equation analysis was run with ACT-Composite Scores as the dependent variable and all high school mathematics courses and their grades as the independent variables.

12. An SPSS Multiple Correlation Equation analysis was run with ACT-Mathematics Scores as the dependent variable and the same independent variables as #11, to check for the highest correlation.

13. The information obtained from steps 5, 6, 11, and 12 were analyzed to answer the questions raised in chapter one.

Analysis

The analysis of the information was done in two sections. These are, the analysis of the state supported institutions in Utah and the analysis of Brigham Young University (BYU). The reason for this separation is that BYU required all entering freshmen to take Math 100 or to pass an examination to take a higher level course. Many freshmen capable of succeeding in a higher level mathematics course were assumed to have decided to take this mathematics course as their first mathematics course. So, to prevent misinterpretation of the final results and to prevent bias due to a wide range of abilities taking this level course at BYU, that school was analyzed separately. The study for BYU did, however, use the same general method that was used for the other schools.

The method of obtaining the courses freshmen were taking, was to use the course catalogue of each school to list the 100 and 200 level (lower division) mathematics courses offered and then check them with the student data base information to get a list of courses freshmen took as their first mathematics course.

The method of obtaining the percentages of freshmen in each class level by sex, was done by taking the number of male and female students in each course and dividing that number by the total number of freshmen in all of the colleges surveyed, to get the total percentage of freshmen taking that course.

The ACT Score prediction for success in each college mathematics course came from the College Multiple Regression Equation:

$$ACT_{Col}=b_1(S) + b_2(L) + b_3(G) + b_0$$

b_i = the constants of the linear regression equation

S = the sex of the student

L = the level of the first college mathematics course (see figure 1, p. 27)

G = the grade received in the college mathematics course

The predicted ACT Scores for high school preparation in mathematics course work came from the high school Multiple Regression Equation:

$$ACT_{HS} = b_1(T) + b_2(L) + b_3(A) + b_4(N) + b_5(S) + b_0$$

b_i = the constants of the linear regression equation

T = the time since the last high school mathematics course was taken, in years

L = the highest level of high school mathematics course taken (see figure 2, p. 28)

A = the high school mathematics GPA

N = the number of high school mathematics courses taken

S = the sex of the student

The constants (b's) for the multiple regression equations were obtained by using the SPSS Program from the Burroughs program library and running a hierarchal and a stepwise-in multiple correlation. The hierarchal method used the order: level of course, sex, high school GPA, number of mathematics courses, time since last mathematics course.

The differences in these correlation methods are: In the hierarchal method of constructing a multiple regression equation, the program in SPSS uses the order of introducing the variables that are specified by the person running the program. In the stepwise-in method, the program calculates the effect of each of the independent variables left to use and then selects the one that contributes the most to the correlation to the prediction of the dependent variable.

The results of these regression equations are listed in tables 1 and 5, showing the order of introduction of each independent variable and the resulting correlation.

Summary

This study was conducted in 2 sections, the first section used the records of college freshmen in the State of Utah. It determined the correlation between ACT-Composite Scores or ACT-Mathematics Scores (whichever is higher) and the type of college mathematics course, and grade in that course, taken as the student's first college mathematics experience. This part of the study used a census of all college freshmen attending Utah State University, Weber State College, University of Utah, Westminster College, or Brigham Young University during the school year 1979-1980.

The second section of the study was a survey of high school graduates in Utah in 1979. The information used in this section was gathered from samples taken from Logan

High School, Skyview High School, Weber High School, Roy High School, and Olympus High School. This information was used to develop a multiple correlation equation for ACT-Composite Scores or ACT-Mathematics Scores, the one with the higher correlation from the college section, and high school mathematics courses taken and grades received in each. A prediction was then made as to the college mathematics course a freshman could expect to succeed in as predicted by high school mathematics courses, grades, and the student's sex.

College Level	University of Utah	Utah State University	Weber State College	Westminster
Level V	112 Calculus (2nd) 116 Calculus with Computers (2nd)	221 Analytical Geometry and Calculus II 246 Calculus II 229 Calculus Computer Laboratory	212 Calculus and Analytical Geometry II	202 Calculus II
Level IV	111 Calculus 115 Calculus with Computers 208 Calculus for Pharmacy Students 107 Elem. Statist.	220 Analytical Geom. and Calculus I 245 Calculus I	211 Calculus 241 Applied Statistics	201 Calculus I 260 Inferent. Statistics
Level III	105 College Algebra 106 Plane Trig.	105 College Algebra 106 Plane Trig.	106 Trigonometry 107 College Algebra 141 Intro. to Probability and Stat. 115 Finite Mathematics	104 Element. Functions (precalculus) 110 Finite Mathematics 205 Elementary Statistics
Level II	101 Intermediate Algebra	101 Intro. to College Algebra 201 Mathematics for Elementary Teachers 103 Elements of Math.	105 Intermediate Algebra 108 Mathematics for Elementary Teachers	100 Intermediate Algebra
Level I	100 Prealgebra	001 Basic Mathematics 002 Elements of Algebra	100 College Arith. 101 First Course in Algebra	191 Basic Math 193 Elementary Algebra

Fig. 1. Heirarchy of college mathematics courses by level and college

LEVEL	ROY	OLYMPUS	LOGAN	WEBER	SKY VIEW
V	Calculus Advanced Placement Math	Calculus 1-2 Probability & Statistics Analytic Geom.	Calculus	Calculus Plane Analytic Geometry	Calculus
VI	College Algebra	Algebra 5 Trigonometry	Algebra III Trigonometry	College Algebra	Algebra III Trigonometry
III	Algebra II Geometry	Algebra 3-4 Geometry	Algebra II Geometry	Algebra II Geometry	Algebra II Geometry
II	Algebra I	Algebra 1-2	Algebra I	Algebra I Unified Math	Algebra I
I	Business Math Consumer Math General Math	Basic Math High School Math Survey Math	Business Math Consumer Math	General Math Business Math	Basic Math Consumer Math

Fig. 2. Heirarchy of high school mathematics courses by level and school

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
High School GPA (optional)			Predicted college GPA			ACT-Math Score			ACT-Comp Score			First Math. course grade A,B,C, D,F,P.		Sex	Index # of first Mathematics course						College code USU, UTA, WSC, WST, BYU.			Quarter

Unlabeled

Block = 100 records

Density = 1600 bits per inch

Standard ASCII

Fig. 3. Format of tape storage of information

Group	Mean ACT-Math	Standard Deviation	Mean ACT-Composite	Standard Deviation	Percent Freshmen
Entire Pop.	19.74	6.93	24.43	4.97	100.00%
Sex; Male	20.62	6.64	26.19	4.11	65.82%
No class	10.14	5.45	14.51	6.41	3.01%
Level I	14.20	5.50	18.04	6.15	9.72%
Level II	18.02	5.26	22.23	5.91	17.84%
Level III	22.04	5.45	29.91	3.53	21.67%
Level IV	26.42	4.14	31.71	3.86	12.42%
Level V	29.71	4.28	26.73	3.89	1.22%
Sex:Female	18.04	7.15	21.91	6.94	34.18%
No class	10.12	6.41	13.92	5.84	4.02%
Level I	14.17	6.35	18.50	5.47	7.66%
Level II	16.56	5.85	19.44	4.26	12.57%
Level III	20.75	6.51	22.69	4.70	7.33%
Level IV	26.84	4.59	24.44	4.48	1.54%
Level V	29.71	4.28	26.50	4.85	0.45%

Fig. 4. Percentage of college freshmen by sex and course level with mean ACT Scores and standard deviations

CHAPTER IV

RESEARCH RESULTS

College Courses

To answer the question, "What mathematics courses are College Freshmen taking as their first course?", data from the census of college records is reported in Figure 1, (p. 27). These courses were then broken down into the five predetermined levels by their prerequisites. Each of the courses listed was taken by some freshmen at the institution indicated.

The results from the college census were correlated at Utah State University using the computer library, program, the "Statistical Package for the Social Sciences" (SPSS).

To answer the question "what is the percentage of freshmen taking courses at each level?", census data was tabulated and results are given in figure 4, (p. 30) "The Percentages of College Freshmen by Sex and College Course Level". The mean ACT Scores and Standard Deviations are also listed in Figure 4.

The census of the accessible population of college freshmen at USU, U of U, WSC, and Westminster had a mean ACT-Mathematics Score of 19.74 with a standard deviation of 6.93, (maximum possible score is 36.0). There was a mean ACT-Composite Score of 24.43 with a standard deviation of 4.97.

For males, the mean ACT-Mathematics Score was 20.62 with a standard deviation of 6.64. There were 65.82% of the population who were male. Of the entire population, 3.04% were males that did not take mathematics course as a freshman. Their mean ACT-Mathematics Score was 10.14. Of the males that took level I mathematics courses, their mean ACT-Mathematics Score was 14.21. This comprised 9.72% of the population. Of those males that took level II mathematics courses, their ACT-Mathematics Score was 18.03. There were 17.84% of the population in this group. For the males that took level III mathematics courses, 21.65% of the population, there was a mean ACT-Mathematics Score of 22.05. For males that took level IV mathematics courses, 12.42% of the population, their mean ACT-Mathematics Score was 26.43. For males in level V mathematics courses, 1.22% of the population, their mean ACT-Mathematics Score was 29.71.

For females, the mean ACT-Mathematics Score was 18.04 with a standard deviation of 7.16. There were 38.14% of the population who were female. Of the entire population, 4.02% were females that did not take any mathematics course as a college freshman. Their mean ACT-Mathematics Score was 10.12. Of the females that took level I mathematics courses, their ACT-Mathematics Score was 14.18. This comprised 7.66% of the population. Of the females that took level II mathematics courses, their mean ACT-Mathematics Score was 16.57. There were 12.57% of the population in this area. For females that took level II mathematics courses, 7.33% of the population, their mean ACT-Mathematics Score was 20.76. For females that took level IV mathematics courses, 1.54% of the population, their mean ACT-Mathematics Score was 29.71.

It was interesting to note that the males' mode for mathematics classes enrolled was at level III for mathematics courses taken, while, the females' mode was level II. It was also interesting to observe that the mean ACT-Mathematics Score for females was below that for males for levels I, II, and III but matched or exceeded males scores for levels IV and V. It would appear that most females are not taking higher levels of mathematics courses as freshmen, but those that do are as well prepared as the males.

It was also observed that only 16.83% of the total population took courses above level II (level of College Algebra) of which only 1.99% were female, while 41.82% of the population took courses below level III.

College Correlation

The correlations for the college census were obtained from the college computer records and a multiple regression was run on them using the SPSS library program.

For the colleges, the multiple regression gave R=0.65 (see table 1 p. 35). The order of introduction was obtained using the stepwise-in method of selection. The order was then set up such that all variables were checked and the one with the largest effect was entered first, (see table 2, p. 35) "Level" with r=0.59 was the largest, the rest of the variables were then checked with this first variable and the one with the next net largest effect is entered second, this process was then continued until all of the variables were used or a minimum net increase was reached for the last variable introduced. The order of introduction was "level" with R^2=0.35, that is 34% of the ACT-Mathematics Score can be attributed to the effects of course level taken. The second variable introduced was "grade", received in the college mathematics course, the change in R^2 was 0.07. The third variable introduced was "sex", its R^2 change was 0.01. The net effect of these variables gave R=0.65 with R^2=0.42, which indicated that 42% of the correlation between college mathematics success and ACT-Mathematics Scores can be explained by these variables. The regression formula that developed was:

$$ACT\text{-}M_p = 3.58(\text{level}) + 1.40(\text{grade}) - 1.07(\text{sex}) + 9.43$$

where the following mean:

$ACT\text{-}M_p$ -- the predicted ACT-Mathematics Score

level -- the level of the college mathematics course

grade -- the grade received in the college course

TABLE 1

ORDER OF INTRODUCTION OF VARIABLES IN STEP-WISE MULTIPLE REGRESSION AND RESULTING VALUES, FOR THE COLLEGE FRESHMEN PREDICTIONS

Dependent Variable.. ACT-Mathematics

Independent Variable	Multiple R	R Square	RSQ Change	Simple R	B
Level	0.59	0.35	0.35	0.59	3.58
Grade	0.64	0.41	0.07	0.32	1.40
Sex	0.65	0.42	0.01	-0.18	-1.07
(Constant)					9.43

TABLE 2

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENT FOR EACH VARIABLE WITH ALL THE OTHERS, FROM THE COLLEGE FRESHMEN RECORDS

	ACT-M	ACT-C	Grade	Sex	Level
ACT-M	1.00	0.27	0.32	-0.18	0.59
ACT-C	0.27	1.00	0.25	0.16	0.15
Grade	0.32	0.25	1.00	0.09	0.11
Sex	-0.18	0.16	0.09	1.00	-0.23
Level	0.59	0.15	0.11	-0.23	1.00

TABLE 3

PREDICTED ACT-M SCORES FOR THE COLLEGE FRESHMEN MULTIPLE REGRESSION EQUATION

Row#	Predicted ACT-M	Level	Grade	Sex
1	14.7	1	2	1
2	13.7	1	2	2
3	16.1	1	3	1
4	15.1	1	3	2
5	17.5	1	4	1
6	16.5	1	4	2
7	18.3	2	2	1
8	17.2	2	2	2
9	19.7	2	3	1
10	18.6	2	3	2
11	21.1	2	4	1
12	20.1	2	4	2
13	21.9	3	2	1
14	20.8	3	2	2
15	23.3	3	3	1
16	22.2	3	3	2
17	24.7	3	4	1
18	23.6	3	4	2
19	25.5	4	2	1
20	24.4	4	2	2
21	26.9	4	3	1
22	25.8	4	3	2
23	28.3	4	4	1
24	27.2	4	4	2
25	29.0	5	2	1
26	28.0	5	2	2
27	30.5	5	3	1
28	29.4	5	3	2
29	31.8	5	4	1
30	30.8	5	4	2

sex -- the sex of the student

This formula was used to generate table 3 (see p. 36). The choices for "sex" are: male = 1, female = 2. The choices for "grade" are: A = 4, B = 3, C = 2, since success was defined as a "c" or better no D's or F's were recorded in this table. The alternatives for "level" are: the four levels given in figure 1 (p. 27) with level 1 being the lowest and level 5 as the highest. These values were substituted for their appropriate variables in the equation on page 34 to give the values for ACT-Mathematics prediction.

To read table 3, assume one wishes to know what ACT-Mathematics Score a male freshman should have to obtain a grade of "B" in Prealgebra. The variable values would be "sex"=1, for male, "grade"=3, for a "B", and "level"=1, for Prealgebra (figure 1, p. 27). These values are then found on table 3 in row 3, which gives a predicted ACT-Mathematics Score of 16.1. Thus if the student has an ACT-Mathematics of 16.1 or better, he should receive a grade of "B" in Prealgebra. Another example, for a female to succeed (a grade of "C" or better) in College Algebra what should her ACT-Mathematics Score be? The values to look for are: "sex"=2, for female, "level"=2, for College Algebra (see figure 1, p. 27), "grade"=2, for "C" or better. The appropriate values are found in row 8, table 3, giving an ACT-Mathematics Score of 17.2 or better, she should receive a grade of "C" in College Algebra.

Table 3 can also be used to tell a high school senior which level course they should succeed in, in college mathematics. As an example, if a male student enters college with an ACT-Mathematics Score of 22.2, what level of mathematics course should he be able to succeed in? The values to look for in table 3 are: ACT-M should be below 22.2 but as close as possible, "sex"=1, and "grade"2. The closest ACT-M would be 21.9 in row 13. The level in row 13 is "level"=3, thus a male high school graduate with an ACT-Mathematics Score of 22.2 should be able to receive a grade of "C" or better in a level 3 course (college Algebra) as a freshman in college.

High School Preparation

The correlations from the high school samples, were obtained using the SPSS Program for Linear Regression using the stepwise-in mehtod of variable introduction, that was explained in the preceding section. The multiple correlation and the order of introduction for the 5 schools were:

School 1: ACT-Mathematics R=0.78, the order of introduction: level, sex, average, number, and time did not contribute to the multiple correlation significantly. ACT-Composite R=0.64. The order of introduction; level, number, sex, average, and time.

School 2: ACT-Mathematics R=0.82, the order of introduction was; level, average, sex, number, and time.

ACT-Composite R=0.71, the order of introduction; level, average, sex, number, and time.

School 3: ACT-Mathematics R=0.84, the order of introduction was; level, average, number, sex, and time. ACT-Composite R=0.74, order of introduction; level, average, number, sex, and time.

School 4: ACT-Mathematics R=0.85, the order of introduction was; level, average, sex, time, and number. ACT-Composite R=0.78, the order of introduction; level, time, sex, average, and number.

School 5: ACT-Mathematics R=0.87, the order of introduction was; level, average, number, sex, and time. ACT-Composite R=0.80, the order of introduction; level, average, sex, time, and number.

Using all 5 schools in one Multiple Regression Equation, the cross correlation coefficients are shown in Table 5 (see p. 41). The multiple correlation coefficient obtained was ACT-Mathematics R=0.81. That indicated that 65.7% of the ACT-Mathematics Score can be predicted by the equation:

$$\text{ACT-M}_{hs}=3.74(\text{level})+2.65(\text{average})-1.60(\text{sex})$$
$$-0.75(\text{time})+0.43(\text{number})-0.21$$

The order of the independent variables was that used in the stepwise-in SPSS Program, see Table 6 (p. 42) for the partial correlation coefficients.

For the ACT-Composite Scores R=0.71, then 50.7% of the ACT-Composite Score can be explained (predicted) by the formula:

$$ACT\text{-}C_{hs}=2.72(\text{level})+1.84(\text{average})-0.64(\text{sex})-0.25(\text{time})+0.14(\text{number})+6.62$$

These equations were then used to predict the ACT Scores from the high school data. The predicted scores can be seen in Table 7 (p. 43, compare to the full Table 11 in appendix E).

To read Table 7 , assume you wish to know what a female student with a "B" average in 2 mathematics classes, who took her last mathematics class 2 years ago, and her highest class was General Mathematics. The values to look for are: "level"=1, general mathematics level, "sex"=2, "time"=2 (2 years ago), "number"=2 (2 mathematics classes). From Table 7 (p. 43), these values are found in row 13 (compare to row 55 Table 11, appendix E). The predicted ACT-M is 7.60, the predicted ACT-M is 13.28.

Another example: What are the average ACT-C and ACT-M Scores for a male high school student, who took 3 mathematics classes, the last as a senior, maintained a "C" average in those classes, and took Geometry as the highest level course? The values to look for in Table 7 are: "sex"=1 (for male), "level"=3 (Geometry from figure 1, p. 27), and "time"=0. From Table 7 (p. 43, compare Table 11 row 200), these values can be found in row 18. The

TABLE 4

HIGH SCHOOL DATA MULTIPLE CORRELATION COEFFICIENTS
AND ORDER OF INTRODUCTION OF VARIABLES

	School 1	School 2	School 3	School 4	School 5	Comp
ACT-M	R=0.78	R=0.82	R=0.84	R=0.85	R=0.87	R=0.81
Order of Intro	Level Sex Average Number Time	Level Average Sex Number Time	Level Average Number Sex Time	Level Average Sex Time Number	Level Average Number Sex Time	Level Average Sex Time Number
ACT-C	R=0.62	R=0.71	R=0.74	R=0.78	R=0.80	R=0.71
Order of Intro	Level Number Sex Average Time	Level Average Sex Number Time	Level Average Number Sex Time	Level Time Sex Average Number	Level Average Sex Time Number	Level Average Sex Time Number

TABLE 5

THE PEARSON PRODUCT MOMENT CORRELATION COEFFICIENT
FOR EACH VARIABLE WITH THE OTHERS, FROM
THE HIGH SCHOOL INFORMATION

	Time	Average	Level	Sex	Number	ACTM	ACTC
Time	1.00	-0.14	-0.53	0.35	-0.73	-0.50	-0.40
Averag	-0.14	1.00	0.32	0.03	0.32	0.47	0.42
Level	-0.53	0.32	1.00	-0.29	0.75	0.76	0.67
Sex	0.35	0.03	-0.29	1.00	-0.32	-0.31	-0.23
Number	-0.74	0.32	0.74	-0.32	1.00	0.65	0.54
ACTM	-0.50	0.47	0.76	-0.31	0.65	1.00	0.84
ACTC	-0.40	0.42	0.67	-0.23	0.54	0.84	1.00

TABLE 6

ORDER OF INTRODUCTION OF VARIABLES IN STEPWISE-IN MULTIPLE REGRESSION AND RESULTING VALUES, FOR THE HIGH SCHOOL INFORMATION

Dependent Variable..ACT-Mathematics

Independent Variable	Multiple R	R Square	RSQ Change	Simple R	B
Level	0.76	0.57	0.57	0.76	3.73
Average	0.79	0.63	0.06	0.47	2.64
Sex	0.80	0.65	0.02	-0.31	-1.60
Time	0.81	0.66	0.01	-0.50	-0.75
Number	0.81	0.66	0.00	0.65	0.43
(Constant)					-0.21

Dependent Variable..ACT-Composite

Independent	Multiple R	R Square	RSQ Change	Simple R	B
Level	0.67	0.45	0.45	0.67	2.72
Average	0.71	0.50	0.50	0.42	1.84
Sex	0.71	0.50	0.00	-0.23	-0.67
School	0.71	0.51	0.00	-0.02	-0.02
Time	0.71	0.51	0.00	-0.40	-0.25
Number	0.71	0.51	0.00	0.54	0.14
(Constant)					6.62

TABLE 7

CONDENSED PREDICTED ACT-C AND ACT-M SCORES FROM THE HIGH SCHOOL MULTIPLE REGRESSION EQUATION

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
1	12.48	7.64	1	2	1	1	0
2	12.23	6.88	1	2	1	1	1
3	11.97	6.13	1	2	1	1	2
4	11.72	5.38	1	2	1	1	3
5	12.62	8.05	1	2	1	2	0
6	12.76	8.49	1	2	1	3	0
7	12.89	8.92	1	2	1	4	0
8	11.81	6.03	1	2	2	1	0
9	11.95	6.46	1	2	2	2	0
10	12.09	6.89	1	2	2	3	0
11	12.23	7.32	1	2	2	4	0
12	14.32	10.28	1	3	1	1	0
13	13.28	7.5.	1	3	2	2	2
14	13.03	6.85	1	3	2	2	3
15	17.18	14.44	2	3	1	2	0
16	17.46	15.30	2	3	1	4	0
17	18.55	15.46	2	4	2	2	0
18	18.20	15.97	3	2	1	3	0
19	19.00	15.41	3	3	1	1	3
20	20.42	17.29	3	4	2	1	2
21	21.72	19.23	4	3	1	1	3
22	22.62	21.92	4	3	1	2	0
23	22.37	21,17	4	3	1	2	1
24	23.64	22.53	4	4	2	1	0
25	22.83	21.41	5	2	2	2	0
26	24.67	24.05	5	3	2	2	0
27	27.04	27.87	5	4	1	1	0
28	27.46	29.16	5	4	1	4	0
29	26.37	26.27	5	4	2	1	0
30	26.79	27.55	5	4	2	4	0

predicted ACT-M is 15.97, the predicted ACT-C is 18.20.

How can the high school ACT Scores and the college ACT Scores be used to assist a high school student prepare for college? An entering male high school student may desire to go to college and he may wish to take College Algebra as a freshman in college. What are the minimum high school requirements he should take to prepare for college mathematics success? First look at Table 3 (p. 36), we find that a male (sex=1), taking College Algebra (level=3), to get a "C" (average=2), needs an ACT-M Score of 21.9 in row 13. Looking at Table 7 above, the high school preparation for a male to get an ACT-M Score of 21.9 or slightly higher is (see row 22, compare Table 11 row 324) "level"=4, "sex"=1, "number"=2, and "average"=3. Then the high school student should take 2 mathematics courses in high school, maintain a "B" average in them, and take Geometry or Algebra II as one of those courses.

Effect of Sex

To answer the last question, "What effect does the student's sex have on the prediction of ACT Scores for success in each college mathematics course?". There are many variables that have not been considered that could have a significant effect on this variable. From Table 1 (p. 35) the Stepwise-in Multiple Correlation showed a change of less than 0.01 for R^2. The simple R between ACT-Mathematics and sex was only 0.18 (the negative sign is not important due to the fact the selection of male=1 was not part of the effect). The change in R^2 for ACT-Mathematics in the high school Multiple Regression (see Table 6, p. 42) was only 0.02 with a simple R of 0.31, again, almost negligable when compared with level and average.

The effect of sex may have been statistically significant at the level used ($\alpha = .05$) but it was not realistically significant to the study or to the students that will need the information. The effect of sex does not add enough to the ACT prediction to change what a student should take to prepare for college if male or female and thus is not really helpful in the equation. It was noted that in figure 4 (p. 30) for level I, II, and II the females mean ACT-Mathematics Scores were below the males ACT-Mathematics Score, but for level IV and V the females scores were the same or higher than the males scores. Thus, there may be fewer females taking the higher level courses, but those that do are as well prepared as the males.

Brigham Young University Results

ACT-Mathematics Scores only, will be discussed here because of the higher correlations for them over the composite scores. The results were obtained in the same manner as for the other institutions. The SPSS Multiple Regression Program was run using the same independent variables. The Pearson Product Moment Vibariate Correlation Coefficients were obtained (see Table 8, p. 48). The multiple r obtained was R=0.63 (Table 8, p. 48, indicates the values) and the order of introduction was level, grade, and sex. It can be seen upon comparison with the other institutions results that this is 0.18 below their multiple R. This seems to justify the separation made in the study. The difference appears to be a result of the large number of freshmen taking Math 100 at Brigham Young Unviersity, which is a level I course. This large percentage in the class with higher ACT Scores seems to give a higher mean ACT Score for Brigham Young University. The man ACT-Mathematics Score for level I was 17.4 as compared to a mean score of 13.98 for the state supported institutions.

For Brigham Young University 74.38% of the freshmen took level I courses (46.25% took Math 100), 3.02% took level II courses, 14.05% took level III courses, 2.65% took level IV courses, and 1.31% took level V courses. Compared with the other institutions, 17.38% took level I courses, 30.41% took level II courses, 29.00% took level III courses, 13.96% took level IV courses, and 1.67% took level V courses.

The formula for Brigham Young University's prediction of ACT-Mathematics Scores is:

$$\text{ACT-M}_{BYU}=2.96(\text{level})+1.7(\text{grade})-2.31(\text{sex})+16.00$$

The predicted ACT Scores can be seen in Table 10 on page 49. Compare a college female student, with a grade of "C", in a level 1 course. For Brigham Young University the ACT-M Score would be 20.6, for the other institution the ACT-M Score would be 12.48. Compare a male college student with a grade of "B" in a level III mathematics course. For Brigham Young University the ACT-M Score would be 28.31, for the other institution the ACT-M score would be 15.50.

The institutions other than BYU would appear to have less capable students in their mathematics classes, but this is an effect of the requirement of freshmen taking Math 100 at Brigham Young University.

TABLE 8

THE PEARSON PRODUCT MOMENT CORRELATION COEFFICIENT FOR EACH VARIABLE WITH ALL OF THE OTHER VARIABLES, FROM THE BRIGHAM YOUNG UNIVERSITY INFORMATION

	ACT-M	ACT-C	GRADE	SEX	LEVEL
ACT-M	1.00	0.83	0.44	-0.33	0.48
ACT-C	0.83	1.00	0.27	-0.31	0.44
GRADE	0.44	0.27	1.00	-0.23	0.13
SEX	-0.38	-0.31	-0.23	1.00	-0.20
LEVEL	0.48	0.44	0.13	-0.20	1.00

TABLE 9

ORDER OF INTRODUCTION OF VARIABLES IN STEPWISE-IN MULTIPLE REGRESSION AND RESULTING VALUES, FOR THE BRIGHAM YOUNG UNIVERSITY INFORMATION

Dependent Variable..ACT-Mathematics

Independent Variable	Multiple R	R Square	SQR Change	Simple R	B
Level	0.48	0.23	0.23	0.48	2.96
Grade	0.61	0.37	0.15	0.44	1.71
Sex	0.63	0.40	0.02	-0.32	-2.31
(Constant)					16.00

TABLE 10

PREDICTED ACT-M SCORES FROM THE BRIGHAM YOUNG UNIVERSITY MULTIPLE REGRESSION EQUATION

Row	Predicted ACT-M	Level	Grade	Sex
1	20.68	1	2	1
2	18.37	1	2	2
3	22.39	1	3	1
4	20.08	1	3	2
5	24.01	1	4	1
6	21.79	1	4	2
7	23.64	2	2	1
8	21.33	2	2	2
9	25.35	2	3	1
10	23.04	2	3	2
11	27.06	2	4	1
12	24.75	2	4	2
13	26.60	3	2	1
14	24.30	3	2	2
15	26.31	3	3	1
16	26.01	3	3	2
17	30.03	3	4	1
18	27.72	3	4	2
19	29.59	4	2	1
20	27.26	4	2	2
21	31.28	4	3	1
22	28.97	4	3	2
23	32.99	4	4	1
24	30.68	4	4	2
25	32.53	5	2	1
26	30.22	5	2	2
27	34.24	5	3	1
28	31,93	5	3	2
29	35.95	5	4	1
30	33.65	5	4	2

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Purpose of the Study

This study was aimed at determining the correlation between high school preparation in mathematics, and achievement in the first mathematics course taken as a college freshman. The questions that were considered were:

1. What high school mathematics courses had the 1979 graduates in the state of Utah completed?
2. What courses are incoming college freshmen, in Utah taking as their first college mathematics course?
3. What are the percentages of freshmen, by sex, in each course?
4. What ACT scores did entering Freshmen in Utah in 1979-80 receive in mathematics and composite scores compared by level of high school mathematics courses completed?
5. What predicted ACT Scores were needed for a freshman to receive a grade of "C" or better in each mathematics course for college freshmen.
6. What high school preparation would be advisable to help college freshmen pass each college mathematics course?

7. Was the student's sex a factor in predicting success in college mathematics?

Methods and Procedures

The research design was of the survey format. The survey was used due to the need to examine, collect, and analyze data from a large number of student records. The research information was collected from two different sources. The first was the records of college freshmen enrolled in Utah's five colleges for the fall semester 1979. The second was the records of the high school students that graduated from 5 Wasatch Front high schools in 1979.

The information was used to develop two Multiple Regression Equations, one from the college information and the other from the high school information. Both of these equations predicted ACT Scores using the information that was collected.

The equations that were developed were:

$$ACT\text{-}M_c - 3.58(L)+1.40(G)-1.07(S)+9.43$$

where the following were defined as:

$ACT\text{-}M_c$ - The predicted College ACT-Mathematics Score

L - The level of the college mathematics course taken

G - The grade received in the course

S - The sex of the student

$$ACT\text{-}M_{HS} = 3.74(L)+2.64(A)-1.60(S)-0.75(T) +0.43(N)-0.21$$

where the following were defined as:

$ACT\text{-}M_{HS}$ - The predicted high school ACT-Mathematics score

L - The highest level mathematics course taken in high school

A - The high school mathematics GPA

S - The student's sex

T - The length of time since the last mathematics course

N - The number of mathematics courses taken in high school

To obtain the course levels used in the above equations, the college courses were ordered according to prerequisite courses listed in the college course catalogue. The high school levels were obtained by interviewing some high school teachers and college education professors.

The high school sample was drawn from the records of five high schools in the Wasatch Front Area. The schools were chosen as a sample of the high schools in the major population centers of the state of Utah. The records that were used from each school were selected using a systematic random sampling. For example, school A had 375 graduates in 1979, 375/75=5 thus every 5th record was used in the survey of school A. The first student was selected at random between 1 and 5, and then every 5th succeeding record was used from the alphabetical listing of all of the 1979 graduates at school A.

The regression formulas and compilation of data was done using the Statistical Package for the Social Sciences (SPSS) Library computer program.

The sample for the college data was all freshmen students attending Utah State University, Weber State College, University of Utah, Westminster College, or Brigham Young University (Brigham Young University was taken separately as it required all freshmen to take Math 100 or test out of it, which placed an unusually large sample in the level I area).

Major Findings

The college courses freshmen are taking are listed in figure 1 on page 27. These courses are available to freshmen and some freshmen are registered in each course.

The percentages of freshmen in each course level are given in figure 4 on page 30, with mean ACT Scores and standard deviations. The mean ACT-Mathematics Score for the entire college population (excluding BYU) was 19.74 (maximum of 36). The mean ACT-Mathematics Score for males was 20.62. The mean ACT-Mathematics Scores were higher than the female scores for "no-mathematics course", level

I, level II, and level III. But, female scores were as high or higher than male scores for level IV and level V.

The correlation between ACT-Mathematics Scores and college preparation as defined by course level, grade, and sex was R=0.65. The correlation between ACT-Mathematics Scores and level alone was R=0.59.

For the high school sample each school was first evaluated independently to obtain a multiple R for each school. The mathematics correlations were: school 1, R=0.78; school 2, R=0.82; school 3, R=0.83; school 4, R=0.85; and school 5, R=0.87. the mathematics multiple correlation for all 5 high schools combined was R=0.81. The ACT-Mathematics Score correlated with just "Level" (the highest factor) was R=0.76. The number of courses did not change the multiple R significantly at the α =.05 level.

The last question answered was the effect the student's sex had on their predicted ACT Scores. The simple r for sex with ACT-Mathematics Score was only r=0.18 this was significant at the α =.05 level statistically but, it was not significant when it came to predicting ACT-Mathematics Scores for students. This change amounts to a difference of 0.18 for an ACT Score of 23.20. That could be obtained by guessing at 2 questions and either getting them correct or missing them.

The Brigham Young University results were calculated separately from the other colleges. The Brigham Young University requires all entering freshmen to take Math 100 a level I course, or "test out" of it. Most incoming freshmen choose to take Math 100. In the Fall Semester 1979, 46.25% took Math 100. This large number of students, some qualified to take higher level courses, tended to raise the averages for the ACT Scores. The multiple R for Brigham Young University was R=0.63.

Importance of Findings

The courses college freshmen are taking for their first college mathematics course vary from General Mathematics to second semester Calculus. More males took the higher levels of mathematics courses than females. The males' mode was level III with 21.4% of the total, the females' mode was level II with 12.6% of the total population (see figure 4, p. 30). The males had a higher ACT-Mathematics mean score than the females for those taking "no mathematics class" through those taking level III classes, but, the females' ACT-Mathematics mean score was higher or as high as the males for level IV and level V. This appears to indicate that females are less prepared in the lower levels of college mathematics, but, those females that do take the higher levels of mathematics are as well prepared as the males.

Only 16.83% of the population took courses above the level of College Algebra. Most students of both sexes do not elect higher mathematics their first year.

In the college correlation for ACT-Mathematics Scores, the multiple regression equation gave R=0.65, using: level of mathematics course, grade in course, and sex of the student as the variables. This indicated that 41.75% of the ACT-Mathematics Score could be attributed to these variables.

In the high school correlation, data from the five high schools was used, for each separate high school first, and, then all combined, for one high school correlation. The independent results were: for school 1, R=0.78; for school 2, R=0.82; for school 3, R=0.83; for school 4, R=0.85; for school 5, R=0.87. The most important variable was "level" first and then "average" second, for four schools, the other 3 variables (time, number, sex) varied in order of importance for the 5 schools. This indicated that the level of the highest mathematics course taken in high school was the single most important factor. The exposure to a subject exceeded obtaining a good grade point average in lower level high school mathematics subjects in predicting success in the first college mathematics course.

The multiple correlation for the combined high school data gave an R=0.81, which indicated that 65.70% of the

ACT-Mathematics Score could be predicted from the high school information. The coefficient for "level" in the multiple correlation equation for high schools (see page 39) was 3.74, the coefficient for "average" was 2.65. That implies the effects of a change in level of course taken, is almost 1½ times as important as a complete grade change in the mathematics GPA in high school. That indicates exposure to higher levels of mathematics is 1½ times as important as obtaining higher grades in lower levels of high school mathematics courses. "Level" had a bivariate correlation of r=0.76 with ACT-Mathematics Scores, while "average" had a bivariate correlation of only r=0.47.

The level of preparation of high school seniors was encouraging in that 85% of the females took Algebra I or higher in high school, and 94% of the males took Algebra I or higher. Over 51% of the females and over 71% of the males took courses at the level of Algebra II or Geometry. It was found that 33% of the males and 10% of the females took courses as high as algebra III or Trigonometry. From these indicators, it seems that high school students who plan to go to college are generally taking mathematics courses beyond Algebra I.

The effect of the student's sex on the prediction of their success in college mathematics appeared to be minimal. The change in R^2 for ACT-Mathematics in the college multiple regression equation (see table 1, p. 35) was only 0.01 with a simple r=-0.18, hardly a factor when compared to level with an R^2 change of 0.59 and a simple r=0.59. Or, if sex were compared with the effect of grade with a change in R^2 of 0.41 and a simple r=0.32. The effect of sex on the high school scores was statistically significant at the .05 level, but it was almost negligible in its effect on the prediction of ACT-Mathematics Scores for the students.

Conclusions

The following conclusions have been obtained from this study:

1. Sex is not a major consideration in predicting success in college mathematics using high school mathematics data.

2. There is a high positive correlation between level of high school mathematics courses taken, combined with high school mathematics grades, and the ability to succeed in the appropriate levels of freshmen college mathematics courses.

3. There is a high positive correlation between high school mathematics courses taken and grades received compared with ACT-Mathematics Scores earned.

4. There is a high positive correlation between freshmen college mathematics success and ACT-Mathematics Scores.

5. The mathematics courses that are offered in high school meet the needs of students who plan to continue their education.

6. Female students are as well prepared as male students that took the same level college mathematics courses.

7. High school graduates on the average are not taking the higher levels of high school mathematics courses in preparation for college.

8. The most important high school factor that effects college success is level of high school mathematics course taken. A student that is exposed to the higher level high school mathematics does better in college mathematics.

Recommendations

1. Local school districts, in Utah, should recommend that students planning to attend college take 2 years of high school mathematics including Algebra I.

2. A study should be made to determine if fewer mathematics courses or lower levels of mathematics are being taken by high school students in the last few years than before.

3. The Utah State Board of Education should consider raising the state requirement in mathematics for graduation from high school.

4. Colleges might consider starting a program of probationary acceptance of incoming freshmen, who score low in mathematics on entrance examinations, until they pass certain mathematics requirements, this probationary courses would probably not be counted toward graduation, and should be a review of Algebra I topics.

5. It would appear that the students taking higher levels of mathematics courses in high school received higher ACT Scores and it is recommended that more mathematics be required in high school.

6. It is recommended that higher levels of mathematics be required in high school for admission to college.

7. It is recommended that school administration, mathematics teachers, and school counselors persuade more females in high school to take higher levels of high school mathematics.

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APPENDICES

Appendix A

The Letter to the Chairman of the Mathematics Department

Richard Shepley
USU Triads #7G
Logan, Utah 84321

Dr. Larry Cannon, Chairman
Dept. of Mathematics
Utah State University
Logan, Utah 84321

Dr. Cannon,

I am conducting a dissertation study for Dr. Donald Clark, Mathematics specialist, and the Utah State Board of Education concerning the success of Utah College Freshmen in mathematics courses. I would like to solicit your support and assistance in obtaining some of the information from the records office at your institution. A letter of introduction and explanation of the study and a request for the information needed is being sent to the records office. A letter or phone call from you to the records office in support of the study would be of great help in obtaining access to the needed information if you feel that this would be appropriate.

The study uses the first mathematics course taken by incoming freshmen at all institytions of High er Eduation in the State of Utah to attempt to answer the following questions:

1. What mathematics classes are 1979-1980 entering college freshmen taking in Utah?

2. What percent of the freshmen in Utah are taking each of these classes?

3. What is the percent breakdown of freshmen in each of these classes by sex?

4. Is there a relationship between the secondary school mathematics courses taken and grades recieved, and the first mathematics course taken in college?

5. What are the grades of freshmen in their first college mathematics course compared with number,type, and grade in secondary mathematics courses?

6. Is there a relationship between success in first mathematics course in college and length oftime since last class in secondary school?

This study should be of benifit to you in your department and to the Utah State Board of Education. In particular, this information might better (1) assist in the counseling of entering freshmen as to which mathemathics courses they would succeed in, and (2) assist high school students in better preparing themselves for success in their post-secondary endeavors.

Thank you for your time and assistance. Any further suggestions you might have would also be appreciated.

Sincerely,

Richard A. Shepley

Richard A. Shepley

Appendix B

The Letter to the Records Officer of the College

Richard Shepley
USU Triads #7G
Logan, Utah 84321

Admissions Officer
Utah State University
Logan, Utah 84321

Dear Sir,

I am contacting you to request your assistance in a dissestation study that is being done for Dr. Donald Clark, Mathematics Specialist, and the State Board of Education. Hopefully the study will answer the following questions:

1. What mathematics courses are 1979-1980 entering college freshmen taking in Utah?

2. What percent of the freshmen in Utah are taking each of these courses?

3. What is the percent breakdown of freshmen in each of these courses by sex?

4. Is there a relationship between the secondary school mathematics courses taken and grades recieved, and the first mathematics course taken in college?

5. What is the grade of a freshman in his first college mathematics course as compared with number, type, and grade in secondary mathematics courses?

6. Is there a relationship between success in first

mathematics course in college and length of time since last class in secondary school?

What processes would you suggest to best assist me in gathering the following information: 1. a list of all incoming freshmen for the year 1979-1980, no names are needed just an ID code with the other information correlated, 2. the sex of the student, 3. the first mathematics course taken at your institution, 4. the grade received in that course, 5. the high school graduated from (optional), 6. the mathematics courses in high school from admissions records, 7. when the last high school mathematics class was taken.

This study should be of benifit to your department of mathematics and the Utah State Board of Education. In particular, this information might better (1) assist in the counseling of entering freshmen as to which mathematics courses they might succeed in, and (2) assist high school students in better preparing themselves for success in their post-secondary endeavors.

Thank you for your time and the assistance you may be able to offer.

Sincerely,

Richard A. Shepley

Richard A. Shepley

Appendix C

Student Data Sheet

Student Data Sheet

1. High School Graduated from

__ 1. Logan

__ 2. Skyview

__ 3. Weber

__ 4. Ogden

__ 5. Roy

__ 6. Olympus

2. Sex

__1. Male

__ 2. Female

3. ACT-Composite Score

__ __ __

4. ACT-Mathematics Score

__ __ __

5. Mark all courses taken and grades recieved (4.0 * A)

__ 1. General Mathematics ___ Grade

__ 2. Consumer Mathematics ___

__ 3. Business Mathematics ___

__ 4. Algebra I ___

__ 5. AlgebraII ___

__ 6. Geometry ___

__ 7. Advanced Math/Calculus ___

Appendix D

The Letter to the High School Principal

Richard Shepley
USU Triads #7G
Logan, Utah 84321

Principal
Logan High School
162 West 1^{st} South
Logan, Utah 84321

Mr.

I am conducting a dissertation study for Dr. Donald Clark, Mathematics Specialist, and the Utah State Board of Education concerning the success of Utah college Freshmen in Mathematics.

I am writing you to ask for your permission to gain access to the records of the Graduating Class of 1979. There will be no names used in this study, the sample will in no form evaluate the individual schools or the individual students. The information that is needed is 1. the student's sex, 2. the student's ACT-Composite Score, 3. the student's ACT-Mathematics Score, 4. a list of all mathematics courses taken in high school and corresponding grades recieved.

This information will then be used to develope a Multiple Correlation Equation between ACT Scores and high school mathematics course work and grades recieved. This comparison will then be matched (by ACT Scores) to a Correlation Equation that will be developed between ACT

Scores and first mathematics course taken and grade received, by entering college freshmen. By matching the ACT Scores it is hoped a correspondence will be shown between the type of high school mathematics courses taken, grades recieved, and time since the courses were taken, and success in first college mathematics course (type and grade).

This study could be of use to your school for counseling high school students who plan to attend college or a trade school by showing them which mathematics courses will help them raise their ACT Scores. It could also be used to counsel Seniors that have been accepted to college in which mathematics courses, in college, they might expect the best success. It could also be used to assist in reviewing the mathematics curriculum at your school in college preparation areas of mathematics.

Thank you for your time and assistance and I look forward to hearing from you as to your decision.

Sincerely,

Richard A Shepley

Richard A. Shepley

Appendix E

Table of Predicted High School ACT Scores

TABLE 11

PREDICTED ACT-C AND ACT-M SCORES FROM THE HIGH SCHOOL MULTIPLE REGRESSION EQUATION

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
1	12.48	7.62	1	2	1	1	0
2	12.23	6.88	1	2	1	1	1
3	11.97	6.13	1	2	1	1	2
4	11.72	5.38	1	2	1	1	3
5	12.62	8.06	1	2	1	2	0
6	12.37	7.31	1	2	1	2	1
7	12.11	6.56	1	2	1	2	2
8	11.86	5.81	1	2	1	2	3
9	12.67	8.50	1	2	1	3	0
10	12.51	7.74	1	2	1	3	1
11	12.26	6.99	1	2	1	3	2
12	12.00	6.24	1	2	1	3	3
13	12.90	8.92	1	2	1	4	0
14	12.64	8.17	1	2	1	4	1
15	12.39	7.42	1	2	1	4	2
16	12.14	6.67	1	2	1	4	3
17	11.81	6.03	1	2	2	1	0
18	11.55	5.28	1	2	2	1	1
19	11.30	4.53	1	2	2	1	2
20	11.05	3.78	1	2	2	1	3
21	11.95	6.46	1	2	2	2	0
22	11.69	5.71	1	2	2	2	1
23	11.44	4.96	1	2	2	2	2
24	11.19	4.20	1	2	2	2	3
25	12.09	6.89	1	2	2	3	0
26	11.83	6.14	1	2	2	3	1
27	11.58	5.39	1	2	2	3	2
28	11.32	4.63	1	2	2	3	3
29	12.23	7.32	1	2	2	4	0
30	11.97	6.57	1	2	2	4	1
31	11.72	5.81	1	2	2	4	2
32	11.46	5.06	1	2	2	4	3
33	14.32	10.28	1	3	1	1	0
34	14.07	9.52	1	3	1	1	1
35	13.81	8.77	1	3	1	1	2
36	13.59	8.02	1	3	1	1	3
37	14.46	10.71	1	3	1	2	0
38	14.21	9.95	1	3	1	2	1
39	13.95	9.20	1	3	1	2	2
40	13.70	8.45	1	3	1	2	3
41	14.60	11.13	1	3	1	3	0
42	14.34	10.38	1	3	1	3	1

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
43	14.090	9.630	1	3	1	3	2
44	13.836	8.878	1	3	1	3	3
45	14,737	11.563	1	3	1	4	0
46	14.483	10.811	1	3	1	4	1
47	14.229	10.059	1	3	1	4	2
48	13.975	9.307	1	3	1	4	3
49	13.647	8.672	1	3	2	1	0
50	13.393	7.920	1	3	2	1	1
51	13.139	7.168	1	3	2	1	2
52	12.885	6.416	1	3	2	1	3
53	13.786	9.101	1	3	2	2	0
54	13.532	8.349	1	3	2	2	1
55	13.278	7.597	1	3	2	2	2
56	13.024	6.845	1	3	2	2	3
57	13.925	9.530	1	3	2	3	0
58	13.671	8.778	1	3	2	3	1
59	13.417	8.026	1	3	2	3	2
60	13.163	7.274	1	3	2	3	3
61	14.064	9.959	1	3	2	4	0
62	13.810	9.207	1	3	2	4	1
63	13.556	8.455	1	3	2	4	2
64	13.302	7.703	1	3	2	4	3
65	16.159	12.917	1	4	1	1	0
66	15.905	12.165	1	4	1	1	1
67	15.651	11.413	1	4	1	1	2
68	15.397	10.661	1	4	1	1	3
69	16.298	13.346	1	4	1	2	0
70	16.044	12.594	1	4	1	2	1
71	15.790	11.842	1	4	1	2	2
72	15.536	11.090	1	4	1	2	3
73	16.437	13.775	1	4	1	3	0
74	16.185	13.023	1	4	1	3	1
75	15.929	12.271	1	4	1	3	2
76	15.675	11.519	1	4	1	3	3
77	16.576	14.204	1	4	1	4	0
78	16.322	13.452	1	4	1	4	1
79	16.068	12.700	1	4	1	4	2
80	15.814	11.948	1	4	1	4	3
81	15.486	11.313	1	4	2	1	0
82	15.232	10.561	1	4	2	1	1
83	14.978	9.809	1	4	2	1	2
84	14.724	9.057	1	4	2	1	3
85	15.625	11.742	1	4	2	2	0
86	15.371	10.990	1	4	2	2	1
87	15.117	10.238	1	4	2	2	2
88	14.863	9.486	1	4	2	2	3

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
89	15.764	12.171	1	4	2	3	0
90	15.510	11.419	1	4	2	3	1
91	15.256	10.667	1	4	2	3	2
92	15.002	9.915	1	4	2	3	3
93	15.903	12.600	1	4	2	4	0
94	15.959	11.848	1	4	2	4	1
95	15.395	11.096	1	4	2	4	2
96	15.141	10.344	1	4	2	4	3
97	15.202	11.373	2	2	1	1	0
98	14.948	10.621	2	2	1	1	1
99	14.694	9.869	2	2	1	1	2
100	14.440	9.117	2	2	1	1	3
101	15.341	11.802	2	2	1	2	0
102	15.087	11.050	2	2	1	2	1
103	14.833	10.298	2	2	1	2	2
104	14.579	9.546	2	2	1	2	3
105	15.480	12.231	2	2	1	3	0
106	15.226	11.479	2	2	1	3	1
107	14.972	10.727	2	2	1	3	2
108	14.718	9.975	2	2	1	3	3
109	15.619	12.660	2	2	1	4	0
110	15.365	11.908	2	2	1	4	1
111	15.111	11.156	2	2	1	4	2
112	14.857	10.404	2	2	1	4	3
113	14.529	9.769	2	2	2	1	0
114	14.275	9.017	2	2	2	1	1
115	14.021	8.265	2	2	2	1	2
116	13.767	7.513	2	2	2	1	3
117	14.668	10.198	2	2	2	2	0
118	14.414	9.446	2	2	2	2	1
119	14.160	8.694	2	2	2	2	2
120	13.906	7.942	2	2	2	2	3
121	14.807	10.627	2	2	2	3	0
122	14.553	9.875	2	2	2	3	1
123	14.299	9.123	2	2	2	3	2
124	14.045	8.371	2	2	2	3	3
125	14.946	11.056	2	2	2	4	0
126	14.692	10.304	2	2	2	4	1
127	14.438	9.552	2	2	2	4	2
128	14.184	8.800	2	2	2	4	3
129	17.041	14.014	2	3	1	1	0
130	16.787	13.262	2	3	1	1	1
131	16.533	12.510	2	3	1	1	2
132	16.279	11.758	2	3	1	1	3
133	17.180	14.443	2	3	1	2	0
134	16.926	13.691	2	3	1	2	1
135	16.672	12.939	2	3	1	2	2

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
135	16.418	12.187	2	3	1	2	3
136	17.319	14.872	2	3	1	3	0
137	17.065	14.120	2	3	1	3	1
138	16.811	13.368	2	3	1	3	2
139	16.557	12.616	2	3	1	3	3
140	17.458	15.301	2	3	1	4	0
141	17.204	14.549	2	3	1	4	1
142	16.950	13.797	2	3	1	4	2
143	16.696	13.045	2	3	1	4	3
144	16.369	12.410	2	3	2	1	0
145	16.114	11.658	2	3	2	1	1
146	15.860	10.906	2	3	2	1	2
147	15.606	10.154	2	3	2	1	3
148	16.507	12.839	2	3	2	2	0
149	16.353	12.087	2	3	2	2	1
150	15.999	11.335	2	3	2	2	2
151	15.745	10.583	2	3	2	2	3
152	16.646	13.268	2	3	2	3	0
153	16.392	12.516	2	3	2	3	1
154	16.138	11.764	2	3	2	3	2
155	15.884	11.012	2	3	2	3	3
156	16.785	13.697	2	3	2	4	0
157	16.531	12.945	2	3	2	4	1
158	16.277	12.193	2	3	2	4	2
159	16.023	11.441	2	3	2	4	3
160	18.880	16.655	2	4	1	1	0
161	18.626	15.903	2	4	1	1	1
162	18.372	15.151	2	4	1	1	2
163	18.118	14.399	2	4	1	1	3
164	19.019	17.084	2	4	1	2	0
165	18.765	16.332	2	4	1	2	1
166	18.511	15.580	2	4	1	2	2
167	18.257	14.828	2	4	1	2	3
168	19.158	17.513	2	4	1	3	0
169	18.904	16.761	2	4	1	3	1
170	18.650	16.009	2	4	1	3	2
171	18.396	15.257	2	4	1	3	3
172	19.297	17.942	2	4	1	4	0
173	19.043	17.190	2	4	1	4	1
174	18.789	16.438	2	4	1	4	2
175	18.535	15.686	2	4	1	4	3
176	18.207	15.051	2	4	2	1	0
177	17.953	14.299	2	4	2	1	1
178	17.699	13.547	2	4	2	1	2
179	17.445	12.795	2	4	2	1	3
180	18.346	15.480	2	4	2	2	0

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
181	18.092	14.728	2	4	2	2	1
182	17.838	13.976	2	4	2	2	2
183	17.584	13.224	2	4	2	2	3
184	18.485	15.909	2	4	2	3	0
185	18.231	15.157	2	4	2	3	1
186	17.977	14.405	2	4	2	3	2
187	17.723	13.653	2	4	2	3	3
188	18.624	16.338	2	4	2	4	0
189	18.370	15.587	2	4	2	4	1
190	18.116	14.834	2	4	2	4	2
191	17.862	14.082	2	4	2	4	3
192	17.923	15.111	3	2	1	1	0
193	17.669	14.359	3	2	1	1	1
194	17.415	13.607	3	2	1	1	2
195	17.161	12.855	3	2	1	1	3
196	18.062	15.540	3	2	1	2	0
197	17.808	14.788	3	2	1	2	1
198	17.554	14.036	3	2	1	2	2
199	17.300	13.284	3	2	1	2	3
200	18.201	15.969	3	2	1	3	0
201	17.947	15.217	3	2	1	3	1
202	17.693	14.465	3	2	1	3	2
203	17.439	13.713	3	2	1	3	3
204	18.340	16.398	3	2	1	4	0
205	18.086	15.646	3	2	1	4	1
206	17.832	14.894	3	2	1	4	2
207	17.578	14.142	3	2	1	4	3
208	17.250	13.507	3	2	2	1	0
209	16.996	12.755	3	2	2	1	1
210	16.742	12.003	3	2	2	1	2
211	16.488	11.251	3	2	2	1	3
212	17.389	13.936	3	2	2	2	0
213	17.135	13.184	3	2	2	2	1
214	16.881	12.432	3	2	2	2	2
215	16.627	11.680	3	2	2	2	3
216	17.528	14.365	3	2	2	3	0
217	17.274	13.613	3	2	2	3	1
218	17.020	12.861	3	2	2	3	2
219	16.766	12.109	3	2	2	3	3
220	17.667	14.794	3	2	2	4	0
221	17.413	14.042	3	2	2	4	1
222	17.159	13.290	3	2	2	4	2
223	16.905	12.538	3	2	2	4	3
224	19.762	17.752	3	3	1	1	0
225	19.508	17.000	3	3	1	1	1
226	19.254	16.248	3	3	1	1	2
227	19.000	15.496	3	3	1	1	3

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
228	19.901	18.181	3	3	1	2	0
229	19.647	17.428	3	3	1	2	1
230	19.393	16.677	3	3	1	2	2
231	19.139	15.925	3	3	1	2	3
232	20.040	18.610	3	3	1	3	0
233	19.786	17.858	3	3	1	3	1
234	19.532	17.106	3	3	1	3	2
235	19.278	16.354	3	3	1	3	3
236	20.179	19.039	3	3	1	4	0
237	19.925	18.287	3	3	1	4	1
238	19.671	17.535	3	3	1	4	2
239	19.417	16.783	3	3	1	4	3
240	19.089	16.148	3	3	2	1	0
241	18.835	15.396	3	3	2	1	1
242	18.581	14.644	3	3	2	1	2
243	18.327	13.892	3	3	2	1	3
244	19.228	16.577	3	3	2	2	0
245	18.974	15.825	3	3	2	2	1
246	18.720	15.073	3	3	2	2	2
247	18.466	14.321	3	3	2	2	3
248	19.367	17.006	3	3	2	3	0
249	19.113	16.254	3	3	2	3	1
250	18.859	15.502	3	3	2	3	2
251	18.605	14.750	3	3	2	3	3
252	19.506	17.435	3	3	2	4	0
253	19.252	16.683	3	3	2	4	1
254	18.998	15.931	3	3	2	4	2
255	18.744	15.179	3	3	2	4	3
256	21.601	20.393	3	4	1	1	0
257	21.347	19.641	3	4	1	1	1
258	21.093	18.889	3	4	1	1	2
259	20.839	18.137	3	4	1	1	3
260	21.740	20.822	3	4	1	2	0
261	21.486	20.070	3	4	1	2	1
262	21.232	19.318	3	4	1	2	2
263	20.978	18.566	3	4	1	2	3
264	21.879	21.251	3	4	1	3	0
265	21.625	20.499	3	4	1	3	1
266	21.371	19.747	3	4	1	3	2
267	21.117	18.995	3	4	1	3	3
268	22.018	21.680	3	4	1	4	0
269	21.764	20.928	3	4	1	4	1
270	21.510	20.176	3	4	1	4	2
271	21.266	19.424	3	4	1	4	3
272	20.928	18.789	3	4	2	1	0
273	20.674	18.037	3	4	2	1	1
274	20.420	17.285	3	4	2	1	2

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
275	20.166	16.533	3	4	2	1	3
276	21.067	19.218	3	4	2	2	0
277	20.813	18.466	3	4	2	2	1
278	20.559	17.714	3	4	2	2	2
279	20.305	16.962	3	4	2	2	3
280	21.206	19.647	3	4	2	3	0
281	20.952	18.895	3	4	2	3	1
282	20.698	18.143	3	4	2	3	2
283	20.444	17.391	3	4	2	3	3
284	21.345	20.076	3	4	2	4	0
285	21.091	19.324	3	4	2	4	1
286	20.837	18.572	3	4	2	4	2
287	20.583	17.820	3	4	2	4	3
288	20.644	18.849	4	2	1	1	0
289	20.390	18.097	4	2	1	1	1
290	20.136	17.345	4	2	1	1	2
291	19.882	16.593	4	2	1	1	3
292	20.783	19.278	4	2	1	2	0
293	20.529	18.526	4	2	1	2	1
294	20.275	17.774	4	2	1	2	2
295	20.021	17.022	4	2	1	2	3
296	20.922	19.707	4	2	1	3	0
297	20.668	18.955	4	2	1	3	1
298	20.414	18.203	4	2	1	3	2
299	20.160	17.451	4	2	1	3	3
300	21.061	20.136	4	2	1	4	0
301	20.807	19.384	4	2	1	4	1
302	20.553	18.632	4	2	1	4	2
303	20.299	17.880	4	2	1	4	3
304	19.971	17.245	4	2	2	1	0
305	19.717	16.493	4	2	2	1	1
306	19.463	15.741	4	2	2	1	2
307	19.209	14.989	4	2	2	1	3
308	20.110	17.674	4	2	2	2	0
309	19.856	16.922	4	2	2	2	1
310	19.602	16.170	4	2	2	2	2
311	19.348	15.418	4	2	2	2	3
312	20.249	18.103	4	2	2	3	0
313	19.995	17.351	4	2	2	3	1
314	19.741	16.599	4	2	2	3	2
315	19.487	15.847	4	2	2	3	3
316	20.388	18.532	4	2	2	4	0
317	20.134	17.780	4	2	2	4	1
318	19.880	17.028	4	2	2	4	2
319	19.626	16.276	4	2	2	4	3
320	22.483	21.400	4	3	1	1	0

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
321	22.229	20.739	4	3	1	1	1
322	21.975	19.986	4	3	1	1	2
323	21.721	19.234	4	3	1	1	3
324	22.622	21.919	4	3	1	2	0
325	22.368	21.167	4	3	1	2	1
326	22.114	20.415	4	3	1	2	2
327	21.860	19.663	4	3	1	2	3
328	22.761	22.348	4	3	1	3	0
329	22.507	21.596	4	3	1	3	1
330	22.253	20.844	4	3	1	3	2
331	21.999	20.092	4	3	1	3	3
332	22.900	22.777	4	3	1	4	0
333	22.646	22.025	4	3	1	4	1
334	22.392	21.273	4	3	1	4	2
335	22.138	20.521	4	3	1	4	3
336	21.810	19.886	4	3	2	1	0
337	21.556	19.134	4	3	2	1	1
338	21.302	18.382	4	3	2	1	2
339	21.048	17.630	4	3	2	1	3
340	21.949	20.315	4	3	2	2	0
341	21.695	19.563	4	3	2	2	1
342	21.441	18.811	4	3	2	2	2
343	21.187	18.059	4	3	2	2	3
344	22.088	20.744	4	3	2	3	0
345	21.834	19.992	4	3	2	3	1
346	21.580	19.240	4	3	2	3	2
347	21.326	18.488	4	3	2	3	3
348	22.227	21.173	4	3	2	4	0
349	21.973	20.421	4	3	2	4	1
350	21.719	19.669	4	3	2	4	2
351	21.465	18.917	4	3	2	4	3
352	24.322	24.131	4	4	1	1	0
353	24.068	23.379	4	4	1	1	1
354	23.814	22.627	4	4	1	1	2
355	23.560	21.875	4	4	1	1	3
356	24.461	24.560	4	4	1	2	0
357	24.207	23.808	4	4	1	2	1
358	23.953	23.056	4	4	1	2	2
359	23.699	22.304	4	4	1	2	3
360	24.600	24.989	4	4	1	3	0
361	24.346	24.237	4	4	1	3	1
362	24.092	23.485	4	4	1	3	2
363	23.838	22.733	4	4	1	3	3
364	24.739	25.418	4	4	1	4	0
365	24.485	24.666	4	4	1	4	1
366	24.231	23.914	4	4	1	4	2

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
367	23.977	23.162	4	4	1	4	3
368	23.649	22.527	4	4	2	1	0
369	23.395	21.775	4	4	2	1	1
370	23.141	21.023	4	4	2	1	2
371	22.887	20.271	4	4	2	1	3
372	23.788	22.956	4	4	2	2	0
373	23.534	22.204	4	4	2	2	1
374	23.280	21.452	4	4	2	2	2
375	23.026	20.700	4	4	2	2	3
376	23.927	23.385	4	4	2	3	0
377	23.673	22.633	4	4	2	3	1
378	23.419	21.881	4	4	2	3	2
379	23.165	21.129	4	4	2	3	3
380	24.066	23.814	4	4	2	4	0
381	23.812	23.062	4	4	2	4	1
382	23.558	22.310	4	4	2	4	2
383	23.304	21.558	4	4	2	4	3
384	23.365	22.587	5	2	1	1	0
385	23.111	21.835	5	2	1	1	1
386	22.857	21.083	5	2	1	1	2
387	22.603	20.331	5	2	1	1	3
388	23.504	23.016	5	2	1	2	0
389	23.250	22.264	5	2	1	2	1
390	22.996	21.512	5	2	1	2	2
391	22.742	20.760	5	2	1	2	3
392	23.643	23.445	5	2	1	3	0
393	23.389	22.693	5	2	1	3	1
394	23.135	21.941	5	2	1	3	2
395	22.881	21.189	5	2	1	3	3
396	23.782	23.874	5	2	1	4	0
397	23.528	23.122	5	2	1	4	1
398	23.274	22.370	5	2	1	4	2
399	23.020	21.618	5	2	1	4	3
400	22.692	20.983	5	2	2	1	0
401	22.438	20.231	5	2	2	1	1
402	22.184	19.479	5	2	2	1	2
403	21.930	18.727	5	2	2	1	3
404	22.831	21.412	5	2	2	2	0
405	22.577	20.660	5	2	2	2	1
406	22.323	19.908	5	2	2	2	2
407	22.069	19.156	5	2	2	2	3
408	22.970	21.841	5	2	2	3	0
409	22.716	21.089	5	2	2	3	1
410	22.462	20.337	5	2	2	3	2
411	22.208	19.585	5	2	2	3	3
412	23.109	22.270	5	2	2	4	0

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
413	22.855	21.518	5	2	2	4	1
414	22.601	20.766	5	2	2	4	2
415	22.347	20.014	5	2	2	4	3
416	25.204	25.228	5	3	1	1	0
417	24.950	24.476	5	3	1	1	1
418	24.696	23.724	5	3	1	1	2
419	24.442	22.972	5	3	1	1	3
420	25.343	25.657	5	3	1	2	0
421	25.089	24.905	5	3	1	2	1
422	24.835	24.153	5	3	1	2	2
423	24.581	23.401	5	3	1	2	3
424	25.482	26.086	5	3	1	3	0
425	25.228	25.334	5	3	1	3	1
426	24.974	24.582	5	3	1	3	2
427	24.720	23.830	5	3	1	3	3
428	25.621	26.515	5	3	1	4	0
429	25.367	25.763	5	3	1	4	1
430	25.113	25.011	5	3	1	4	2
431	24.859	24.259	5	3	1	4	3
432	24.531	23.624	5	3	2	1	0
433	24.277	22.872	5	3	2	1	1
434	24.023	22.120	5	3	2	1	2
435	23.769	21.369	5	3	2	1	3
436	24.670	24.053	5	3	2	2	0
437	24.416	23.301	5	3	2	2	1
438	24.162	22.549	5	3	2	2	2
439	23.908	21.797	5	3	2	2	3
440	24.809	24.482	5	3	2	3	0
441	24.555	23.730	5	3	2	3	1
442	24.301	22.978	5	3	2	3	2
443	24.047	22.226	5	3	2	3	3
444	24.948	24.911	5	3	2	4	0
445	24.694	24.159	5	3	2	4	1
446	24.440	23.407	5	3	2	4	2
447	24.189	22.655	5	3	2	4	3
448	27.043	27.869	5	4	1	1	0
449	26.789	27.117	5	4	1	1	1
450	26.535	26.365	5	4	1	1	2
451	26.281	25.613	5	4	1	1	3
452	27.182	28.298	5	4	1	2	0
453	26.928	27.546	5	4	1	2	1
454	26.674	26.794	5	4	1	2	2
455	26.420	26.042	5	4	1	2	3
456	27.321	28.727	5	4	1	3	0
457	27.067	27.975	5	4	1	3	1
458	26.813	27.223	5	4	1	3	2

TABLE 11 (Continued)

Row	Predicted ACT-C	Predicted ACT-M	Level	Average	Sex	Number	Time
459	26.559	26.471	5	4	1	3	3
460	27.460	29.156	5	4	1	4	0
461	27.206	28.404	5	4	1	4	1
462	26.952	27.552	5	4	1	4	2
463	26.698	26.900	5	4	1	4	3
464	26.370	26.265	5	4	2	1	0
465	26.116	25.513	5	4	2	1	1
466	25.862	24.761	5	4	2	1	2
467	25.608	24.009	5	4	2	1	3
468	26.509	26.694	5	4	2	2	0
469	26.255	25.942	5	4	2	2	1
470	26.001	25.190	5	4	2	2	2
471	25.747	24.438	5	4	2	2	3
472	26.648	27.123	5	4	2	3	0
473	26.394	26.371	5	4	2	3	1
474	26.140	25.619	5	4	2	3	2
475	25.886	24.867	5	4	2	3	3
476	26.787	27.552	5	4	2	4	0
477	26.533	26.800	5	4	2	4	1
478	26.279	26.048	5	4	2	4	2
479	26.025	25.296	5	4	2	4	3

VITA

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Candidate for the Degree of

Doctor of Education

Dissertation: Predicting Success in College Mathematics From High School Mathematics Preparation

Major Field: Curriculum Developement and Supervision

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Education: Attended numerous elementary schools as an Air Force dependant, graduated from Oscoda Area High School, Michigan, in 1966, received the Associate of Science Degree from Harrisburg Community College, Harrisburg, Pennsylvania, with a major in Chemistry, in 1968: Received the Bachelor of Science Degeee in Mathematics in 1974, and the Master of Arts in Mathematics Education in 1976, both from Brigham Young University; 1981 completed the requirements for the Doctor of Education degree at Utah State Universtiy, with a major in Curriculum Developement and Supervision.

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