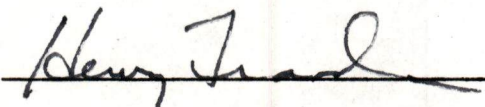
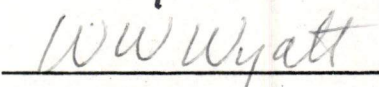
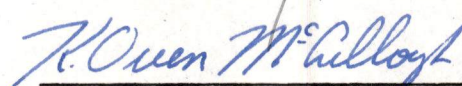


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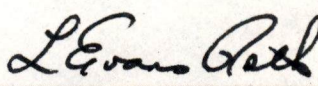
I am submitting herewith a dissertation written by Herbert Lowe Hooper, Jr. entitled "Development of a Prediction Model for Students in Beginning Level Mathematics Courses at Chattanooga State Technical Community College." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Curriculum and Instruction.


Donald J. Dessart
Major Professor

We have read this dissertation
and recommend its acceptance

Accepted for the Council:


Vice Chancellor
Graduate Studies and Research

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DEVELOPMENT OF A PREDICTION MODEL FOR STUDENTS IN BEGINNING
LEVEL MATHEMATICS COURSES AT CHATTANOOGA STATE
TECHNICAL COMMUNITY COLLEGE

A Dissertation
Presented for the
Doctor of Education
Degree
The University of Tennessee, Knoxville

Herbert Lowe Hooper, Jr.

August 1979

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ABSTRACT

Since most community colleges have an "open-door" admissions policy, students enter with a wide range of backgrounds in mathematics. One of the critical needs in many community colleges is to ascertain the appropriate level for students to begin their mathematics courses. It was the purpose of this study to determine prediction of grades equations for each of the beginning level mathematics courses at Chattanooga State Technical Community College.

Participants in the study included 388 students enrolled in either Basic Mathematics, Fundamentals of Algebra, Algebra and Trigonometry I, College Algebra, or Business Mathematics during the Fall Quarter 1978 at Chattanooga State Technical Community College. The criterion variable was the final grade in each course. The independent variables investigated for possible inclusion in the regression equations were high school rank, high school grade point average, number of mathematics courses in high school, ACT Composite Score, ACT Mathematics Score, Chattanooga State Mathematics Placement Test, Nelson-Denny Reading Test Total Score, Nelson-Denny Reading Test Comprehension Score, Nelson-Denny Reading Test Vocabulary Score, and age. Since information was not available on each variable for all students, each course was divided into groups based on the information available on the

independent variables for students in that group. The stepwise regression technique was used to develop prediction of grades equations for each beginning level course by group. The 5 percent entrance and exit level for variables on the partial-F test was used.

At least one prediction of grades equation was developed for each course except Basic Mathematics. The Chattanooga State Mathematics Placement Test (form A) was the single best predictor of grades for the courses: Fundamentals of Algebra, Algebra and Trigonometry I, and College Algebra. The Chattanooga State Mathematics Placement Test (form B) was the single best predictor of grades for Business Mathematics. At least one of the three scores on the Nelson-Denny Reading Test correlated significantly with a student's grade in Basic Mathematics, Fundamentals of Algebra, Algebra and Trigonometry I, and College Algebra. The ACT Mathematics Score correlated significantly with final grades in both Algebra and Trigonometry I, and College Algebra. The ACT Composite score correlated significantly with the final grades in both Fundamentals of Algebra and Algebra and Trigonometry I. The high school grade point average and the high school rank correlated significantly with the final grades in Algebra and Trigonometry I and College Algebra, respectively.

The implication of the study was that each community college should consider developing its own mathematics

placement test and corresponding multiple regression equation for each beginning level mathematics course.

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CHAPTER I

THE PROBLEM AND THE EXPERIMENTAL DESIGN

Since most community colleges have an "open-door" admissions policy, students enter with a wide range of backgrounds in mathematics. One of the critical needs in many community colleges is to ascertain the appropriate level for students to begin their mathematics courses.

I. STATEMENT OF THE PROBLEM

The purpose of this study was to determine prediction of grades equations for each of the beginning level mathematics courses at Chattanooga State Technical Community College.

II. METHOD

Description of the Subjects

Participants in the study included students enrolled in beginning level mathematics courses at Chattanooga State Technical Community College; namely, Basic Mathematics (MA 100), Fundamentals of Algebra (MA 105), Algebra and Trigonometry I (MA 115), College Algebra (MA 117), or Business Mathematics (MG 165) during the Fall Quarter 1978. During this quarter, participants represented all of the 11 sections of MA 100, all of the 17 sections of MA 105, 6 of 7

sections of MA 115, all of the 5 sections of MA 117, and 2 of 3 sections of MG 165. Each of the courses—MA 100, MA 105, MA 115, MA 117, and MG 165—met for five hours per week. Some sections of MA 100, MA 105, MA 115, and MA 117 are self-paced and are taught using audio-tutorial materials. Students have at most two quarters to complete these courses. The instructor for each course followed the appropriate outline as provided by the department.

Variables in the Study

The criterion variable in the study was the final grade for students taking MA 100, MA 105, MA 115, MA 117, or MG 165. The independent variables were: (a) high school rank, (b) high school grade point average, (c) number of completed high school mathematics courses, (d) ACT composite score, (e) ACT math score, (f) Chattanooga State Math Placement Test (form A) score, (g) Chattanooga State Math Placement Test (form B) score, (h) Nelson-Denny Reading Test (total) score, (i) Nelson-Denny Reading Test (comprehension) score, (j) Nelson-Denny Reading Test (vocabulary) score, and (k) age.

Selection of Subjects

For many students who register at Chattanooga State Technical Community College for the first time, the Admissions Office, at the time of registration, has not

received all the information required of entering degree-seeking students. Each student is required to submit an application, a high school grade transcript or GED scores, and either their scores on the ACT test or their results from the Chattanooga State Placement Battery. The Chattanooga State Placement Battery consists of a writing sample of approximately two hundred words, the Nelson-Denny Reading Test, and either form A or form B of the Chattanooga State Mathematics Placement Test. The Chattanooga State Mathematics Placement Test (form A) and the Chattanooga State Mathematics Placement Test (form B) are included in Appendix B.

Since all degree-seeking students must take either the ACT Test or the Chattanooga State Placement Battery, and since the Admissions Office has incomplete files on many students at the time of registration, six different groups of students were analyzed on the basis of the information available on them at the time of registration (Table I). Only those students who had no missing data for at least one of the groups were included in the regression analysis. Students taking MA 100 could be included in any of the six groups; whereas students taking MA 105, MA 115, or MA 117 are, generally, in either group I, II, III, or IV. Students enrolling in MG 165 are in either group II, IV, V, or VI.

All data were obtained from student records in the Chattanooga State Admissions Office, with the written

TABLE I

IDENTIFICATION OF GROUPS BY HIGH SCHOOL RECORDS,
ACT SCORES, CHATTANOOGA STATE PLACEMENT
BATTERY, AND AGE

Group	Record Information Available
I	high school rank high school grade point average number of high school mathematics courses CSTCC Mathematics Placement Test (form A) Nelson-Denny Reading (total) Nelson-Denny Reading (comprehension) Nelson-Denny Reading (vocabulary) age
II	high school rank high school grade point average number of high school mathematics courses ACT composite score ACT mathematics score age
III	CSTCC Mathematics Placement Test (form A) Nelson-Denny Reading (total) Nelson-Denny Reading (comprehension) Nelson-Denny Reading (vocabulary) age
IV	ACT composite score ACT mathematics score age
V	high school rank high school grade point average number of high school mathematics courses CSTCC Mathematics Placement Test (form B) Nelson-Denny Reading (total) Nelson-Denny Reading (comprehension) Nelson-Denny Reading (vocabulary)

TABLE I (continued)

Group	Record Information Available
VI	CSTCC Mathematics Placement Test (form B) Nelson-Denny Reading (total) Nelson-Denny Reading (comprehension) Nelson-Denny Reading (vocabulary) age

permission of each student participating in the study. A copy of the consent form is included in Appendix A.

Description of the Instruments Used

The three instruments used in this study were the American College Test (ACT), Nelson-Denny Reading Test, Chattanooga State Mathematics Placement Test (form A), and the Chattanooga State Mathematics Placement Test (form B).

The American College Test is a scale of general scholastic achievement that yields five scores: an English score, a mathematics score, a natural science score, a social studies score, and the composite score. The range of the two scores used in this study, the composite score and the mathematics score, is from 0 to 36.

The Nelson-Denny Reading Test is a general scale of reading ability that consists of three scores: comprehension, vocabulary, and total. These scores are represented as grade levels. The time limit for the test is thirty minutes.

The Chattanooga State Mathematics Placement Test (form A) is composed of thirty-six multiple choice algebraic, and arithmetic problems. The test must be completed in not more than thirty minutes. The final score is the total number of problems on the test that have been answered correctly.

The Chattanooga State Mathematics Placement Test (form B) is composed of thirty-six multiple choice arithmetic problems. The test must be completed in not more than thirty

minutes. The final score is the total number of problems in the test that have been answered correctly.

III. DEFINITIONS OF TERMS

The following definitions of terms are used in this study:

1. Basic Mathematics, MA 100, is a five credit-hour, developmental mathematics course consisting, primarily, of arithmetic, ratio and proportion, and percent. It is a self-paced course using a workbook and complementary slide-tape presentation.

2. Fundamentals of Algebra, MA 105, is a five credit-hour developmental, mathematics course consisting of those topics usually taught in a high school, first-year algebra course. Fundamentals of Algebra can be taken either as a lecture class or as a self-paced class.

3. Developmental Course. A developmental course is a remedial course designed to prepare students for courses in the regular college curriculum.

4. CSTCC is the acronym for Chattanooga State Technical Community College.

5. Algebra and Trigonometry I, MA 115, is the first of a two-quarter precalculus sequence. All engineering and science technology students study this sequence.

6. College Algebra, MA 117, is a college algebra course, primarily for nonscience and nonengineering students.

7. Business Mathematics, MG 165, is primarily for secretarial science and business-oriented students.

8. CSTCC Mathematics Placement Test (form A) is given as part of the CSTCC placement battery of tests for students who have either MA 115 or MA 117 as part of their curriculum.

9. CSTCC Mathematics Placement Test (form B) is given as part of the CSTCC placement battery of tests, primarily for students who study MG 165 as part of their curriculum.

10. High School Rank is the ratio of the student's class rank to the class size.

IV. EXPLANATION OF NOTATION

Unless otherwise designated, the following symbols will be used in this study:

- Y : Predicted grade for a given course
- X_1 : High school rank
- X_2 : High school grade point average
- X_3 : Number of high school mathematics courses
- X_4 : ACT composite score
- X_5 : ACT mathematics score
- X_6 : Chattanooga State Mathematics Placement Test
(form A) score

X_7 : Chattanooga State Mathematics Placement Test
(form B) score

X_8 : Nelson-Denny Reading Test (total) score

X_9 : Nelson-Denny Reading Test (comprehension) score

X_{10} : Nelson-Denny Reading Test (vocabulary) score

X_{11} : Age in years

Group I : Students whose record included their high school rank, high school grade point average, number of high school mathematics courses, CSTCC Mathematics Placement Test (form A), Nelson-Denny Reading Test (total), Nelson-Denny Reading Test (comprehension), Nelson-Denny Reading Test (vocabulary), and age.

Group II : Students whose record included their high school rank, high school grade point average, number of high school mathematics courses, ACT composite score, ACT mathematics score, and age.

Group III: Students whose record included their CSTCC Mathematics Placement Test (form A), Nelson-Denny Reading Test (total), Nelson-Denny Reading Test (comprehension), Nelson-Denny Reading Test (vocabulary), and age.

Group IV : Students whose record included their ACT composite score, ACT mathematics score, and age.

Group V : Students whose record included their high school rank, high school grade point average, number of high school mathematics courses, CSTCC Mathematics Placement Test (form B), Nelson-Denny Reading Test (total), Nelson-Denny Reading Test (comprehension), Nelson-Denny Reading Test (vocabulary), and age.

Group VI : Students whose record included their CSTCC Mathematics Placement Test (form B), Nelson-Denny Reading Test (total), Nelson-Denny Reading Test (comprehension), Nelson-Denny Reading Test (vocabulary), and age.

V. LIMITATIONS OF THE STUDY

The project was limited to the introductory mathematics class; MA 100, MA 105, MA 115, MA 117, and MG 165 at Chattanooga State Technical Community College for the Fall Quarter 1978. Data were obtained only on those students who fell into either Group I, Group II, Group III, Group IV, Group V, or Group VI. Any student not falling into one of the six groups was not included in the study. The prediction

equations developed from this study are applicable only to these or similar populations.

VI. STATISTICAL TREATMENT OF DATA

The mean, standard deviation, and range for each variable were determined for each course. A correlation matrix, by course, for all variables was presented. A stepwise regression procedure (Draper, 1966, pp. 171-172) was performed, by course, on all groups with adequate sample size. Finally, a comparison of predicted and observed grades was made for MA 105, Spring Quarter 1979.

The data were calculated using the SAS, stepwise, multiple-regression program (Barr, 1976, pp. 251-256) available at The University of Tennessee, Knoxville, Computing Center.

VII. IMPORTANCE OF THE STUDY

The watchword for many institutions of higher learning, particularly the community college, is the "open-door." As Cross (1976, p. 3) indicated:

American higher education has worked hard for the past quarter of a century to achieve educational opportunity for all.

The CSTCC catalog (1977, p. 9) stated in its philosophy:

The purpose of Chattanooga State Technical Community College is to offer highly diversified and comprehensive programs which serve the educational

needs of the community, recognizing that the community consists of individuals with a wide range of cultural, educational, and sociological backgrounds. An "open-door" policy assures opportunity for any student seeking self-improvement and personal enrichment through education.

As a result of this cultural, educational, and sociological diversity among students at "open-door" institutions, they enter with a wide range of backgrounds and skills in mathematics. Their understandings and skills in mathematics range from those students who are deficient in arithmetic to those who are ready to begin the study of calculus. In order for the "open-door" not to become a "revolving-door," it behooves mathematics departments to offer a number of different levels of introductory mathematics courses appropriate to the mathematical background of its entering students; a policy which is pursued at Chattanooga State Technical Community College as diagramed in Figure 1.

Students generally start their study of mathematics at Chattanooga State in either Basic Mathematics (MA 100), Fundamentals of Algebra (MA 105), Algebra and Trigonometry I (MA 115), College Algebra (MA 117), or Business Mathematics (MG 165). Basic Mathematics and Fundamentals of Algebra are developmental or remedial courses; whereas, Algebra and Trigonometry I, College Algebra, and Business Mathematics are beginning mathematics courses for career or transfer programs of the College. If a student is required in his program to take either MA 115 or MA 117 and needs remediation

in arithmetic, he would be recommended to start in MA 100, then proceed to MA 105 before entering either MA 115 or MA 117. Students needing remediation before entering MG 165 are recommended to take MA 100. On the other hand, if a student is deficient only in algebra, he would be recommended to start with MA 105 before taking either MA 115 or MA 117. Generally, if a person needs no remediation in mathematics, he would start in MA 115, MA 117, or MG 165, depending on his program of study at Chattanooga State. Some students who attend Chattanooga State are ready to start into Algebra and Trigonometry II or Calculus and Analytic Geometry I; however, these students are the exception and will not be considered in this study. It is important that students begin in the highest level course in which they have a high probability of completing successfully; consequently, an accurate prediction of grades for the appropriate beginning level course is necessary for proper placement. Determining those variables which are significant predictors of students grades and the corresponding prediction equations for each beginning level mathematics course at CSTCC is the essence of this study.

VIII. ORGANIZATION OF THE STUDY

Chapter I consisted of the statement of the problem, method, definition of terms, explanation of notation, limitations of the study, statistical treatment of data, and importance of the study. In Chapter II, the researcher

reviewed the literature of the topic. Chapter III presented a summary of the data, tables, and regression equations. In Chapter IV, the study is summarized, conclusions are stated, and implications for future research are recommended.

CHAPTER II

REVIEW OF THE LITERATURE

I. CHARACTERISTICS OF TWO-YEAR COMMUNITY COLLEGES

As stated in The Open-Door Colleges: Policies for Community Colleges (1970, p. 11):

The American community/junior college, as a relative newcomer to the higher education ranks, has only gradually defined its unique purposes and functions. Originally conceived to relieve the university's burden by concentrating on the first two years of a transfer program, the public two-year colleges have very slowly broadened their philosophical and operational bases. A second major function now includes a widespread commitment to vocational/technical education, with a third primary purpose including various continuing education and community service programs designed for the adult segment of the local community. Perhaps the last major community college function to be included has been a remedial or developmental educational role, whereby previously underdeveloped human resources are salvaged. These four functions constitute the essential components of a comprehensive community college.

In his description of the community college student, Roueche (1968, p. 453) observed:

Community college students are much more representative of a total population mentally, socially, and economically, and along with reports of increased heterogeneity come indications that an increasing proportion of full-time students in community colleges are low achievers.

Munday (1976) indicated that those students who were not eighteen to twenty-two years old, white, fulltime, from the upper half of their high school classes, and from middle- and

upper-class socioeconomic backgrounds would comprise the growth segment of higher education for the future.

According to the State Board of Regents for the State of Tennessee, any high school graduate or GED recipient is eligible for admission to public community colleges supported by the State of Tennessee. This open-admissions policy is characteristic of many public-supported community colleges throughout the United States. In The Open Door Colleges (1970, p. 11) the Carnegie Commission recommended that all states enact legislation to provide admission to public community colleges "to all applicants who are high school graduates or are persons over eighteen years of age who are capable of benefiting from continuing education." Kleinstein (1976) stated that open admissions was conceived as offering all New York City high school students a real opportunity for a college education. In particular, the City University of New York was not to become a "revolving door" flunking out a number of students roughly equal to the number of additional students that entered, and not to confer a "watered down" degree.

As a result of the heterogeneity of its students, mathematics departments throughout the United States are confronted with students who have wide age ranges and mathematical backgrounds varying from a deficiency in the multiplication of whole numbers to an understanding of the

elementary concepts of calculus. Coupled with these variations are different levels of reading ability, motivation and interest and a variety of levels of emotional and educational maturity. Beginning level mathematics courses in community colleges range from courses in arithmetic to calculus with a significant emphasis being placed on remedial courses. As indicated by Roueche (1968) of the 60,600 students enrolled in California public junior college mathematics classes in the fall of 1964, 75 percent were taking mathematics offered in the high school. Remediation is not inexpensive. Akst (1976) stated that the City University of New York spends \$35,000,000 per year for all remediation or developmental programs; English and math combined. After sampling 10,000 of the 440,000 students who took the ACT assessment in October and December 1973, Munday (1976) reported that of those nontraditional students with ACT scores less than twelve, 45 percent needed help in writing, 58 percent needed help in reading, and 86 percent needed help in mathematics. Also, more of the nontraditional students prefer the public, two-year college. Chattanooga State Technical Community College's Statement of Purpose and Objectives (CSTCC Catalog, 1979-80, p. 9) listed as an objective, "A series of developmental courses in mathematics, English, reading, and personal adjustment to enable students to overcome deficiencies in these areas."

Developmental courses in mathematics usually include arithmetic, elementary algebra and intermediate algebra. Other beginning level mathematics courses in most community colleges are college algebra, algebra and trigonometry, business mathematics, contemporary mathematics, mathematics for elementary school teachers, and calculus. Some students are required to take only one or two mathematics courses, such as contemporary mathematics or mathematics for elementary school teachers; whereas, others in the community college are required to take at least four quarters of mathematics usually terminating with either a five-quarter sequence of calculus, a two-quarter sequence of statistics, or some combination of those.

II. NEED FOR PREDICTION MODELS

Colleges, for a number of years, have recognized the need of placement of students in the beginning level mathematics courses best suited to their abilities. Precipitated by their students' lack of success in their initial mathematics courses, Seigle (1954, p. 577) stated:

Students have often been placed in courses or they have chosen them without knowledge of their fitness for these courses. Some of the students have chosen wisely, while others have failed or have withdrawn from the courses. The results at Washburn University, Topeka, Kansas, have not been entirely satisfactory, because a too large percent of those enrolling in mathematics courses either have failed or have withdrawn from the course.

In a series of studies, Wick (1965), Howlett (1969), Edwards (1972), Dahlke (1974), and Edwards (1976), all recognized the need for proper placement in a student's initial mathematics course in college. As indicated by Morgan (1970), 50 percent of the students enrolled in their initial mathematics course in 1966-67 at University Community and Technical College of the University of Toledo failed. As demonstrated by Wick (1965), Seigle (1954), and others, the use of multiple regression techniques for predicting success in college mathematics courses represents a considerable improvement over the use of single variable predictors.

III. INDEPENDENT VARIABLES

The criterion variable in all of the studies investigated was the final course grades of previous mathematics courses. The independent variables varied somewhat from study to study. Fenneman (1973) used in his study percentile rank in high school graduating class, high school grade point average, number of years of high school mathematics (algebra and beyond), high school mathematics grade point average, ACT mathematics score, ACT science score, ACT social science score, ACT English score, ACT composite score, Iowa Silent Reading Advance Test score, and Mathematics Attitude score. Based on the data available on each student, Howlett (1969), in his study of placement in mathematics for entering college

freshmen at Michigan Technological University, used various combinations of the following variables: Michigan Technological University Advanced Mathematics Placement Exam, Cooperative Algebra Test, Cooperative Trigonometry Test, Cooperative Reading score, ACT English score, ACT mathematics score, ACT composite score, SAT verbal score, SAT mathematics score, National Merit English score, National Merit Mathematics score, National Merit Selective score, and class rank. Morgan (1970), in his attempt to predict success in junior college mathematics, used the score on the Cooperative Mathematics Test, the number of years of high school mathematics, the mean grade point average in high school mathematics, and the student's age, in months beyond the seventeenth birthday, as the independent variables. At the university level, Seigle (1954) used at Washburn University the following independent variables: grades in analytic geometry, high school grade point average, semesters of high school mathematics, scores on Washburn Entrance Mathematics Tests, "Q" scores on the A.C.E. Psychological Test, "L" scores on the A.C.E. Psychological Test, total scores on the A.C.E. Psychological Test, reading comprehension score, mechanics of expression score, effectiveness of expression score, and total English score.

Misanchuk (1977), in his research on developing a model for predicting scholastic achievement, concluded there does

not seem to be any systematic or underlying theory or rationale to guide the selection of the various predictors. A number of studies such as Wich's (1965) and Howlett's (1969) would tend to indicate the independent variables considered for the prediction equation were selected, primarily, because of the availability of data for those variables. However, other studies would tend to indicate that careful consideration was given to the selection of potential predictors of success in mathematics. Wampler (1966) chose variables that would possibly measure a range of aptitude factors such as induction, number facility, general reasoning, syllogistic reasoning, verbal comprehension, spatial orientation, and visualization. The initial domain of potential predictor variables for Edwards' (1972) study included such variables as reading, mathematics interest, high school average, work status while attending college, number of class hours for which registered, mathematics achievement, and sex. Since the community college population, in many cases, is considered different from either the university or the four-year college, the variables used for predicting success in initial mathematics courses have been somewhat different. In attempting to differentiate between low-achievers and high-achievers in mathematics in selected east Texas community colleges, Pearce (1976) investigated such variables as self-concept, math attitude,

academic motivation, age, family income, race, and sex. Visor (1975), in his study of predictors of success in the general curriculum programmed mathematics basic arithmetic courses at Forest Park Community College in St. Louis, in addition to other commonly considered variables, investigated vocational choice and length of time since receiving high school diploma or GED certificate. Dahlke (1974), in his investigation of the best predictors of success in an individualized course in arithmetic as a community college, considered, among others, such variables as years of pre-college schooling, previous and present hours of enrollment at the college, reasons for enrolling in the course, study methods, motivation for studying, attitudes toward scholastic activities important to the classroom, and opinions toward arithmetic.

IV. MEASUREMENT INSTRUMENTS USED BY CATEGORIES OF INDEPENDENT VARIABLES

In attempting to predict success in college mathematics by measuring various characteristics of college students, some of the categories and instruments used were:

<u>Category</u>	<u>Instrument</u>
1. Achievement	1a. American College Test (ACT)
	b. Scholastic Aptitude Test (SAT)
	c. Stanford Achievement Test

- d. CEEB Comparative Guidance and Placement (CGP)
 - e. Cooperative Mathematics Test
 - f. Scholarship Qualifying Test (National Merit)
 - g. Iowa Mathematical Aptitude Test
 - h. American Council on Education Psychological Examination for College Freshmen (ACE)
 - i. The Cooperative School and College Ability Test: Series II (SCAT)
2. Math Attitude
- 2a. Math Attitude Scale by Aiken and Dregor
 - b. Thurston Scale
 - c. Dutton Test
3. Self-Concept
- 3a. Tennessee Self-Concept
 - b. CGP
 - c. The Thorndike Dimensions of Temperament (TDOT)
4. Motivation
- 4a. CGP
 - b. Study of Values Scale
5. Reading
- 5a. Nelson-Denny Reading Test
 - b. Gates Reading Survey
 - c. CGP
 - d. Cooperative Reading Test

e. ACE (Reading portions) English
Test

V. BEST PREDICTORS

In the extensive study conducted to predict success in mathematics courses for students at Washburn University, data were gathered on 1205 students between 1945 and 1949. As reported by Seigle (1954), the Washburn Entrance Mathematics Test was the single best predictor of success in college algebra. The second best indicator was the student's high school grade point average. Together, these two variables accounted for 64 percent of the explained variance. The other variables in the multiple prediction equation were the number of units of high school mathematics a student had taken and two components of the American Council of Education Psychological Test; however, these variables accounted for only an additional 3 percent of the explained variance. Based on the split-half technique of the Spearman-Brown Prophecy formula, the reliability of the Washburn Entrance Mathematics Test was 0.953.

Wick (1965) found that the high school mathematics record along with the high school rank were consistently the source of the best predictors of success in first-year college mathematics. In his study, the correlations were 0.59 and 0.51, respectively. He also concluded that multiple

regression techniques for predicting success represented a considerable improvement over the use of single predictor variables.

At the University Community and Technical College of the University of Toledo, Morgan (1970) found, in order of importance, the best predictors to be the Cooperative Mathematics Test, high school grades in mathematics, years of high school mathematics, and age. The biserial correlation coefficient using all four variables was 0.65. This correlation was significant at the 1 percent level. Using the discriminant function analysis, the resulting equation was found to be accurate in 90 percent of its predictions.

In a study of 359 remedial students enrolled in six public community colleges in Connecticut and one in Massachusetts, Edwards (1972) found that using the high school grade point average, CGP Mathematics Test score, Dutton's Attitude Scale on Mathematics, CGP Sentence Test score, and CGP Mathematics Interest score, predictions of success in remedial mathematics could be made 71 percent of the time. These five variables accounted for 33 percent of the explained variance.

Based on the studies of Corotto (1963) and Seigle (1954), aptitude tests and achievement tests designed to measure specific content areas appear to provide greater predictive accuracy of success in mathematics than do tests of general intelligence or abilities. At the University of Houston,

Corotto found significant correlations between the quantitative portion of the ACE Test and a remedial algebra course and between the Mathematics Screening Test developed at the University of Houston and a college algebra course at the 1 percent level of significance.

Remedial courses in arithmetic are common at the community college level. These courses include such topics as operations with whole numbers, common fractions, decimal fractions, and percent. As a result of the wide range of abilities and the variety of reasons for students taking this course, it is generally a self-paced course. In this format, not only is predicting for success important, but it is also significant to predict the time for completion or dropout for the beginning student. Dahlke (1974) performed a study at Washburn Community College, Ann Arbor, Michigan, for a three-credit arithmetic course in which he established predictions equations for the final grade in the course, time of completion, and time of dropout. The student's precourse achievement in arithmetic, indicated by his Computation Test score, was the best predictor of success and the third best predictor of the time of completion. The reasons as to why students enrolled in the arithmetic course played an important role in predicting success and time of completion or dropout. In fact, of the eleven significant predictors identified in the study, seven pertained to reasons for enrolling in the course

and at least one "reasons for enrolling" variable belonged to each of the three sets of significant predictors. Also, age was significant in predicting the final grade in the arithmetic course.

Typically, most colleges have used intellectual variables to predict success for entering students; however, many consider the community college student today to be a "new" type of student who does not fit into the more traditional mold of the typical college student. Pearce (1976) defined, in his study, low-achievers in mathematics as students entering the community college with an ACT mathematics score of twelve or less, a high school grade average of less than C, or a combination of the two. Using the Tennessee Self-Concept Scale, the Math Attitude Scale, and the motivational portion of the Comparative Guidance and Placement Battery, he found that low-achievers in mathematics had significantly lower self-concepts, poorer attitudes towards mathematics, less academic motivation in mathematics, lower achievement profiles, and lower family incomes than average or better mathematics students. He also concluded that black college freshmen are more likely to be low-achievers in mathematics than white college freshmen. Visor (1975) conducted a similar study at Forest Park Community College in St. Louis, Missouri. He examined the relationship of selected predictor variables and the success of students

in a programmed basic arithmetic course that took place in a mathematics lab. On the basis of data from 151 day students and 41 evening students, he found that the single best predictor for day students was their pretest score on the diagnostic test, while the single best predictor for evening students was whether or not a vocational choice had been made. In a stepwise regression analysis, the first five variables selected, when both day and evening students were combined, were the arithmetic pretest score, age, vocational choice, length of time since receiving high school diploma or GED certificate, and percentile rank on an admissions test.

Some community colleges offer a remedial course in algebra in both the individualized format and the lecture format. The individualized format has the advantage of allowing students more than one quarter or semester to complete the course. However, most mathematics departments and students wish to minimize the time spent in remedial courses; consequently, it is important to be able to distinguish between those students who should take the lecture course and those who should take the individualized course. Cole (1976) conducted a study at Davidson County Community College, North Carolina, in which he attempted to determine those students taking developmental algebra that could complete successfully the individualized algebra in one quarter; those predicted more likely not to succeed were

placed in the lecture sections. Using a stepwise discriminate function analysis on a sample of 147 students, he found the significant predictors from the CEEB Comparative Guidance and Placement Test to be Sentence Ability, Mosaic Comparisons, Academic Motivation, Reading Ability, Secretarial Interest and Home Economics Interest. Using these variables between the Fall of 1973 and the Spring of 1975, the correct classification of students to either the individualized course or the lecture course was made 70.7 percent of the time. During the Fall of 1975, using the discriminate functions to predict success or nonsuccess of students enrolling in development algebra, 17 percent more of the students were able to complete the course successfully in one quarter than in the previous data-based group.

VI. SUMMARY

Because of the variety of backgrounds, abilities, and attitudes of college students in mathematics, especially two-year community college students, the need for proper placement in their initial mathematics course is apparent.

As illustrated by a number of studies, the use of multiple regression techniques for predicting success in college mathematics courses represents a considerable improvement over the use of single variable predictors. The variables tested for inclusion in the multiple regression

model seem to be highly individualized by college. Most of the multiple regression models used variables which attempted to measure some combination of such areas as achievement in mathematics, attitude toward mathematics, self-concept, motivation and reading ability.

In general, aptitude tests and achievement tests designed to measure specific content areas in mathematics seem to provide greater predictive accuracy of success than most other variables studies. In many cases an achievement or diagnostic test in mathematics developed for a particular college, especially a two-year college, was a better predictor of success in mathematics than a national, standardized exam developed for placement purposes.

CHAPTER III

PRESENTATION OF THE FINDINGS

The purpose of this chapter is to summarize the methods of analyzing the data and to present the results of those analyses. For each course, MA 100, MA 105, MA 115, MA 117, and MG 165, the following analyses will be presented: an analysis of means, standard deviations, and ranges for all variables; an analysis of correlations between all variables; a stepwise regression analysis; and an analysis of the residuals for group III of MA 105 for the Spring Quarter 1979. The dependent variable for each course was the final numerical grade for the course. The independent variables were assigned to groups (Table II) and the groups were assigned to the five initial mathematics courses (Table III).

The study was conducted in the Fall Quarter 1978, and there was a total participation of 388 students. A follow-up study to examine the residuals between the observed final grades in each course and the predicted final grades was scheduled for the Spring Quarter 1979; however, the only group to have an adequate sample size of first quarter mathematics students at Chattanooga State was group III of MA 105.

TABLE II
IDENTIFICATION OF GROUPS BY
INDEPENDENT VARIABLES

Group	Variables
I	$X_1, X_2, X_3, X_6, X_8, X_9, X_{10}, \text{ and } X_{11}$
II	$X_1, X_2, X_3, X_4, X_5, \text{ and } X_{11}$
III	$X_6, X_8, X_9, X_{10}, \text{ and } X_{11}$
IV	$X_4, X_5, \text{ and } X_{11}$
V	$X_1, X_2, X_3, X_7, X_8, X_9, X_{10}, \text{ and } X_{11}$
VI	$X_7, X_8, X_9, X_{10}, \text{ and } X_{11}$

TABLE III
COURSES, GROUPS, AND SAMPLE SIZES FOR INITIAL
MATHEMATICS COURSES AT CHATTANOOGA STATE,
FALL QUARTER 1978

Courses	Groups	Sample Size
MA 100	I	5
	II	5
	III	24
	IV	5
	V	2
	VI	8
MA 105	I	20
	II	21
	III	68
	IV	33
MA 115	I	11
	II	25
	III	30
	IV	37
MA 117	I	4
	II	8
	III	26
	IV	14
MG 165	I	6
	II	2
	IV	6
	VI	28

I. BASIC MATHEMATICS, MA 100

The mean, standard deviation, and range for each variable are presented in Table IV. The correlation matrix for all variables is presented in Table V. Group III was the only group analyzed by the stepwise regression procedure; however, at the 5 percent level of significance, no significant prediction equations resulted. Due to inadequate sample sizes, groups I, II, IV, V, and VI were excluded from the stepwise regression study in MA 100 (Table III).

II. FUNDAMENTALS OF ALGEBRA, MA 105

The mean, standard deviation, and range for each variable are presented in Table VI. The correlation matrix for all variables is presented in Table VII. The stepwise regression analysis by group is presented in Tables VIII through XV. All four groups—I, II, III, and IV—were analyzed by the stepwise regression procedure and used the 0.05 significance level as the criteria on the partial-F test for entrance of a variable into the prediction equation. Table XVI provides an analysis of the residuals between the observed and predicted grades for group III of MA 105 for Spring Quarter 1979. Table XVII provides an analysis of the residual between the observed and predicted grades for group III, using only variables X_6 and X_8 . Figure 2 presents a graphical means of predicting final grades for group III of

TABLE IV
MEANS, STANDARD DEVIATIONS, AND RANGES BY
VARIABLES FOR MA 100

Variable	Sample Size	Mean	Standard Deviation	Minimum	Maximum
Y	38	86.97	7.94	65.00	98.00
X ₁	14	0.49	0.29	0.07	0.95
X ₂	9	2.29	0.44	1.38	2.82
X ₃	18	1.56	0.62	1.00	3.00
X ₄	5	10.60	2.19	8.00	14.00
X ₅	5	7.80	2.17	5.00	10.00
X ₆	21	10.10	3.16	4.00	19.00
X ₇	8	16.13	3.31	12.00	21.00
X ₈	29	10.96	2.53	6.00	15.00
X ₉	29	10.37	2.49	6.30	15.00
X ₁₀	29	11.30	2.73	7.30	15.00
X ₁₁	34	26.76	10.82	17.00	50.00

TABLE V
INTERCORRELATIONS AND SAMPLE SIZE OF THE INDEPENDENT VARIABLES AND
CRITERION VARIABLE FOR THE TOTAL SAMPLE FOR MA 100

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}
Y	-0.23 14	0.51 9	0.57* 18	0.63 5	-0.08 5	0.38 21	0.27 8	0.44* 29	0.22 29	0.49** 29	0.34* 34
x_1		-0.86* 9	-0.31 13	-0.63 5	-0.86 5	0.06 8	0.00 1	0.45 9	0.63 9	-0.13 9	-0.41 12
x_2			0.71* 8	0.72 5	0.55 5	0.99 3	0.00 1	-0.25 4	-0.29 4	-0.07 4	0.00 7
x_3				0.67 5	0.13 5	0.34 11	0.00 1	-0.50 12	-0.62* 12	-0.15 12	0.12 15
x_4					0.72 5	0.00 1	0 0	0.00 1	0.00 1	0.00 1	0.94 4
x_5						0.00 1	0 0	0.00 1	0.00 1	0.00 1	0.95* 4
x_6							0 0	0.19 21	0.23 21	0.05 21	0.12 19
x_7								0.49 8	0.54 8	0.37 8	-0.04 8
x_8									0.75** 21	0.86** 29	0.15 27
x_9										0.35 29	-0.26 27
x_{10}											0.37 27

**Significant at the 0.01 level.

*Significant at the 0.05 level.

TABLE VI
MEANS, STANDARD DEVIATIONS, AND RANGES BY
VARIABLES FOR MA 105

Variable	Sample Size	Mean	Standard Deviation	Minimum	Maximum
Y	112	81.36	15.52	12.00	99.00
X ₁	55	0.54	0.22	0.09	0.98
X ₂	44	2.41	0.53	1.26	3.53
X ₃	63	2.19	0.78	1.00	4.00
X ₄	33	13.83	4.50	6.00	21.00
X ₅	33	11.21	4.70	1.00	22.00
X ₆	98	18.52	5.17	5.00	31.00
X ₇	0	0	0	0	0
X ₈	69	12.60	2.42	6.00	15.00
X ₉	69	12.04	2.66	6.00	15.00
X ₁₀	69	13.07	2.20	7.30	15.00
X ₁₁	112	24.08	7.77	17.00	49.00

TABLE VII

INTERCORRELATIONS AND SAMPLE SIZE OF THE INDEPENDENT VARIABLES AND
CRITERION VARIABLE FOR THE TOTAL SAMPLE FOR MA 105

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}
Y	-0.24 55	0.22 44	0.25* 63	0.47** 33	0.22 33	0.58** 98	0	0.44** 69	0.45** 69	0.27* 69	0.15 112
x_1		-0.88** 42	-0.17 52	0.02 26	-0.13 26	-0.40** 46	0	-0.17 31	-0.22 31	-0.05 31	0.24 55
x_2			0.02 42	-0.01 23	0.24 23	0.30 36	0	-0.07 22	-0.04 22	-0.09 22	-0.21 44
x_3				0.49* 25	0.46* 25	0.10 53	0	0.26 39	0.19 39	0.20 39	0.00 63
x_4					0.64** 33	0.46* 21	0	0.62 6	0.38 6	0.78 6	0.35* 33
x_5						0.26 21	0	-0.10 6	-0.37 6	0.18 6	0.08 33
x_6							0	0.13 68	0.16 68	0.10 68	-0.12 98
x_7								0	0	0	0
x_8									0.91** 69	0.89** 69	0.26* 69
x_9										0.67** 69	0.25* 69
x_{10}											0.24* 69

**Significant at the 0.01 level.

*Significant at the 0.05 level.

TABLE VIII
STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP I VARIABLES, FUNDAMENTALS
OF ALGEBRA, MA 105

Step	Equations	F	R	R ²
I	$Y = 26.58 + 290X_6$	10.72**	0.61	0.37
II	$Y = 10.30 + 10.23X_3 + 2.65X_6$	9.63**	0.73	0.53

**Significant at the 0.01 level.

TABLE IX

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
EQUATIONS FROM GROUP I VARIABLES, FUNDAMENTALS
OF ALGEBRA, MA 105

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	2.8991 (x_6)	0.8855	10.72	0.0042
II	2.6479 (x_6)	0.7950	11.09	0.0040
	10.2275 (x_3)	4.2730	5.73	0.0285

TABLE X
STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP II VARIABLES, FUNDAMENTALS
OF ALGEBRA, MA 105

Step	Equations	F	R	R ²
I	$Y = 38.76 + 2.92X_4$	10.55**	0.597	0.357
II	$Y = 2.61 + 14.22X_2 + 3.00X_4$	7.82**	0.682	0.465
III	$Y = -100.94 + 26.49X_2 + 2.82X_4 + 3.92X_{11}$	7.21**	0.748	0.560

**Significant at the 0.01 level.

TABLE XI

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
EQUATIONS FROM GROUP II VARIABLES, FUNDAMENTALS
OF ALGEBRA, MA 105

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	2.9222 (x_4)	0.8996	10.55	0.0042
II	2.9962 (x_4)	0.8440	12.60	0.0023
	14.2195 (x_2)	7.4612	3.63	0.0728
III	2.8215 (x_4)	0.7929	12.66	0.0024
	26.4851 (x_2)	9.4596	7.84	0.0123
	3.9196 (x_{11})	2.0463	3.67	0.0724

TABLE XII
STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP III VARIABLES, FUNDAMENTALS
OF ALGEBRA, MA 105

Step	Equations	F	R	R ²
I	$Y = 48.70 + 1.88X_6$	27.27**	0.540	0.292
II	$Y = 20.65 + 1.71X_6 + 2.48X_8$	26.00**	0.667	0.444
III	$Y = 32.87 + 1.69X_6 + 5.84X_8 - 4.14X_{10}$	22.92**	0.720	0.518

**Significant at the 0.01 level.

TABLE XIII

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
EQUATIONS FROM GROUP III VARIABLES, FUNDAMENTALS
OF ALGEBRA, MA 105

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	1.8825 (X_6)	0.3605	27.27	0.0001
II	1.7088 (X_6)	0.3245	27.73	0.0001
	2.4775 (X_8)	0.5873	17.79	0.0001
III	1.6860 (X_6)	0.3047	30.62	0.0001
	5.8355 (X_8)	1.2080	23.34	0.0001
	-4.1416 (X_{10})	1.3256	9.76	0.0027

TABLE XIV
STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP IV VARIABLES, FUNDAMENTALS
OF ALGEBRA, MA 105

Step	Equation	F	R	R ²
I	$Y = 53.34 + 1.89X_4$	8.83**	0.47	0.22

**Significant at the 0.01 level.

TABLE XV

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
EQUATIONS FROM GROUP IV VARIABLES, FUNDAMENTALS
OF ALGEBRA, MA 105

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	1.8920	0.6366	8.83	0.0057

TABLE XVI
EXAMINATION OF RESIDUALS, GROUP III, MA 105
SPRING QUARTER 1979

Observation Number	Observed Value	Predicted Value	Residual
1	94	92.17	1.82
2	70	82.29	-12.29
3	94	83.72	10.28
4	75	69.13	5.87
5	81	78.80	2.20
6	88	85.41	2.59
7	98	85.41	12.59
8	87	70.63	16.37
9	80	90.48	-10.48
10	82	75.45	6.55
11	80	80.71	- 0.71
12	93	78.34	14.66
13	91	86.97	4.03
14	99	95.55	4.45
15	91	95.55	- 3.45
16	95	90.72	4.28
17	96	80.34	15.66
18	73	75.34	- 2.34
19	91	91.40	- 0.40
20	78	80.34	- 2.34
21	80	88.79	- 8.79
22	91	98.93	- 7.07
23	85	75.61	9.39
24	87	74.42	13.58

Mean of residuals is 3.19.

Standard deviation of residuals is 8.29.

TABLE XVII

EXAMINATION OF RESIDUALS, GROUP III,¹ VARIABLES X_6
AND X_8 ONLY, MA 105, SPRING QUARTER 1979

Observation Number	Observed Value	Predicted Value	Residual
1	94	92.05	1.95
2	70	82.48	-12.48
3	94	83.50	10.50
4	75	64.78	10.22
5	81	80.67	0.31
6	88	85.21	2.79
7	98	85.21	12.79
8	87	64.40	13.60
9	80	90.34	-10.34
10	82	75.37	6.63
11	80	81.22	- 1.22
12	93	79.28	13.72
13	91	84.47	6.53
14	99	95.47	3.53
15	91	98.89	- 7.89
16	95	90.09	4.91
17	96	80.08	15.92
18	73	73.38	- 0.38
19	91	86.59	4.41
20	78	80.08	- 2.08
21	80	88.63	- 8.63
22	91	98.89	- 7.89
23	85	79.06	5.94
24	87	77.32	9.68

Mean of residuals is 3.02

Standard deviation of residuals is 8.17.

$$^1Y = 20.65 + 1.71X_6 + 2.48X_8.$$

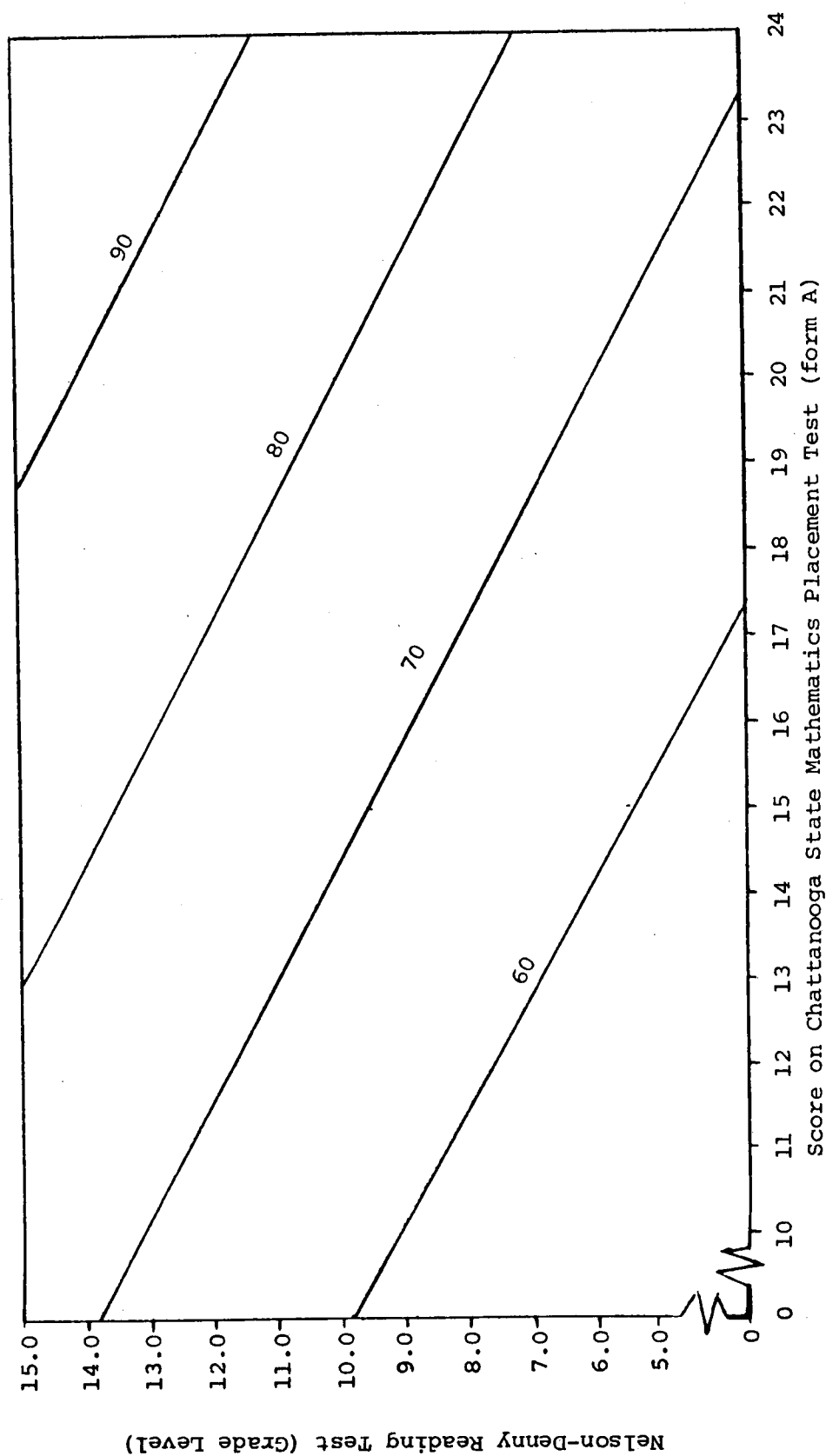


Figure 2. Prediction of grades¹ from group III, MA 105.

$$^1Y = 20.65 + 1.71X_6 + 2.48X_8.$$

MA 105, using variables X_6 and X_8 . The sample sizes for the Spring Quarter 1979 for groups I, II, and IV of MA 105 were too small to study the residuals of those groups.

III. ALGEBRA AND TRIGONOMETRY I, MA 115

The mean, standard deviation, and range for each variable are presented in Table XVIII. The correlation matrix for all variables is presented in Table XIX. The stepwise regression analysis by group is presented in Tables XX through XXVII. All four groups—I, II, III, and IV—were analyzed by the stepwise regression procedure.

IV. COLLEGE ALGEBRA, MA 117

The mean, standard deviation, and range for each variable are presented in Table XXVIII. The correlation matrix for all variables is presented in Table XXIX. The stepwise regression analysis by group is presented in Tables XXX through XXXIII. Due to inadequate sample sizes, groups I and II were excluded from the study (Table III, page 34). Groups III and IV were the only groups to be analyzed by the stepwise regression procedure.

V. BUSINESS MATHEMATICS, MG 165

The mean, standard deviation, and range for each variable are presented in Table XXXIV. The correlation

TABLE XVIII
MEANS, STANDARD DEVIATIONS, AND RANGES BY
VARIABLES FOR MA 115

Variable	Sample Size	Mean	Standard Deviation	Minimum	Maximum
Y	95	82.12	15.88	11.00	100.00
X ₁	45	0.37	0.25	0.03	0.93
X ₂	45	2.83	0.61	1.17	3.86
X ₃	52	2.58	0.94	1.00	5.00
X ₄	37	18.22	4.06	9.00	25.00
X ₅	37	18.05	5.35	2.00	28.00
X ₆	92	24.43	5.72	12.00	36.00
X ₇	0	0	0	0	0
X ₈	30	12.97	2.33	6.00	15.00
X ₉	30	12.48	2.54	6.00	15.00
X ₁₀	30	13.01	2.31	7.10	15.00
X ₁₁	95	23.79	8.50	18.00	81.00

TABLE XIX

INTERCORRELATIONS AND SAMPLE SIZE OF THE INDEPENDENT VARIABLES AND
CRITERION VARIABLE FOR THE TOTAL SAMPLE FOR MA 115

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}
Y	-0.11 45	0.43** 45	-0.04 52	0.43* 37	0.55** 37	0.61** 92	0	0.43* 30	0.53** 30	0.33 30	0.01 95
x_1		-0.78** 39	0.12 43	-0.52* 28	-0.26 28	-0.32* 43	0	-0.57* 14	-0.37 14	-0.58* 14	0.05 45
x_2			-0.18 40	0.58** 30	0.40* 30	0.46** 43	0	0.51 12	0.60* 12	0.31 12	-0.15 45
x_3				0.00 30	0.10 30	0.00 50	0	-0.22 19	-0.22 19	-0.11 19	0.03 52
x_4					0.66** 37	0.43* 34	0	0.72 6	0.50 6	0.59 6	-0.04 37
x_5						0.58** 34	0	0.52 6	0.49 6	0.42 6	-0.19 37
x_6							0	0.63** 30	0.71** 30	0.51** 30	0.00 92
x_7								0	0	0	0
x_8									0.84** 30	0.92** 30	0.21 30
x_9										0.62** 30	0.08 30
x_{10}											0.27 30

**Significant at the 0.01 level.

*Significant at the 0.05 level.

TABLE XX
STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP I VARIABLES, ALGEBRA AND
TRIGONOMETRY I, MA 115

Step	Equations	F	R	R ²
I	$Y = 10.07 + 2.64 X_6$	13.59**	0.776	0.602
II	$Y = -6.65 + 28.53X_1 + 2.96X_6$	14.66**	0.886	0.786
III	$Y = 5.43 + 28.16X_1 + 2.93X_6 - 0.49X_{11}$	19.00**	0.944	0.891

**Significant at the 0.01 level.

TABLE XXI

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
EQUATIONS FROM GROUP I VARIABLES, ALGEBRA AND
TRIGONOMETRY I, MA 115

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	2.6389 (x_6)	0.7157	13.59	0.0050
II	2.9635 (x_6)	0.5706	26.98	0.0008
	28.5350 (x_1)	10.8916	6.86	0.0307
III	2.9336 (x_6)	0.4358	45.32	0.0003
	28.1560 (x_1)	8.3172	11.46	0.0117
	-0.4950 (x_{11})	0.1909	6.72	0.0358

TABLE XXII
STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP II VARIABLES, ALGEBRA AND
TRIGONOMETRY I, MA 115

Step	Equations	F	R	R ²
I	$Y = 66.67 + 1.08X_5$	15.53**	0.635	0.403
II	$Y = 82.95 + 0.88X_5 - 0.60X_{11}$	15.49**	0.765	0.585
III	$Y = 75.75 + 3.39X_3 + 0.83X_5 - 0.65X_{11}$	15.47**	0.830	0.688

**Significant at the 0.01 level.

TABLE XXIII

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
EQUATIONS FROM GROUP II VARIABLES, ALGEBRA AND
TRIGONOMETRY I, MA 115

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	1.0819 (X_5)	0.2746	15.53	0.0007
II	0.8802 (X_5)	0.2430	13.12	0.0015
	-0.5960 (X_{11})	0.1920	9.63	0.0052
III	0.8265 (X_5)	0.2164	14.59	0.0010
	-0.6469 (X_{11})	0.1713	14.25	0.0011
	3.3895 (X_3)	1.2826	6.98	0.0152

TABLE XXIV
STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP III VARIABLES, ALGEBRA AND
TRIGONOMETRY I, MA 115

Step	Equation	F	R	R ²
	$Y = 30.71 + 2.07X_6$	20.79**	0.653	0.426

**Significant at the 0.01 level.

TABLE XXV

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
EQUATIONS FROM GROUP III VARIABLES, ALGEBRA AND
TRIGONOMETRY I, MA 115

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	2.0725 (x_6)	0.4546	20.79	0.0001

TABLE XXVI

STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP IV VARIABLES, ALGEBRA AND
TRIGONOMETRY I, MA 115

Step	Equation	F	R	R ²
	$Y = 64.46 + 1.17X_5$	14.94**	0.547	0.299

**Significant at the 0.01 level.

TABLE XXVII

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
 EQUATIONS FROM GROUP IV VARIABLES, ALGEBRA AND
 TRIGONOMETRY I, MA 115

Step	Coefficient	Standard Error	Partial F-Test	Probable F
I	1.1677 (x_5)	0.3021	14.94	0.0005

TABLE XXVIII
MEANS, STANDARD DEVIATIONS, AND RANGES BY
VARIABLES FOR MA 117

Variable	Sample Size	Mean	Standard Deviation	Minimum	Maximum
Y	54	78.81	14.50	40.00	98.00
X ₁	22	0.40	0.27	0.03	0.92
X ₂	13	2.89	0.65	1.32	3.80
X ₃	26	2.62	0.80	1.00	4.00
X ₄	14	16.86	4.04	13.00	23.00
X ₅	14	16.00	5.56	5.00	28.00
X ₆	46	23.11	6.52	8.00	34.00
X ₇	0	0	0	0	0
X ₈	26	13.22	2.33	7.70	15.00
X ₉	26	12.74	2.30	7.00	15.00
X ₁₀	26	13.29	2.44	8.60	15.00
X ₁₁	54	24.54	8.81	18.00	54.00

TABLE XXIX

INTERCORRELATIONS AND SAMPLE SIZE OF THE INDEPENDENT VARIABLES AND
CRITERION VARIABLE FOR THE TOTAL SAMPLE FOR MA 117

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}
Y	-0.60** 22	0.59* 13	0.15 26	0.36 14	0.60* 14	0.62** 46		0.31 26	0.22 26	0.45* 26	0.25 54
x_1		-0.98** 12	-0.16 19	-0.80** 11	-0.51 11	-0.59* 19	0	-0.32 10	-0.23 10	-0.44 10	-0.07 22
x_2			0.35 12	0.56 8	0.52 8	0.53 11	0	0.46 4	0.89 4	0.21 4	-0.58* 13
x_3				0.46 11	0.77* 11	0.24 23	0	-0.16 12	-0.07 12	-0.15 12	-0.06 26
x_4					0.64* 14	0.29 11	0	0.00 2	0.00 2	0.00 2	-0.26 14
x_5						0.79** 11	0	1.00 2	1.00 2	-1.00 2	-0.14 14
x_6							0	0.15 26	0.09 26	0.16 26	0.02 46
x_7								0	0	0	0
x_8									0.84** 26	0.88** 26	0.50* 26
x_9										0.61** 26	0.41* 26
x_{10}											0.46* 26

**Significant at the 0.01 level.

*Significant at the 0.05 level.

TABLE XXX
 STEPWISE PREDICTION EQUATIONS FOR PREDICTING
 GRADES FROM GROUP III VARIABLES,
 COLLEGE ALGEBRA, MA 117

Step	Equations	F	R	R ²
I	$Y = 51.79 + 1.14X_6$	8.41**	0.509	0.259
II	$Y = 23.59 + 1.01X_6 + 2.35X_{10}$	7.52**	0.629	0.395

**Significant at the 0.01 level.

TABLE XXXI

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
 EQUATIONS FROM GROUP III VARIABLES,
 COLLEGE ALGEBRA, MA 117

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	1.1417 (x_6)	0.3938	8.41	0.0079
II	1.0082 (x_6)	0.3681	7.50	0.0117
	2.3520 (x_{10})	1.0346	5.17	0.0327

TABLE XXXII
STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP IV VARIABLES,
COLLEGE ALGEBRA, MA 117

Step	Equations	F	R	R ²
I	$Y = 55.12 + 1.34X_5$	6.63*	0.596	0.356

*Significant at the 0.05 level.

TABLE XXXIII

B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
EQUATIONS FROM GROUP IV VARIABLES,
COLLEGE ALGEBRA, MA 117

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	1.3408 (X_5)	0.5209	6.63	0.0244

TABLE XXXIV
MEANS, STANDARD DEVIATIONS, AND RANGES BY
VARIABLES FOR MG 165

Variable	Sample Size	Mean	Standard Deviation	Minimum	Maximum
Y	58	87.09	12.12	45.00	100.00
X ₁	19	0.42	0.23	0.09	0.83
X ₂	13	2.76	0.56	1.65	3.41
X ₃	27	2.15	0.95	1.00	4.00
X ₄	6	14.17	4.45	9.00	22.00
X ₅	6	13.33	7.87	6.00	28.00
X ₆	0	0	0	0	0
X ₇	43	25.37	6.06	10.00	35.00
X ₈	28	11.93	2.76	6.00	15.00
X ₉	28	11.30	2.71	6.00	15.00
X ₁₀	28	12.30	2.62	6.80	15.00
X ₁₁	58	25.79	8.60	18.00	47.00

matrix for all variables is presented in Table XXXV. The stepwise regression analysis by group is presented in Tables XXXVI through XXXVII. Due to inadequate sample sizes, groups I, II, and IV were excluded from the study (Table III, page 34). Group IV was the only group to be analyzed by the stepwise regression procedure.

VII. SUMMARY

For each of the beginning level mathematics courses, MA 1-0, MA 105, MA 115, MA 117, and MG 165, for the Fall Quarter 1978, the following analyses were presented in this chapter: an analysis of means, standard deviations, and ranges for all variables; an analysis of correlations between all variables; a stepwise regression analysis; and an analysis of residuals for group III of MA 105 for the Spring Quarter 1979.

TABLE XXXV
INTERCORRELATIONS AND SAMPLE SIZE OF THE INDEPENDENT VARIABLES AND
CRITERION VARIABLE FOR THE TOTAL SAMPLE FOR MG 165

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁
Y	0.07 19	0.37 13	-0.24 27	0.06 6	-0.14 6		0.44** 43	0.30 28	0.15 28	0.30 28	0.06 58
X ₁		-0.86** 12	0.17 19	-0.99* 4	-0.97* 4	0	0.21 15	-0.59 10	-0.37 10	-0.50 10	0.32 19
X ₂			-0.18 13	1.00 2	1.00 2	0	0.11 10	0.69 7	0.71 7	0.64 7	-0.51 13
X ₃				0.57 5	0.61 5	0	0.27 21	-0.34 13	-0.21 13	-0.65* 13	-0.01 27
X ₄					0.95** 6	0	0.62 4	0	0	0	-0.28 6
X ₅						0	0.55 4	0	0	0	-0.13 6
X ₆							0	0	0	0	0
X ₇								0.26 28	0.06 28	0.28 28	0.14 43
X ₈									0.92** 28	0.87** 28	0.30 28
X ₉										0.73** 28	0.07 28
X ₁₀											0.22 28

**Significant at the 0.01 level.

*Significant at the 0.05 level.

TABLE XXXVI

STEPWISE PREDICTION EQUATIONS FOR PREDICTING
GRADES FROM GROUP VI VARIABLES,
BUSINESS MATHEMATICS, MG 165

Step	Equation	F	R	R ²
I	$Y = 69.31 + 0.82X_7$	12.11**	0.564	0.318

**Significant at the 0.01 level.

TABLE XXXVII
B COEFFICIENTS AND STANDARD ERROR FOR PREDICTION
EQUATIONS FROM GROUP VI VARIABLES,
BUSINESS MATHEMATICS, MG 165

Step	Coefficients	Standard Error	Partial F-Test	Probable F
I	0.8168 (x_7)	0.2347	12.11	0.0018

CHAPTER IV

SUMMARY AND CONCLUSIONS

As a result of the "open-door" policy of most community colleges and many colleges and universities, there is usually a high attrition rate in many beginning level mathematics courses. Consequently, it is important to identify those variables which correlate significantly with a person's final grade in his initial mathematics course. The subsequent inclusion of those variables in a prediction equation has the potential of providing valuable information for the proper placement of a student in his beginning mathematics course. As a result of the particular needs of communities, the course offerings and the sequence of those offerings tend to differ, somewhat, for each community college. As a result of this uniqueness, the purpose of this study was to determine prediction of grades equations for each of the beginning level mathematics courses at Chattanooga State Technical Community College.

I. SUMMARY OF THE STUDY

Based on admissions application information required of all degree-seeking students entering Chattanooga State, at least one prediction equation was developed for each beginning level mathematics course, with the exception of MA 100. Since

not all application information is known on a student when he enters, potential prediction equations were based on different sets of available information. The only variable to correlate significantly, at the 1 percent level, with the final grade in MA 100 was the vocabulary portion of the Nelson-Denny Reading Test, $r = 0.49$. Using the 0.05 level on the partial F-test for the stepwise regression technique, as the entry level for new variables, no prediction equation resulted for MA 100.

The individual variables with the highest significant correlations at the 1 percent level, with the final grade in MA 105, were the Chattanooga State Mathematics Placement Test (form A), $r = 0.58$; the ACT Composite Score, $r = 0.47$; score on the comprehension portion of the Nelson-Denny Reading Test, $r = 0.45$; and the total score on the Nelson-Denny Reading Test, $r = 0.44$. The final prediction equations developed for MA 105 were:

$$(1) Y = 10.30 + 10.23X_3 + 2.65X_6$$

$$(2) Y = -100.94 + 26.49X_2 + 2.82X_4 + 3.92X_{11}$$

$$(3) Y = 32.87 + 1.69X_6 + 5.84X_8 - 4.14X_{10}$$

$$(4) Y = 53.34 + 1.89X_4$$

The percentage of explained variance ranged from 56 percent in equation (2) to 22 percent in equation (4). The analysis of residuals for group III indicated a mean of 3.19 with a standard deviation of 8.90. An analysis was also made of

the residuals, using only variables X_6 and X_8 of group III. The corresponding prediction equation was $Y = 20.65 + 1.71X_6 + 2.48X_8$. The mean of the residuals using this equation was 3.02 with a standard deviation of 8.73.

The individual variables with the highest significant correlation at the 1 percent level, with the final grade in MA 115, were the Chattanooga State Mathematics Placement Test (form A), $r = 0.61$; ACT Mathematics Score, $r = 0.55$; Nelson-Denny Reading Comprehension Score, $r = 0.53$; high school grade point average, $r = 0.43$; and ACT composite Score, $r = 0.43$. The final prediction equations developed for MA 115 were:

$$(1) Y = 5.43 + 28.16X_1 + 2.93X_6 - 0.49X_{11}$$

$$(2) Y = 75.75 + 3.93X_3 + 0.83X_5 - 0.65X_{11}$$

$$(3) Y = 30.71 + 2.07X_6$$

$$(4) Y = 64.46 + 1.17X_5$$

The percentage of explained variance ranged from 89 percent in equation (1) to 30 percent in equation (4); however, equation (1) resulted from a sample size of only ten. Equation (2) resulted in an explained variance of 69 percent.

The individual variables with the highest correlations at the 1 percent level, with the final grade in MA 117, were the Chattanooga State Mathematics Placement Test (form A),

$r = 0.62$; and the high school rank, $r = -0.60$. The final prediction equations developed for MA 117 were:

$$(3) Y = 23.59 + 1.01X_6 + 2.35X_{10}$$

$$(4) Y = 55.12 + 1.34X_5$$

The percentage of explained variance was 40 percent in equation (3) and 36 percent in equation (4).

The only variable to correlate significantly at the 1 percent level, with the final grade in MG 165, was the Chattanooga State Mathematics Placement Test Score (form B), $r = .44$. The prediction equation developed using this variable was $Y = 69.31 + 0.82X_7$. The percentage of explained variance for this equation was 32 percent.

II. CONCLUSIONS

Statement of Conclusions

Based upon the results of this study, the following conclusions were reached with regard to the mathematics classes at Chattanooga State Technical Community College:

1. The Chattanooga State Mathematics Placement Test (form A) is the single best predictor of grades for MA 105, MA 115, and MA 117.
2. The Chattanooga State Mathematics Placement Test (form B) is the single best predictor of grades for MG 165.
3. At least one of the three scores on the Nelson-Denny Reading Test correlated significantly with a student's final grade in MA 100, MA 105, MA 115, and MA 117.

4. The ACT Mathematics Score correlated significantly with final grades in both MA 115 and MA 117.

5. The ACT Composite Score correlated significantly with the final grades in both MA 105 and MA 115.

6. The high school grade point average and the high school rank correlated significantly with the final grades in MA 115 and MA 117, respectively.

7. Significant regression equations for predicting grades in MA 105, MA 115, MA 117, and MG 165 were determined.

8. No significant prediction equations were developed for Basic Mathematics.

9. There was no significant correlation between the number of high school mathematics courses taken by a student and his final grade in either MA 115, MA 117, or MG 165.

Discussion of the Summary and Conclusions

The purpose of this study was to find significant prediction equations for predicting the final grades of students in beginning level mathematics courses at Chattanooga State Technical Community College. This was accomplished for all beginning level mathematics courses except Basic Mathematics (cf. conclusions 7 and 8). However, the prediction of grades equations for the courses MA 105, MA 115, and MA 117 did not necessarily contain the same independent variables.

The mathematics score of the ACT Test correlated significantly with the final grades in Algebra and Trigonometry I and College Algebra, but not with the final grades in the two developmental courses, Basic Mathematics and Fundamentals of Algebra (cf. conclusion 4). This would imply that the math portion of the ACT examination is inappropriate for predicting final grades in developmental courses at Chattanooga State. The mean ACT examination scores for MA 100 and MA 105 students were low, 7.8 and 11.2, respectively.

The comprehension score and the total score on the Nelson-Denny Reading Test correlated significantly with the final grades in Fundamentals of Algebra and Algebra and Trigonometry I; whereas, the vocabulary score correlated significantly with Basic Mathematics and College Algebra (cf. conclusion 3). This correlation between reading and grades in college mathematics courses agrees with Seigle's (1954) study and Edwards' (1972) study.

The study agreed with Seigle's (1954) study and Corotto's (1963) study that achievement tests designed to measure specific content areas appear to be one of the better predictors of grades for beginning level mathematics courses (cf. conclusions 1 and 2). Consequently, all students should be recommended to take the Chattanooga State Mathematics Placement Test before entrance to the College. On the basis of the results of the Chattanooga State Mathematics Placement

Test (form A) and the prediction of grades equations for MA 115, $Y = 10.07 + 2.64 X_6$ or $Y = 30.71 + 2.07X_6$, or MA 117, $Y = 51.79 + 1.14X_6$, a recommendation would be made as to whether a student would have a reasonable chance of completing either MA 115 or MA 117 with at least a grade of "C." If a student's score on the Chattanooga State Mathematics Placement Test predicts a grade of at least 75, then he would be recommended to take the appropriate course, either Algebra and Trigonometry I or College Algebra. A score of 22 to 25, depending on the equation used, on the Chattanooga State Mathematics Placement Test (form A) would predict a final grade in MA 115 of at least 75, while a score of 20 would predict a final grade of 75 in MA 117.

If a student's score on the Chattanooga State Mathematics Placement Test fails to predict a final grade of at least 75 in either MA 115 or MA 117, then a prediction of his final grade in Fundamentals of Algebra, MA 105, would be made. This prediction would be made on the basis of either the equation $Y = 26.58 + 2.90X_6$, or the graph representing the equation $Y = 20.65 + 1.71X_6 + 2.48X_8$ (Figure 2, page 50). If the student's score predicts a final grade of at least 75 in MA 105 but less than 75 in either Algebra and Trigonometry or College Algebra, then he would be recommended to take MA 105. A score between 14 and 17 on the Chattanooga State Mathematics Placement Test (form A) would predict a final

grade in MA 105 of at least 75. If a student's score did not predict a final grade of at least 75 in MA 105, then he would be recommended to take Basic Mathematics, MA 100.

Based on the study, the only significant predictor of final grades in Business Mathematics, MG 165, was the Chattanooga State Mathematics Placement Test (form B). In order to predict a grade of 75 in MG 165, it was only necessary to score seven on the Chattanooga State Mathematics Placement Test (form B). On the basis of the experience of teachers of MG 165, it was concluded this score was entirely too low; consequently, the study did not seem to provide reliable information for the purpose of predicting final grades for students taking MG 165.

As indicated in the Summary, the analysis of residuals between the observed grade and predicted grade for group III of MA 105 was made for two equations. One equation, $Y = 32.87 + 1.69X_6 + 5.84X_8 - 4.14X_{10}$, had residuals with a mean and standard deviation of 3.19 and 8.90, respectively; whereas, the other equation, $Y = 20.65 + 1.71X_6 + 2.48X_8$, had residuals with a mean and standard deviation of 3.02 and 8.73, respectively. On the basis of the 24 grades examined at the end of the Spring Quarter 1979, the variability of the residuals was about the same for the two-variable model as it was for the three-variable model. As indicated by the positive means of the residuals for the two prediction equations, the equations

were generally underestimating a student's final grade. One possible explanation for the large positive residuals, 10.0 or above, in the data was that some students, especially older ones, are quite apprehensive about going to college and as a result do poorly on their placement testing. In some cases, these students are quite capable and have one to two years of algebra in their background; consequently, as they recall the algebra and become more confident of themselves, they do much better than their predicted grade would indicate. Of those students with residuals of +10.0 or greater, 75 percent were at least 26 years of age.

It was surprising that the number of mathematics courses taken in high school did not correlate significantly with the final grades in either MA 115 or MA 117. The mean number of high school mathematics courses taken by students in MA 115 and MA 117 was 2.58 and 2.63, respectively. One reason for this lack of correlation might be that students in MA 115 and MA 117 have not used algebra in a number of years. The mean age of students in MA 115 and MA 117 is 23.79 years and 24.54 years, respectively.

Suggestions for Further Research

The following are suggestions for further research on improving placement of college students in their initial mathematics courses. These suggestions are offered with the hope that additional information may be obtained that will

be instrumental in identifying those variables which are significant predictors of success for beginning college mathematics students.

One study worthy of consideration would be to investigate the correlation between the psychological factors, as measured by the Tennessee Self-Concept Test, and the final grades in beginning level mathematics courses. The Tennessee Self-Concept Test measures such factors as physical self, moral-ethical self, personal self, family self, social self, and self-criticism. This study could provide valuable information for placement purposes, especially for developmental or remedial courses. In many cases, the developmental student in mathematics seems to have not only a low self-concept in mathematics, but also a low self-concept in general.

Many community colleges have their beginning level mathematics courses offered in two instructional formats: self-paced and lecture-discussion. In self-paced courses, students are able to take up to two to three quarters to complete the course. For advising purposes, a worthy study would be to predict the length of time required for a student to complete or drop out of a self-paced course. Prediction of time of completion or dropout would aid in identifying those students who need special attention and counseling.

A study to identify reasons and their corresponding degree of importance as to why a person enrolls in a

beginning level mathematics course would seem worthwhile. This type of study could provide a measurement of the motivation a person has for a given course, especially a developmental course. Some of the reasons might be "need review of algebra," "recommended by advisor," "required to take because of low score on placement test," "will be helpful in courses other than mathematics I will be taking," and so forth. Those "reasons" that are significant could be included in a prediction of grades equation.

Only one variable was found in this study to have a significant correlation with the final grades in Business Mathematics, MG 165. A valuable study would be to identify other variables which would correlate significantly with the final grades in a business mathematics course. Some variables that might be considered would be a student's score on a mathematics attitude scale, his grade in a consumer mathematics course in high school, work status while attending college, and so forth.

One function of a community college is to provide a set of remedial or developmental courses in such areas as English, reading, and mathematics. Generally, the ACT or SAT will not differentiate between students who need various levels of developmental mathematics. A valuable study would be to develop two placement tests: one to indicate those students who need a course in arithmetic as opposed to

elementary algebra, and the other to differentiate between those students who need a course in elementary algebra in contrast to intermediate algebra. Appropriate cut-off scores could be determined for each test, using a cross-section of community colleges.

Implications

This study had implications for both Chattanooga State and other colleges. As expected, the implications for Chattanooga State had the potential of being more significant than for other colleges.

As a community college, Chattanooga State was only five years old, 1973-1978, at the time of this study. In the Fall Quarter 1978, the enrollment was 4200 students, which was an 11 percent increase in headcount over the Fall Quarter 1977. The failure rate of students in beginning level mathematics courses had ranged from 10 percent to 60 percent, with a median failure rate of around 40 percent. The high failure rate had resulted partially from a lack of information on which to base course recommendations. This study provided additional information on which to base recommendations for a student's initial mathematics course at Chattanooga State. The implications of this study for Chattanooga State were both short-term and long-term.

In the short-term, Chattanooga State did not have computer facilities that would accommodate multiple regression

prediction of grades equations. Consequently, on the basis of a student's score on the Chattanooga State Mathematics Placement Test and the prediction of grades equations that resulted from this study, an advisor recommended the appropriate beginning level mathematics course for each new student. Approximately 90 percent of all new students at Chattanooga State take the Chattanooga State Placement Battery.

A recommendation to take MA 115 was based primarily on a minimum score between 22 and 25 on the Chattanooga State Mathematics Placement Test Score (form A). In borderline cases, the student's total and comprehension scores on the Nelson-Denny Reading Test and, when known, the student's high school grade point average were considered.

A recommendation to take MA 117 was based primarily on a minimum score of 20 on the Chattanooga State Mathematics Placement Test (form A). In borderline cases, the score on the vocabulary portion of the Nelson-Denny Reading Test was considered, as well as the student's high school rank or high school grade point average, when known.

If a student was not recommended to take either MA 115 or MA 117, then a recommendation was made regarding MA 105. The minimum score ranged from 14 to 17 on the Chattanooga State Mathematics Placement Test (form A). Additional factors considered were the total, comprehension, and

vocabulary scores on the Nelson-Denny Reading Test and the number of high school mathematics courses taken. If a student did not meet the minimum criteria for taking MA 105, then he was recommended to take MA 100.

The study did not provide sufficient information on which to base a recommendation for taking MG 165.

The above guidelines were used by faculty advisors to recommend initial mathematics courses for new students during the 1979-80 school year. A follow-up study to indicate the success of student placement in their initial mathematics courses was planned for 1979-80.

The long-term implication of this study for Chattanooga State was that the prediction of grades equations that resulted from this study and/or the follow-up study would be stored in the computer. As information was supplied to a faculty advisor on the significant independent variables for a given beginning level mathematics course, he would put this information into the computer and receive a prediction of the grade for the student in the appropriate course. The plan was to have computer terminals available for assisting in the advisement of students by the Fall Quarter 1980.

The implications of this study for other colleges, especially community colleges, was that each college should consider developing its own mathematics placement test and the corresponding multiple regression equations for each

beginning level mathematics course. The variables used in the multiple regression equations would be dependent on the information that was readily accessible on new students.

LIST OF REFERENCES

LIST OF REFERENCES

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APPENDIXES

APPENDIX A

COURSE OUTLINES AND RELATED MATERIALS

CHATTANOOGA STATE TECHNICAL COMMUNITY COLLEGE
Chattanooga, Tennessee

TO: Students taking MA 100, MA 105, MA 115, MA 117, or MG 165 as their first mathematics course at Chattanooga State during either the Fall Quarter 1978 or the Spring Quarter 1979.

FROM: Herbert L. Hooper, Jr., Director of Project for Determining Prediction Equations

The purpose of this letter is to request your participation in a project that would allow me to use some of the following information about you:

1. High school rank
2. High school grade point average
3. Number of high school mathematics courses
4. ACT composite score
5. ACT math score
6. Chattanooga State Math Placement Test (form A)
7. Chattanooga State Math Placement Test (form B)
8. Nelson-Denny Reading Test (total)
9. Nelson-Denny Reading Test (comprehension)
10. Nelson-Denny Reading Test (vocabulary)
11. Age
12. Final numerical grade in MA 100, MA 105, MA 115, MA 117, or MG 165

The portion of the above information that is available on you would be taken from your records in the Chattanooga State Admissions Office.

The purpose of this project is to develop prediction equations for each of the above courses. These prediction equations would be used to predict the final grade of a student taking one of the above courses as their first mathematics course at Chattanooga State. Consequently, this would allow us to recommend the appropriate mathematics course for a new student.

The prediction equations and other summary data from this study would be used in my Doctoral dissertation. Only I will have access to the data collected and it will be kept in strict confidence. In fact, after all the data have been collected, the name and social security number of each person will be removed from the data.

I would appreciate your cooperation in this project; however, I will use the data on you only if you volunteer for me to do so. Using, or not using, data on you will in no way affect your grade in the course. Even though you may initially volunteer for me to use the data on you,

you may withdraw this consent and withdraw from the project at any time without prejudice.

I will be glad to answer any of your questions about this project. My office is in the Instructional Materials Center.

If you agree to participate in the project as described above, please sign your name below. If you are under 18 years of age, please see me.

NAME

COURSE SYLLABUS

Basic Mathematics—MA 100

Class Hours: 5

Credit Hours: 5

Laboratory Hours: 0

Catalogue Course Description: A one-quarter arithmetic course in whole numbers, fractions, decimals, simple linear equations, ratios and proportion, and percent.

Prerequisite and/or Corequisite: None

Textbook(s) and Other Reference Material Basic to Course: Community College Teachers in New York State, ModuMath.

- I. A systematic and orderly list of activities and/or events that will comprise the total allotted time for the course. The activities, whether based on weeks, units, or topics, should correspond to the number of weeks in the quarter.

Week/Unit/Topic Basis:

<u>Week</u> No. 1	Unit I—Whole Numbers—Modules 1.1-1.5
No. 2	Unit I—Whole Numbers—Modules 1.6-1.9
No. 3	Unit I—Whole Numbers—Modules 1.10-1.12
No. 4	Unit I—Equations and Prime Numbers—Modules 1.13-1.14
No. 5	Unit II—Common Fractions—Modules 2.1-2.4
No. 6	Unit II—Common Fractions—Modules 2.5-2.6
No. 7	Unit II—Common Fractions—Modules 2.7-2.8
No. 8	Unit III—Decimal Fractions—Modules 3.1-3.4
No. 9	Unit III and IV—Decimal Fractions and Percent— Modules 3.5-4.1
No. 10	Unit IV—Percent—Modules 4.2-4.3

- II. A list of specific objectives which should include (1) skills, (2) knowledge, and (3) attitudes* (where applicable) that the student will obtain or be able to perform upon completion of the course. Also, indicate the ideal expected degree of achievement.

A. Objectives: Whole Numbers

The student will be able to:

1. read decimal numerals.
2. write in words decimal numerals for whole numbers.

3. write the decimal numeral for a whole number stated in words.
4. write decimal numbers for a whole number stated in words.
5. state the number represented by each digit in a decimal numeral.
6. construct a number line.
7. graph whole numbers on a number line.
8. find the coordinate of a point on a number line.
9. decide which of two points represents the smaller (or larger) whole number.
10. use the symbols $>$ and $<$ to compare whole numbers.
11. state from memory the 100 addition facts.
12. interpret the addition of whole numbers on a number line.
13. recognize and use the identity for addition.
14. recognize and solve word problems involving addition of small whole numbers.
15. find the sum of two or more whole numbers.
16. state from memory the 100 subtraction facts.
17. subtract whole numbers, provided that the first is greater than or equal to the second.
18. check a subtraction problem by addition.
19. solve word problems involving subtraction.
20. use multiplication as a shortcut for addition.
21. interpret multiplication on a number line.
22. show multiplication facts as arrays.
23. use multiplication to find areas.
24. use multiplication to figure out combinations.
25. multiply by 0.
26. recognize and use the identity for multiplication.
27. state from memory the 100 multiplication facts.
28. solve word problems involving multiplication of small whole numbers.
29. multiply any two whole numbers.
30. solve word problems involving multiplication.
31. read expressions involving exponents.
32. multiply two or more expressions with the same base by adding exponents.
33. recognize and work with expressions having exponents equal to zero.
34. write whole numbers in exponential notation.
35. state from memory the 90 basic division facts.
36. solve simple word problems involving division.
37. use multiplication to check division.
38. divide any whole number by any other (excluding division by zero).
39. solve word problems involving division of whole numbers.
40. use multiplication to check division.
41. express word problems as number sentences.
42. solve word problems involving addition, subtraction, multiplication and division of whole numbers.
43. solve simple equations.

44. solve word problems involving simple questions.
45. determine whether a given whole number greater than 1 is prime or composite.
46. use the Sieve or Eratosthenes.
47. determine the prime factorization of a given whole number.

B. Objectives: Common Fractions

The student will be able to:

1. understand and use fractions in comparing two quantities.
2. understand and use fractions in expressing parts of a whole.
3. understand and use fractions in expressing division.
4. understand and use fractions in measurement.
5. locate fractions on a number line.
6. recognize and use fractions with denominators of 1.
7. divide whole numbers when the quotient is a fraction or a whole number plus a fraction.
8. express fractions in higher and lower terms.
9. reduce fractions to lowest terms.
10. recognize and use fractions equal to 1.
11. recognize and use fractions equal to 0.
12. add two or more fractions with the same denominator.
13. change a mixed number to an improper fraction.
14. change an improper fraction to a mixed number.
15. add any combination of mixed numbers, fractions, and whole numbers, provided all the denominators are the same.
16. find a common denominator of two or more fractions.
17. find the least common denominator of two or more fractions.
18. add two or more fractions with different denominators.
19. indicate the larger (or smaller) of 2 fractions.
20. subtract fractions.
21. subtract mixed numbers.
22. subtract a fraction or mixed number from a whole number.
23. subtract a whole number from a mixed number.
24. solve word problems involving subtraction of fractions.
(In all cases, we assume the first fraction is greater than or equal to the second.)
25. multiply a fraction or mixed number and a whole number.
26. multiply any combination of fractions and mixed numbers.
27. solve word problems involving multiplication of fractions.
28. divide a fraction by a mixed number, a whole number, or another fraction.
29. divide a mixed number by a fraction, a whole number or another mixed number.
30. divide a whole number by a fraction or a mixed number.
31. solve word problems involving division of fractions.
32. determine whether two ratios are equal.
33. solve word problems involving proportions.

C. Objectives: Decimal Fractions

The student will be able to:

1. write decimal fractions in exponential notation.
2. read decimal fractions.
3. change decimals to fractions.
4. change a fraction to a decimal, provided the denominator is a power of 10.
5. recognize the meaning of zeros to the right of a decimal.
6. determine which is the larger (or smaller) of two decimal fractions.
7. add two or more decimal fractions.
8. subtract decimal fractions.
9. solve word problems involving addition and subtraction of decimal fractions.
10. round a number to a given degree of accuracy.
11. multiply decimal fractions.
12. solve word problems involving multiplication of decimals.
13. divide a decimal by a whole number.
14. divide a whole number by a decimal.
15. divide a decimal by another decimal.
16. divide two numbers accurate to a given number of decimal places.
17. solve word problems involving division of decimals.
18. change a fraction or mixed number to a decimal.
19. change a decimal to a fraction or mixed number.
20. use a table to find square roots of whole numbers from 1 to 100.
21. recognize and use the fact that if a and b are any numbers, then $\sqrt{axb} = \sqrt{a} \times \sqrt{b}$.

D. Objectives: Percent

The student should be able to:

1. change fractions and decimals to percents.
2. change percents to fractions and decimals.
3. solve word problems involving percents by using proportions.
4. solve more complicated word problems involving percent.

III. *Specific evaluation process whereby the achievement will be measured. (Use following outline and N/A if not applicable.)*

A. *Testing procedures (number, type—discussion/objective, cumulative/noncumulative):*

Objective type examinations are given on each module (33), but are not used for evaluation purposes. Objective type examinations are given on portions of each unit (6) plus a cumulative type final exam.

- B. *Laboratory expectations (experiments-reports, etc.).
Laboratory experiments should be tied directly to specific
academic activity to reflect theoretical concepts of course.*

N/A

- C. *Field work (library papers, surveys, interviews, practicum,
attendance at suggested/required events):*

N/A

- D. *Other evaluation methods (off-campus evaluation processes,
standardized testing, etc.):*

N/A

- E. *Notation should be made indicating what percentage of grade
will relate (where applicable) in Items A-D.*

Unit Exams—75

Final Exam—25

COURSE SYLLABUS

Fundamentals of Algebra—MA 105

Class Hours: 5

Credit Hours: 5

Laboratory Hours: 0

Catalogue Course Description: A one-quarter review of topics in mathematics necessary for entrance into MA 115 and MA 117. Topics included are fractions of arithmetic, signed numbers, linear equations, and introduction to exponents and radicals. This course may not be transferable.

Prerequisite and/or Corequisite:

- (1) MA 100
- (2) Acceptable ACT score or recommended placement on basis of Chattanooga State Mathematics Placement Exam
- (3) Recommendation of advisor

Textbook(s) and Other Reference Material Basic to Course: Moon, Robert G., Applied Mathematics for Technical Programs—Algebra, Charles E. Merrill Publishing Company, Columbus, Ohio.

- I. A systematic and orderly list of activities and/or events that will comprise the total allotted time for the course. The activities, whether based on weeks, units, or topics, should correspond to the number of weeks in the quarter.

Week/Unit/Topic Basis:

<u>Week</u> No. 1	Units 1-2	Review of exponents, algebraic expressions, and signed numbers; pp. 2-23
No. 2	Units 3-4	Addition, subtraction, multiplication, and division of signed numbers; pp. 24-52
No. 3	Units 5-6	Addition, subtraction, multiplication, and division of algebraic expressions; pp. 56-84
No. 4	Units 7-8	Factoring algebraic expressions, first degree and quadratic equations; pp. 85-112
No. 5	Units 9-10	Reducing, expanding, multiplication and division of fractional expressions; pp. 116-128
No. 6	Unit 11 Unit 12 (frames 1-22)	Addition, subtraction of fractional expressions; solving fractional equations; pp. 139-176

- No. 7 Unit 13 Negative exponents, scientific notation,
 (frames 1-16) radicals and fractional exponents;
 pp. 182-210
 Unit 14
 (frames 1-23)
- No. 8 Unit 15 Operations with radicals, equations
 (frames 1-32) involving exponents and radicals;
 pp. 211-239
 Unit 16
 (frames 1-14)
- No. 9 Units 17-18 Rectangular coordinate system; graphing
 straight lines and parabolas; pp. 244-301
- No. 10 Unit 19 Solving systems of linear equations;
 pp. 302-323

II. *A list of specific objectives which should include (1) skills, (2) knowledge, and (3) attitudes* (where applicable) that the student will obtain or be able to perform upon completion of the course. Also, indicate the ideal expected degree of achievement.*

A. Objectives

Upon completion of the course, the student should be able to:

1. Change certain products to exponential notation.
2. Evaluate exponential expressions.
3. Use the order of operations agreement to evaluate expressions involving a combination of operations.
4. Evaluate variable expressions by substituting whole numbers for the variables.
5. Recognize the use of the closure, commutative, associative and distributive properties.
6. Add, subtract, multiply, divide arithmetic fractions and reduce result to lowest terms.
7. Add, subtract, multiply and divide decimals.
8. Simplify radicals by removing perfect square factors from the radicand.
9. Add and subtract like radicals.

10. Use the Pythagorean Theorem to determine the length of the third side of a right triangle, given the other two sides.
11. Find the absolute value of a number.
12. Use the symbols for "greater than," and "less than."
13. Perform the four basic operations of addition, subtraction, multiplication, and division on signed numbers.
14. Evaluate powers of signed numbers.
15. Add and subtract algebraic expressions having signed numbers for numerical coefficients.
16. Remove grouping symbols when they are preceded by either plus or minus signs.
17. Solve first degree equations and check their solutions.
18. Use first degree equations to solve word problems.
19. Find the following products:
 - (a) A monomial times a monomial
 - (b) A monomial times a polynomial
 - (c) A polynomial times a polynomial
20. Factor the largest common monomial from a polynomial.
21. Recognize a "difference of two squares" and factor it into a "sum times a difference."
22. Factor trinomials into a product of binomials.
23. Solve quadratic equations by factoring and by formula.
24. Construct a table of values for a linear equation of two variables.
25. Name points in the rectangular coordinate plane by using ordered pairs of numbers.
26. Graph linear equations of two variables by using a table of values.
27. Simplify exponential expressions by using the following properties of exponents:
 - (a) The addition property of exponents
 - (b) The subtraction property of exponents
 - (c) The power of a power property
 - (d) The distributive property of exponents
28. Evaluate and simplify expressions involving zero, negative and fractional exponents.
29. Change a fraction to an equivalent form by reducing to lowest terms or raising to higher terms.

30. Add, subtract, multiply and divide algebraic fractions and express results in reduced form.
31. Simplify complex fractions.
32. Solve equations involving fractions.
33. Solve for a specified variable by rearranging formulas and equations.
34. Solve systems of linear equations by graphing.
35. Solve systems of linear equations by addition-subtraction or by substitution.
36. Multiply and divide radicals.
37. Rationalize denominator of fractions containing radicals.
38. Find the following quotients:
 - (a) Monomial divided by a monomial
 - (b) Multinomial divided by a monomial
 - (c) Multinomial divided by a multinomial
39. Obtain data by analyzing graphs.
40. Find the slope of a line.
41. Graph straight lines by using x- and y-intercepts.
42. Graph parabolas.
43. Use systems of linear equations to solve applied problems.

III. *Specific evaluation process whereby the achievement will be measured. (Use following outline and N/A if not applicable.)*

- A. *Testing procedures (number, type—discussion/objective, cumulative/noncumulative):*

The testing program includes 19 unit tests, five module tests and a final examination. Unit and module tests are noncumulative objective type tests consisting of problems and exercises. The comprehensive final examination is cumulative, and also consists of problems and exercises.

- B. *Laboratory expectations (experiments-reports, etc.). Laboratory experiments should be tied directly to specific academic activity to reflect theoretical concepts of course.*

N/A

- C. *Field work (library papers, surveys, interviews, proacicum, attendance at suggested/required events):*

N/A

- D. *Other evaluation methods (off-campus evaluation processes, standardized testing, etc.):*

N/A

- E. *Notation should be made indicating what percentage of grade will relate (where applicable) in Items A-D.*

The unit tests are used only for instructional purposes, and are not used in determining the course grade. Each module test constitutes a major grade. The final examination counts as two major grades. The course grade is the average of these major grades.

COURSE SYLLABUS

MA 115—Algebra & Trigonometry I

Class Hours: 5

Credit Hours: 5

Laboratory Hours: 0

Catalogue Course Description: This is the first of a two-quarter, precalculus or technical mathematics sequence. Topics emphasized are functions and graphs, equations, determinants, right triangle trigonometric functions of any angle, and vectors.

Prerequisite: MA 105 or recommendation to take MA 115 on the basis of ACT score, high school mathematics and Chattanooga State mathematics placement test.

Textbook: Washington, Allyn J. Basic Technical Mathematics (Third Edition). California: Cummings Publishing Company, 1978.

I. Systematic list of activities that will comprise the total allotted time for the course:

<u>Week</u>	<u>Unit</u>	<u>Topic</u>
1	Chapter 1, Sec. 1-6	Number systems, exponents, scientific notation, roots, radicals and fractional exponents—Washington, pp. 1-18*.
2	Chapter 1, Sec. 7-11	Operations with algebraic expressions: solve linear and literal equations, formula manipulation—pp. 19-35.
3	Chapter 2	Functions: evaluating and graphing functions; solving equations graphically—pp. 40-54.
4	Chapter 3	Definition of trigonometric functions; using tables, solving right triangles—pp. 60-78.
5	Chapter 4	Linear equations: graphing systems of linear equations; solving systems of linear equations by substitution, addition, and minors—pp. 83-108.
6	Chapter 5, Sec. 1-6	Factoring algebraic expressions; operations with algebraic fractions—pp. 119-137.

*All assigned page numbers refer to Basic Technical Mathematics (3rd Edition), by Allyn J. Washington.

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|----|----------------------|---|
| 7 | Chapter 5,
Sec. 7 | Solving equations involving fractions—
pp. 138-142. |
| 8 | Chapter 6 | Solving quadratic equations, emphasizing the
quadratic formula—pp. 151-160. |
| 9 | Chapter 7 | Trigonometric functions of any angle; radian
measure; application of radian measure—
pp. 166-179. |
| 10 | Chapter 8 | Vectors—resolving to components, adding
vectors and applications; law of sines and
law of cosines; applications of law of sines
and law of cosines to triangles and vectors—
pp. 186-206. |

II. *Course Objectives, including skills, knowledge, and attitudes (where applicable) that the student will obtain or be able to perform upon completion of the course.*

A student who has successfully completed MA 115 with a grade of C or better will know how to:

1. Perform the operations with algebraic expression.
2. Use the laws of exponents to
 - a. Simplify expressions
 - b. Find roots and simplify radicals
 - c. Express numbers in scientific notation
3. Perform operations with algebraic fractions.
4. Solve:
 - a. Linear equations in one variable
 - b. A system of linear equations in two or three unknowns
 - c. Quadratic equations
5. Graph:
 - a. Linear equations in two unknowns
 - b. A system of linear equations
 - c. Vectors
6. Distinguish between a function and a relation.
7. Find the values of trigonometric functions.
8. Read a trigonometry table.
9. Convert radians to degrees and degrees to radians.

10. Define the trigonometric function in terms of
 - a. Abscissa, ordinate, and radius vector
 - b. Opposite, adjacent, and hypotenuse
11. Use the law of sines and the law of cosines to solve triangles.

III. *Specific evaluation process whereby the achievement will be measured.*

A. *Testing procedures (number, type—discussion/objective, cumulative/noncumulative):*

There will be 3 to 5 fifty (50) minute tests, each consisting of open ended problems and exercises. A test will cover approximately two weeks' material (one or two chapters) and is noncumulative. Each student will take a final comprehensive cumulative exam which is also problems and exercises.

B. *Laboratory expectations (experiments-reports, etc.). Laboratory experiments should be tied directly to specific academic activity to reflect theoretical concepts of course.*

N/A

C. *Field work (library papers, surveys, interviews, practicum, attendance at suggested/required events:*

N/A

D. *Other evaluation methods (off-campus evaluation processes, standardized testing, etc.):*

At the discretion of the instructor, "pop quizzes" and/or homework will constitute a major grade for the course.

E. *Notation should be made indicating what percentage of grade will relate (where applicable) to Items A-D.*

Each 50 minute test will constitute a major grade. "Pop quizzes" and homework will constitute a major grade, when applicable (see D). The final exam will count as two major grades. Each student must have a minimum of 5 major grades or a maximum of 7 major grades. The course grade is the average of these two major grades.

COURSE SYLLABUS

College Algebra—MA 117

Class Hours: 5
Laboratory Hours: 0

Credit Hours: 5

Catalogue Course Description: Sets and the real number system, polynomials, and factoring, linear equations, quadratic equations, inequalities, relations and functions, complex numbers, sequences and series.

Prerequisite: MA 105 or recommendation to take College Algebra on the basis of ACT Score, high school mathematics and Chattanooga State Mathematics placement test.

Textbook(s) and Other Reference Material Basic to Course: Intermediate Algebra (Fourth Edition). California: Wadsworth Publishing Co., Inc., 1976. Drooyan, Irving, and Wooten, William.

- I. A systematic and orderly list of activities and/or events that will comprise the total allotted time for the course. The activities, whether based on weeks, units, or topics, should correspond to the number of weeks in the quarter.

Week/Unit/Topic Basis:

<u>Week</u>	<u>Unit</u>	<u>Topic</u>
1	Chap. 1, Sec. 1-7	Sets and operation, axioms of equality, properties of real numbers, sums and differences, products and quotients, order of operations—Drooyan and Wooten, pp. 3-32*.
2	Chap. 2, Sec. 1-4	Polynomial Definitions, sums and differences, products and quotients of monomials, products of polynomials—pp. 37-53.
3	Chap. 2, Sec. 5-7	Factoring monomials from polynomials, factoring quadratic polynomials, factoring other polynomials—pp. 53-62.
4	Chap. 3, Sec. 1-6	Properties of fractions, reducing and building fractions, operations with fractions, operations with fractional polynomials, complex fractions—pp. 67-93.
5	Chap 4, Sec. 1-5	Positive integral exponents, zero & negative integral exponents, scientific notation, rational exponents and radicals—pp. 97-114.

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| 6 | Chap. 5,
Sec. 1-5 | Solving equations, identities, solving formulas, applications and inequalities—pp. 131-159. |
| 7 | Chap. 6,
Sec. 1, 2,
4 & 5 | Solving quadratic equations by factoring, completing the square and quadratic formula, applications—pp. 169-189. |
| 8 | Chap. 7,
Sec. 1-4,
Chap 8,
Sec. 1 & 2 | Solving equations with two variables, graphing linear equations, relations and functions, distance and slope formulas, graphs of quadratic relations, sketching parabolas—pp. 203-217, 235-240. |
| 9 | Chap. 9,
Sec. 1-4 | The exponential function, the logarithmic function, properties and logarithms to the base 10—pp. 269-279. |
| 10 | Chap. 10,
Sec. 1-2
Appendix B
Sec. 1 | Linear Systems in two variables and three variables, solving systems by matrices—pp. 303-312, 373-375. |

*All assigned page numbers refer to Intermediate Algebra (Fourth Edition) by Irving Drooyan and William Wooten.

II. *A list of specific objectives which should include (1) skills, (2) knowledge, and (3) attitudes* (where applicable) that the student will obtain or be able to perform upon completion of the course. (Also, indicate the ideal expected degree of achievement.)*

By the end of the quarter, the student shall be able to:

1. Perform any operation involving signed numbers.
2. Perform any operation with algebraic expressions.
 - a. Factor algebraic expressions to prime factors.
3. Perform any operation with algebraic fractions.
4. Simplify expressions involving rational exponents.
 - a. Simplify radicals
 - b. Write large numbers in scientific notation.
5. Solve:
 - a. Linear equations in one variable and their applications
 - b. A system of linear equations in two or three unknowns
 - c. Quadratic Equations and their applications.

6. Graph
 - a. Linear equations in two unknowns
 - b. Quadratic Relations
 1. Parabola
 - c. Distance and slope Formula equations.
7. Perform operations involving logarithms.
8. Solve a system of linear equations by setting up a matrix of coefficients and using determinants.

III. *Specific evaluation process whereby the achievement will be measured.*

- A. *Testing procedures (number, type—discussion/objective, cumulative/noncumulative):*

There will be 3 to 5 fifty minute tests, each consisting of open ended problems and exercises. A test will cover approximately two weeks' material (one or two chapters) and is noncumulative. Each student will take a final comprehensive cumulative exam which is also problems and exercises.

- B. *Laboratory expectations (experiments-reports, etc.). Laboratory experiments should be tied directly to specific academic activity to reflect theoretical concepts of course.*

N/A

- C. *Field work (library papers, surveys, interview, practicum, attendance at suggested/required events):*

N/A

- D. *Other evaluation methods (off-campus evaluation processes, standardized testing, etc.):*

At the discretion of the instructor, "pop quizzes" and/or homework will constitute a major grade for the course.

- E. *Notation should be made indicating what percentage of grade will relate (where applicable) in Items A-D.*

Each 50 minute test will constitute a major grade. "Pop quizzes" and homework will constitute a major grade, when applicable (see D). The final exam will count as two major grades. Each student must have a minimum of 5 major grades or a maximum of 7 major grades. The course grade is the average of these major grades.

APPENDIX B

CHATTANOOGA STATE MATHEMATICS PLACEMENT TEST

(FORMS A AND B)

MATHEMATICS PLACEMENT TEST
FORM A

USE SEPARATE ANSWER SHEET

DO NOT WRITE ON THIS SHEET.

1. $\frac{3}{4} + \frac{5}{8} =$ (a) $\frac{8}{12}$ (b) $\frac{11}{8}$ (c) $\frac{15}{32}$ (c) none of these.	5. $.027 \times .06 =$ (a) .162 (b) .087 (c) .00162 (d) none of these.
2. $\frac{2}{3} \div \frac{1}{2} =$ (a) $\frac{1}{3}$ (b) $\frac{2}{5}$ (c) $\frac{4}{3}$ (d) none of these.	6. $.036 \div .06 =$ (a) .06 (b) .6 (c) 6 (d) none of these.
3. Change $7\frac{5}{6}$ to an improper fraction. (a) $\frac{41}{6}$ (b) $\frac{47}{6}$ (c) $\frac{47}{5}$ (d) none of these.	7. Convert 0.038 to a percent. (a) 0.038% (b) 3.8% (c) 38% (d) none of these.
4. $1.453 - .17 =$ (a) 1.436 (b) 1.383 (c) 1.346 (d) none of these.	8. What is 16% of 200? (a) $12\frac{1}{2}$ (b) 3200 (c) 32 (d) none of these. 9. $2 + (-5) + (1) + (7) + (-4) =$ (a) 1 (b) -19 (c) +19 (d) none of these.

10. $(-9) - (-3) =$ (a) -12 (b) 27 (c) -6 (d) none of these.	Solve for the unknown in probs. 16-18.
11. $(-3)(-2)(-4) =$ (a) -9 (b) -24 (c) 24 (d) none of these.	16. $x - 5 = 14$ (a) $x = -2\frac{4}{5}$ (b) $x = 9$ (c) $x = -19$ (d) none of these.
12. $\frac{0}{4} =$ (a) zero (b) four (c) undefined (d) cannot be determined.	17. $\frac{R}{3} + 1 = 4$ (a) $R = 3$ (b) $R = 9$ (c) $R = 1$ (d) none of these.
13. The integers that are larger than (-6) are: (a) $(-6, -5, -4, \dots)$ (b) $(-5, -4, -3, \dots)$ (c) $(-6, -7, -8, \dots)$	18. $x - (4 + 9x) = 12$ (a) $x = 2$ (b) $x = -1$ (c) $x = -2$ (d) none of these.
14. A list of all the positive divisors of 12 is: (a) 1, 2, 3, 4, 6, 12 (b) 2, 3, 4, 6 (c) 3, 4 (d) none of these.	19. A man is twice as old as his son and their combined age is 45. How old is the man? (a) 22 years (b) 15 years (c) 30 years (d) none of these.
15. $6A + 9AB - 3A =$ (a) $12AB$ (b) $3A + 9AB$ (c) $6A + 6B$ (d) none of these.	20. What is 2^5 ? (a) 32 (b) 10 (c) 25 (d) none of these.

21. $(a^2)(a^3) =$ (a) a^6 (b) a^5 (c) a (d) none of these.	27. Multiply: $2x(4x^2 - 3x)$ (a) $4x^3 - 6x^2$ (b) $8x^3 - 6x^2$ (c) $8x^2 - 6x^2$ (d) none of these.
22. $y^8/y^2 =$ (a) y^4 (b) y^6 (c) $1/y^6$ (d) none of these.	28. $(A - 4B)^2 =$ (a) $A^2 - 16B^2$ (b) $A^2 + 16B^2$ (c) $A^2 - 8AB + 16B^2$ (d) $A^2 - 8B^2 + 16B^2$
23. $(-3x^2)^3 =$ (a) $-9x^5$ (b) $9x^6$ (c) $-27x^6$ (d) none of these.	29. The prime factors of $6x^2 - 2x$ are: (a) $(2x + 1)(3x - 2x)$ (b) $2x(3x - 1)$ (c) $2x(3x)$ (d) none of these.
24. Perform the indicated division: $(-50rs^2t^4) (10r^4s^2t)$ (a) $5t^3/r^2$ (b) $40 t^3/r^3$ (c) $\frac{5st^3}{r^3}$ (d) none of these.	30. The prime factors of $8A^2 - 10A - 3$ are: (a) $(8A - 1)(A + 3)$ (b) $(4A - 1)(2A + 3)$ (c) $4A - 3)(2A + 1)$ (d) none of these.
25. What is the square root of 64? (a) 32 (b) 4^2 (c) 8 (d) none of these.	31. $\frac{a}{bc} + \frac{3}{c} =$ (a) $\frac{3a}{bc}$ (c) $\frac{a + 3}{c}$ (b) $\frac{a + 3b}{bc}$ (d) none of these.
26. The 27 in simplest radical form is: (a) 27 (b) $9\sqrt{3}$ (c) $3\sqrt{3}$ (d) none of these.	32. Solve for x: $\frac{x + 1}{3} + \frac{x - 1}{2} = 4$ (a) $x = \frac{4}{5}$ (c) $x = 5$ (b) $x = 1$ (d) none of these.

33. Solve for x : $bx + ab = c$

(a) $c - 2b - a$

(b) $\frac{-ab + c}{b}$

(c) $c - b$

(d) none of these.

35. Determine the ordered pair (x-value and y-value that satisfies the following equations:

$$2x + y = 5$$

$$x - 2y = 5$$

(a) $x = 3, y = 1$

(b) $x = 2\frac{1}{2}, y = 0$

(c) $x = 2, y = 1$

(d) none of these.

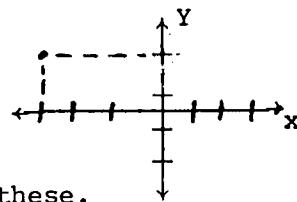
34. Determine the coordinates of the following point:

(a) $(3, 2)$

(b) $(-3, 2)$

(c) $(2, -3)$

(d) none of these.



36. Determine two values of x that satisfy the following equation:

$$x^2 - 7x - 18 = 0$$

(a) $-7, 2$

(b) $2, -9$

(c) $9, -2$

(d) none of these.

MATHEMATICS PLACEMENT EXAMINATION
ANSWER SHEET
FORM A

Name:		Phone:		Social Security No.	
Street Address:		City & State:		Zip Code:	
High School Diploma From:		Year Grad.	Score 1 _____ Score 2 _____	Student Assigned To:	
Math High School Grades:	Gen. Math _____ Alg. I _____	Alg. II _____ Geometry _____	Adv. Math _____ College _____	Type Student _____	Ma 117 _____ Ma 115 _____ Ma 105 or *Ma 105 _____ *Ma 105 _____
Technology or Major at CSTCC _____		High School Grade Pt. Average _____	Full Time Student _____		

PLEASE COMPLETE ALL OF THE ABOVE QUESTIONS BEFORE TURNING IN FORM.

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- | | A | B | C | D |
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| 36. | () | () | () | () |

MATHEMATICS PLACEMENT TEST
FORM B

USE SEPARATE ANSWER SHEET

DO NOT WRITE ON THIS SHEET.

1. Write in numerals:

Seven thousand, six hundred four.

- (a) 70,604
(b) 7,640
(c) 7,604
(d) none of these.

2. Write in words: 203,507

- (a) twenty-three thousand,
five hundred seven
(b) two hundred three thousand,
five hundred seven
(c) two hundred three thousand,
five hundred seventy
(d) two hundred three,
five hundred seven
(e) none of these.

3. Subtract:
$$\begin{array}{r} 40,503 \\ -22,916 \\ \hline \end{array}$$

- (a) 18,587
(b) 17,687
(c) 17,587
(d) 28,587
(e) none of these.

4. Add:
$$\begin{array}{r} 4,673 \\ 8,927 \\ \hline 7,806 \end{array}$$

- (a) 21,496
(b) 30,396
(c) 21,386
(d) 21,596
(e) none of these.

5. Multiply and choose the set in which all three answers are correct:

- (a) $9 \times 9 = 81$
 $4 \times 7 = 26$
 $7 \times 8 = 56$
(b) $8 \times 9 = 74$
 $8 \times 4 = 32$
 $4 \times 6 = 24$
(c) $6 \times 7 = 44$
 $9 \times 7 = 63$
 $6 \times 6 = 36$
(d) $8 \times 6 = 48$
 $9 \times 5 = 45$
 $5 \times 6 = 30$
(e) none of these.

6. Multiply
$$\begin{array}{r} 305 \\ \times 470 \\ \hline \end{array}$$

- (a) 14,350
(b) 143,350
(c) 33,550
(d) 133,450
(e) none of these.

7. Divide: (Indicate if there is a remainder. For example, $7 \div 3 = 2R1$)

$$\frac{58}{8} = ?$$

- (a) 7 R2
(b) 7
(c) 6 R6
(d) 8 R4
(e) none of these.

8. Same instructions as in problem 7. $83 \overline{)54,384}$ (a) 65 R43 (b) 663 R18 (c) 655 R19 (d) 667 R23 (e) none of these.	13. Select the correct value of the missing number: $\frac{3}{7} = \frac{24}{?} =$ (a) 8 (b) 42 (c) 16 (d) 56 (e) none of these.
9. Find the value of 2^4. (a) 256 (b) 8 (c) 16 (d) 32 (e) none of these.	14. Reduce to lowest terms: $\frac{12}{18} = \frac{?}{?}$ (a) $\frac{1}{2}$ (b) $\frac{3}{4}$ (c) $\frac{2}{3}$ (d) $\frac{4}{6}$ (e) none of these.
10. Find the value of: $\frac{(8)(6)}{2}$ (a) 12 (b) 7 (c) 24 (d) 10 (e) none of these.	15. Change $7\frac{5}{6}$ to an improper fraction. (a) $\frac{41}{6}$ (b) $\frac{45}{6}$ (c) $\frac{41}{5}$ (d) $\frac{48}{5}$ (e) none of these.
11. Find the value of $2 \times (3 + 1)$ (a) 7 (b) 5 (c) 6 (d) 4 (e) none of these.	
12. If 6 articles cost \$1.80, find the cost of 15 articles. (a) \$2.00 (b) \$3.00 (c) \$4.50 (d) \$3.80 (e) none of these.	

16. Add and reduce answer to lowest terms:

$$\frac{2}{3} + \frac{1}{4} = ?$$

- (a) $\frac{3}{7}$
 (b) $\frac{2}{12}$
 (c) $\frac{1}{6}$
 (d) $\frac{11}{12}$

(e) none of these.

17. Add and reduce to lowest terms:

$$\frac{1}{12} + \frac{3}{12} = ?$$

- (a) $\frac{4}{24}$
 (b) $\frac{1}{6}$
 (c) $\frac{1}{3}$
 (d) $\frac{1}{4}$

(e) none of these.

18. Subtract: $5 - 2\frac{2}{5} = ?$

- (a) $3\frac{2}{5}$
 (b) $2\frac{3}{5}$
 (c) $3\frac{3}{5}$
 (d) $2\frac{2}{5}$

(e) none of these.

19. Subtract: $\frac{3}{8} - \frac{3}{16} =$

- (a) $\frac{3}{8}$
 (b) 0
 (c) $\frac{3}{32}$
 (d) $\frac{3}{16}$

(e) none of these.

20. Multiply: $\left(\frac{2}{3}\right) \left(\frac{9}{11}\right) = ?$

- (a) $\frac{6}{11}$
 (b) $\frac{4}{11}$
 (c) $1\frac{7}{11}$
 (d) $\frac{18}{33}$

(e) none of these.

21. Multiply: $2\frac{1}{2} \times 6 \times \frac{7}{15} = ?$

- (a) $\frac{1}{9}$
 (b) $\frac{1}{4}$
 (c) 4
 (d) 9

(e) none of these.

22. Simplify the complex fraction:

$$\frac{\frac{1}{6}}{\frac{2}{3}}$$

- (a) $\frac{1}{9}$
 (b) $\frac{1}{4}$
 (c) 4

(d) 9

(e) none of these.

23. Divide: $\frac{3}{5} \div \frac{5}{6} = ?$

- (a) $\frac{1}{2}$
- (b) $1\frac{7}{18}$
- (c) $\frac{18}{25}$
- (d) 2
- (e) none of these.

24. Select the correct value of the missing number:

$$\frac{507}{10000} = ?$$

- (a) 0.507
- (b) 0.00507
- (c) 0.057
- (d) 0.0507
- (e) none of these.

25. Add: $17.8 + 0.524 + 3.18 = ?$

- (a) 21.504
- (b) 10.20
- (c) 21.54
- (d) 20.504
- (e) none of these.

26. Subtract: $5.04 - 4.587 = ?$

- (a) 0.453
- (b) 1.453
- (c) 0.563
- (d) 1.563
- (e) none of these.

27. Divide: $1.324 \div 0.04 = ?$

- (a) 3.31
- (b) 0.331
- (c) 33.1
- (d) 331
- (e) none of these.

28. Change to a decimal: Example:

$$\frac{1}{16} = 0.0625 \text{ or } 0.06\frac{1}{4}$$

$$\frac{3}{8} = ?$$

- (a) 0.325
- (b) 3.75
- (c) 37.5
- (d) $0.37\frac{1}{2}$
- (e) none of these.

29. Change to a common fraction in lowest terms: $0.025 = ?$

- (a) $\frac{1}{4}$
- (b) $\frac{1}{40}$
- (c) $\frac{1}{400}$
- (d) $\frac{1}{80}$
- (e) none of these.

30. Find the value of: $\frac{.04 + 0.3}{.09 + .08}$

- (a) 0.2
- (b) $\frac{7}{17}$
- (c) 2
- (d) 20
- (e) none of these.

31. Find the value of: $\sqrt{16}$ (a) 8 (b) 4 (c) 256 (d) 32 (e) none of these.	34. Change the decimal to an equivalent percent: $1.37 = \underline{\hspace{1cm}}\%$ (a) 1.37% (b) 137% (c) 13.7% (d) 0.0137% (e) none of these.
32. If 2.4 lb. cost 5.6¢, how many pounds will cost 6.3¢ (a) 3.2 lb. (b) 2.1 lb. (c) 2.7 lb. (d) 3.0 lb. (e) none of these.	35. \$1.50 is $\underline{\hspace{1cm}}\%$ of \$6.00? (a) 40% (b) 25% (c) 4.0% (d) 125% (e) none of these.
33. Find 18% of 2.3: (a) 0.0414 (b) 4.14 (c) 41.4 (d) 0.414 (e) none of these.	36. If the rate of interest is 7% per year and the interest for one year is \$52.50, find the principal: (a) \$367.50 (b) \$7,500 (c) \$820 (d) \$750 (e) none of these.

MATHEMATICS PLACEMENT EXAMINATION
ANSWER SHEET
FORM B

Name:		Phone:		Social Security No.:	
Street Address:		City & State:		Zip Code:	
High School Diploma from:		Year Grad.	Score 1 _____ Score 2 _____		Student Assigned To:
Math High School Grades:	Gen.Math _____ Alg. I _____	Alg. II _____ Geometry _____	Adv. Math _____ College _____	Type Student _____	Mg 165 _____
Technology or Major at CSTCC _____		High School Grade Pt. Average _____	Full Time Student _____		*Ma 100 _____

PLEASE COMPLETE ALL OF THE ABOVE QUESTIONS BEFORE TURNING IN FORM

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| 36. | () | () | () | () | () |

VITA

Herbert Lowe Hooper, Jr. was born in Ooltewah, Tennessee, on January 11, 1937. He attended elementary school in that community and graduated from Ooltewah High School in June 1955. After one year at the University of Florida, he transferred to the University of Tennessee at Knoxville and graduated in June 1960, with a Bachelor of Science degree in accounting.

After a tour of duty with the United States Army, he taught mathematics at East Ridge High School in Chattanooga, Tennessee, from January 1962 until June 1964. In September 1964, he entered the Graduate School of The University of Tennessee at Knoxville as a member of The University's National Science Foundation's Academic Year Institute. In June 1965, he received the Master of Mathematics degree.

From June 1965 to September 1967, he taught mathematics at the McCallie School in Chattanooga, Tennessee. In September 1967, he began teaching mathematics at Chattanooga State Technical Community College. From 1967 to June 1979, he has served as mathematics instructor, mathematics department head, and acting division head for the Instructional Materials Center.

In the summer of 1970, he attended a SREB institute in statistics at Southern Methodist University. From September 1975, through August 1978, he completed the course work for

the Doctor of Education degree in curriculum and instruction, with an emphasis in mathematics education. He is a member of the Tennessee Mathematics Teachers Association and the National Council of Teachers of Mathematics.

Herbert is married to the former Brenda Garrett and has one child, Ann-Marie, 11.