An Evaluation of a Self-Assessment Test Used to Predict Success in Introductory College Mathematics Courses

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Abstract

The purpose of this research was to determine the ability of a self-assessment test to predict success in introductory college mathematics courses. The test is administered by the Mathematical Sciences Department at Salisbury State College. It is a twenty question multiple-choice test. It is given on the first day of class, graded and returned to the students for interpretation of their chances of succeeding in the course. Data for the evaluation was collected from the graded answer sheets, a student survey, an instructor survey, and unofficial student advisory sheets. The data was analyzed using a statistical package for SPSSX and a program, "Test Grader", available on the VAX 11/780 at Salisbury State College. The test was analyzed to determine item difficulty, item discrimination, and reliability and validity coefficients. The information from the surveys was used primarily for descriptive purposes. Results of the evaluation revealed that the testing procedures are acceptable. The screening and Self-Assessment Test that is currently in use has a degree of reliability and validity to justify its continued use. However, there was evidence that suggested that a shorter version of the current test

may be just as adequate for predicting academic success in the introductory mathematics courses at Salisbury State College.

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Chapter I

Introduction

Education of the masses has been a significant issue in the history of the United States. For the early colonists, the importance of education was an offshoot of their religious zeal. Colonial legislatures, influenced by their strong association with the church, and individual religious groups established schools promptly to propagate their faith and to enhance the general good of the community. When the thirteen colonies became an independent nation, new philosophies influenced education. If the authority of the new republic was to rest on the consent of the people, then all individuals would need to be educated for their responsibilities as citizens of a democracy. Public education became available to more people because of its democratizing effects. Mandatory school attendance for all children reflects our society's strong belief in education.

The growth of towns and commerce, the rise of a strong middle class, and increased industrialization and technology gave rise to new occupations and a need for more sophisticated training and skills. A high school diploma became mandatory for participation in the work force of our modern society. As people became educated to meet the demands of a changing society, the values of the society also changed. Education no longer just served the needs of religion, a new government, or industry; to be well educated became a value. Slowly, the number of students persuing an academic career beyond high school grew.

And the cycle continues. Our society is only beginning to adjust to the changes brought about by computer technology. New occupations and skills that accompany this technology require educational experiences beyond high school. Technical schools, community colleges, traditional four year colleges, and universities are experiencing increasing enrollments. Of course, not all of those pursuing advanced degrees or certification are doing so merely for job opportunities. As our society has become more sophisticated and standards of living have risen, higher education has become a goal for more people. By 1990 almost one half of the population will have attended college (Crary, Pfahl & Donaldson, 1980).

While more people are seeking experience in higher education, colleges have to deal with the problems created by large numbers of applications.

One of the problems is determining the suitability of the applicant for the programs that the institution offers. The "open door" policy at most community colleges has brought to those campuses the largest student population in the history of higher education. It has also brought many students who have not mastered skills necessary for success in most college-level courses. Selection of applicants for admission to four-year colleges and universities has been extensively studied. The purpose of some of these studies has been to predict college grades or grade-point averages using the applicant's high school performance and/or scores on scholastic aptitude or achievement tests. Some studies have also used personality, attitude and demographic variables to predict success (Crooks, 1980, p.2).

However, the problem does not end once the student is admitted to a college or university. A student who seems to demonstrate potential for success at the college may not succeed in a specific program, department, or course. For example, the placement of students in an appropriate introductory college mathematics course relative to their background and/or abilities is a problem many colleges and universities face. Some students enroll in a course where they have already mastered the content. On the other hand, students can be in a course for which they do not have the necessary background. The desirable situation would be to place students in a course best suited to their backgrounds.

In order to discern a student's abilities, the college, the mathematics department, or a specified authority must devise an instrument for assessing the student's skills. After the student's level of mathematics competency has been identified, he/she can be placed in an appropriate course or remedial program. According to Hecht (1980), who has worked to validate a placement test used by colleges in New Jersey:

> If students are placed into courses according to a reasonable placement policy and on the basis of scores from a valid placement test, then instructors should find students in their courses to be appropriately prepared to deal with the demands of the course. Under ideal circumstances, the resulting composition of students should be fairly homogeneous with none overprepared for the course and none underprepared. (p.19)

A valid placement test is a test that measures a student's ability in mathematics and therefore provides information concerning a student's fitness for a particular course. The validity of a test does not rest solely on the characteristics of the test but is also a function of the use of the scores from the test (Hecht, 1980). Validation of a mathematics placement test requires evaluation of the test and evaluation of the effectiveness of the use of the scores to predict a student's suitability for a course. This is the general motivation of this study.

Statement of the Problem

The purpose of this research project is to evaluate a placement test administered to students enrolled in introductory college mathematics courses at Salisbury State College. The test is used on the assumption that the results will enable instructors and students to ascertain the student's correct placement in a course relative to their abilities. This assumption has not been verified.

The specific objectives for this research will be:

1. To perform an item analysis of the placement test.

2. To discover subsections of the placement test using the results of the item analysis.

3. To evaluate the nature of good performance versus bad performance in areas on the placement test.

4. To review the procedures used to administer the placement test.

5. To determine the reliability of the placement test as a predictor of student success in introductory college mathematics courses.

6. To determine the reliability of the placement test as a predictor of student success in introductory college mathematics courses given that the student has had the prerequisite Algebra II background.

7. To determine if a subsection of the placement test can predict student success as well as the whole test.

8. To decide how a student's performance on the placement test should be interpreted and reported to the student.

Value of the Research

The value of this research will be apparent in three phases of placement testing. Firstly, the research will evaluate the testing instrument to locate and examine items that may be extremely easy or difficult. Ambiguous questions or distractors will also be scrutinized. Subsequent changes or deletions of such questions will improve the test instrument.

Secondly, this research will add to the evidence concerning the predictive validity of the placement test being studied. The existing evidence is based on a smaller and more limited population. It has been assumed from this earlier study that the test does identify students' abilities in mathematics and can be used to predict possible success in introductory courses. This research will lend credence to that assumption.

Thirdly, with this research a clearer and more accurate report of the meaning of the placement test scores will be developed. Students, with the guidance of their instructors, should be able to use the placement test for self-assessment of their mathematics ability. Their score may indicate that they are totally unprepared for the course in which they are enrolled. It may indicate that they will need extra assistance or work to master the required material. The score may reflect the student's readiness to proceed in the course. Therefore, students will need to know how to interpret a score as it relates to the likelihood of their success in the course.

Limitations of the Research

The basic purpose of this research was to determine the ability of a placement test to predict success in introductory mathematics courses at Salisbury State College. Success has been defined as receiving a final grade of C or better. This level of performance is the standard at Salisbury State College for receiving credit for required courses in a student's major. However, the use of grades as a criterion against which to evaluate a test creates limitations for the research. One major problem is the reliability of course grades. The five-point scale, A to F, is a rough index and may contribute to the unreliability of grades. Final grades are assigned by one instructor for performance in one course at one point in time and may be influenced by many subjective factors. Grading standards will vary from instructor to instructor. In addition, highly effective instruction in a subject will tend to reduce the variance in final achievement and therefore the course grades.

There are also limitations of the research caused by the selection of the sample being studied. The data reporting the students' performances on the placement test, mathematics background and final course grades were collected from courses taught during the 1982 and 1983 semesters. The student and faculty questionnaires recording reactions to the test were administered to a different sample during the Spring semester of 1984. Therefore, students and some instructors who used the test within the last two years were not in the group whose reactions to the test will be reported. This time lag between collecting the data and reporting the results creates another problem for the research. There is no information concerning the students who withdrew from any of the courses. It would be of great value to know at what time during the semester the students withdrew from a course and its relationship to their performance on the placement test. The results for students in this category will be segregated to help compensate for the lack of more specific information on their decision to drop out of a particular course.

There were 484 subjects in the sample who reported their results on the placement test. However, there is not an equal distribution of this number over the six courses that will be studied. The unevenness of the samples may cause difficulties in making generalizations to the populations for each course.

The analysis of the correlations between scores from the mathematics section of the Scholastic Aptitude Test (SAT) and the placement test scores could have been enhanced if more data had been available. Almost one third of the student records requested did not contain the SAT scores. This problem could have been solved by requesting more records than the researcher anticipated would be necessary.

There is also a question as to the information which will generalize beyond Salisbury State College. This study is an institutional study, and as such, it has implications for placement of students in introductory mathematics courses at Salisbury State College. However, the method employed here could be used by any institution to assess a placement test.

Definitions of Terms

The placement test that is the subject of this research was designed for, and is administered to, students enrolled in six introductory mathematics courses at Salisbury State College. Since the title, reference number or content of these courses may be peculiar to Salisbury State College, the following descriptions were obtained from the 1983-1984 Academic Catalogue for Salisbury State College:

Math 110 Finite Mathematics-3 hrs. credit. For students in the behavioral, biological, management and social sciences. An introduction to functions, graphs, linear programming, probability, computing and additional topics as time permits.

Math 113 Introductory Statistics-3 hrs. credit. An introduction to the making of decisions under conditions of uncertainty. Organization and analysis of data, normal and binomial distributions, sampling, hypothesis testing, linear regression, correlation. Three hours per week.

Math 114 Introduction to Nonparametric Statistics-3 hrs. credit. An introduction to the art of making statistical inference when the distribution is unknown or mathematically intractable. Hypothesis testing, estimation, contingency tables, measures of association, efficiency. Primarily for nursing and social sciences. Three hours per week.

Math 121 Algebra and Trigonometry-4 hrs. credit. A precalculus algebra-trigonometry course. Real numbers, functions and graphs, including the study of polynomial, rational algebraic, trigonometric, exponential and logarithmic functions. Intended for students who plan to take the calculus sequence. Does not satisfy General Education requirements. Four hours per week.

Math 150 Algebra with Calculus-3 hrs. credit. Review of algebra. An introductory study of differentiation and anti-differentiation with emphasis on techniques and application. Problems will be taken from Business, Management, and other fields. Three hours per week.

Math 151 Elementary Probability and Statistics for Business-3 hrs. credit. Introduction to: Elementary Probability, Probability Distributions, Descriptive Statistics, Hypothesis Testing and Estimation. Prerequisite: 2 years of high school algebra. Three hours per week.

The following definitions have been provided to clarify terms that may be unique to this research:

Successful - To receive a final grade of C or better in a course of study.

Unsuccessful - To receive a final grade of D or F in a course of study.

Withdraw - denoted "W". To exit from a course prior to completion using the required procedures dictated by the college.

Self-assessment test - A twenty question multiple-choice test administered by the Mathematical Sciences Department at Salisbury State College to students enrolled in introductory mathematics courses. The test is administered on the first day of class. Students are informed of their performance on the test and advised of their chances to succeed in the course during the first class meeting. It is the sole responsibility of each student to use this information to decide to continue in the course or to seek remedial assistance.

Satisfying the prerequisite - To have successfully completed a sequence of Algebra I and Algebra II or to have successfully completed Mathematics 100, a remedial mathematics program, at Salisbury State College or an equivalent course from another institution.

The following definitions are also provided:

Reliability - The consistency of scores obtained from the test takers. It is a measure of how well a test measures what it purports to measure. A reliable test should sort out those who know from those who do not know.

Validity - "the extent to which a test measures what it is supposed to measure and also the appropriateness with which inferences can be made on the basis of the test results." (Sattler, 1982, p.23)

Chapter II

Review of Literature and Related Research

The research related to the prediction of mathematics achievement of college students is conflicting. Some researchers look to the information obtained from standardized tests. From the review of the literature in the article Cognitive Predictors of Final Grades in Finite Mathematics, the scores students received on the Scholastic Aptitude Test (SAT) were the best predictors of success in college followed by high school rank, high school mathematics grades, and finally intelligence quotients (Troutman, 1978). In a study reported by Richards, Holland, and Lutz (1966) the most consistently high predictor of academic accomplishment was high school grades. The study also concluded that some weighted combination of high school grades and the American College Testing Program test (ACT) is a better predictor than high school grades alone. Larkin (1983) concluded in her study that the use of the Basic Algebra and Advanced Algebra Test published by the Mathematical Association of America helped to reduce the failure rate in introductory college mathematics courses.

The study by Haase and Caffrey (1983) on assessment procedures contradicts these findings. According to their research, high school grades are almost useless as a tool for predicting mathematics achievement. High grades reported on a student's transcript may have been earned in lower competency level classes or may be affected by grade inflation. There is no way to communicate this information to the admissions office. In another study Haase (1983) declares the scores derived from the SAT and ACT ineffective as predictors of college scholarship because of the lack of applicable information at the developmental mathematics program at McNeese State University (Yellott, 1981) it was found that neither the ACT nor the Mathematical Association of America Placement Testing Program tests were effective predictors of final course grades.

Some researchers have suggested using a variety of students' traits instead of scores earned on achievement tests to predict success in college mathematics courses. Intelligence, self-concept, age, reason for taking the course, mathematics interest, and attitude toward mathematics have been posited as predictive variables (Frerichs & Eldersveld, 1981). In a paper presented at the 1981 meeting of the

American Educational Research Association, instructional style and cognitive style were added to the list of variables. Successful students were characterized as those who elected a traditional style of instruction, were older, assessed their own mathematics skills higher and scored high on mathematics achievement tests (Frerichs & Eldersveld, 1981). These findings were also reported by Barbara Ann Kimes (1973) who added that sex, enrollment status, employment status, future plans after college, and the educational level of the students' parents were not factors that were likely to aid in predicting student accomplishment. Other factors that seem to make no significant contribution include membership in a minority group, attendance in high school advanced placement mathematics, or attendance in algebra courses of varying lengths (Helmick, 1983).

The factor that seems most useful for predicting success in introductory college mathematics courses is the score obtained from tests designed by the institutions that administer the test and use the results. Terence J. Crooks (1980, p.3) refers to these tests as "context-specific predictors". Although the purpose of his work was to find the best predictor of success in an introductory college physics course, much of his discussion and findings are relevant to this paper. Crooks first reports that high school percentile rank or high school grade point average has been the best single predictor of potential academic achievement. Scores from scholastic aptitude tests and standardized achievement tests yield slightly lower results. In general only slightly modest improvements in predictability have resulted from including personality, attitude, and demographic variables.

It is Crooks belief that prediction can best be improved by using different predication equations for specific courses, curricula, or departments instead of looking for a general measurement of college success. This end is best met by locally designed tests, homemade tests as it were. To quote Crooks:

> I believe that a major reason for the limited success of differential predication studies has been the almost universal reliance on widely used and broadly conceived prediction variables. The variables, such as high school percentile rank, ACT scores, SAT scores and standardized achievement test scores, have achieved such wide usage largely because they are general in nature and tend to predict performance in diverse settings and subjects rather well. For this reason, they may not be very well suited to use in differential prediction. The present (Crook's) study compares the usefulness of variables developed specifically for a particular setting (pp. 3-4)

Crooks correlated final course marks with ACT mathematics scores, SCAT quantitative scores, and with a twenty-five minute test specifically designed to assess mathematics skills needed to understand the course marks with a correlation r=.60. The two general measures of mathematics skills correlated .43 and .45, respectively with the course marks. According to Crooks, "The use of context-specific predictors seems likely to be of greatest benefit when predicting performance in individual courses." (p. 8).

Similar results were reported by Faith Illeen Helmick (1983). The purpose of her study was to investigate the predictive capabilities of selected variables i.e., scores on an institutionally designed mathematics placement test, the overall high school grade-point-average, and the ACT mathematics scores and develop a usable prediction model to place students in appropriate courses. The study concluded that the placement test was an appropriate and easily usable predictor of performance.

A mathematics placement test written by a faculty member at Lake Superior College was found to be a prediction tool superior to the recommendations from mathematics professors following individual student conferences. The student's high school transcript, ACT profile, and admission application were made available to the professors. Although there was no significant difference between the predictive abilities of the Lake Superior test and two standardized tests, the investigator recommended adoption of the former as the preferred placement test (Bone, 1981).

Lawrence W. Hecht (1980) found the New Jersey College Basic Skills Placement Test to have an acceptable degree of predictive validity to justify its continued use for colleges in New Jersey.

To evaluate the Screening and Self-Assessment Test used at Salisbury State College several test characteristics will be examined through an item analysis. The first of these will be item difficulty or easiness percentages. Item difficulty refers to the percentage of students who get each item correct. The higher the easiness percentage the easier the test item is. Extremely difficult or extremely easy items add little information about academic performance (Nunnally, 1972). It is felt by most instructors that test questions should start easy and gradually get harder to get a wide spread of scores. What actually happens is a narrower spread than if all items were approximately equal in difficulty

(Diedrich, 1964).

According to Jim C. Nunnally (1972) this rating is ideal if 50% of the students pick the correct response for each question. The way this works is that on each item a somewhat different 50% would get the item correct. Only if the items measured exactly the same thing would the same 50% get all of the items correct. Since the 50% would be composed of somewhat different students on each item, there is ample room for one student to get all of the items correct and for another to get none of the items correct. It is hard to determine the most appropriate easiness percentages for a multiple choice test because guessing is an important factor. For example, with four choices a test-taker has a 25% chance of guessing the correct answer. Questions with an easiness percentage or item difficulty of 20% could be answered by chance alone (Nunnally, 1972). Multiple choice tests with four responses are more popular than five responses because it is hard to create five different plausible choices unless one is "none of these" (Diederich, 1964).

Another important factor of item analysis is the determination of the extent to which each item measures the same thing as the total test. This measurement is the index of discrimination. If all other factors are equal, a test question with a large index of discrimination is a better contributor to the whole test than an item with a smaller index. A negative index may indicate an ambiguous question or a mistake (Nunnally, 1972). The index of discrimination used in this study is the point biserial correlation. It shows the extent to which testers who did well on the whole test did better on a particular item than testers who did poorly on the whole test.

An analysis of the distribution of the responses for each question on the multiple choice test provides additional information about the test. If incorrect alternative answers receive 5% or less of the testers' response it may indicate a bad distractor that should be eliminated from the choices. If a distractor is chosen more than the correct answer, the item may be ambiguous (Nunnally, 1972).

One of the most common methods of validating educational tests is the examination of the relationship between test scores and final course grades. The correlation between test scores and final grades are called validity coefficients (Hecht, 1980). The relationship between scores obtained prior to instruction and final grades can be predictive. However, instruction affects the predictive ability of test scores and reduces the validity coefficient. If there is a time lapse between obtaining a placement test score and issuing a final grade and effective instruction takes place in the intervening time period some students' final grades could be much higher than anticipated.

The reliability of a test must also be analyzed. A test is reliable if it provides highly precise indications of students' standings with respect to one another. A correlation coefficient, denoted r, indicates the extent to which persons are ordered alike on two measures. When the correlation coefficient is used to measure how well two tests correspond it is called a reliability coefficient. Values of r close to one indicate that test-takers are ranked the same on both tests. If the tests' results are due entirely to chance there would be practically no relationship between the two tests and r would equal zero. A correlation coefficient of -1 indicates an inverse ranking (Nunnally, 1972). The wider the range of developed mathematical skills in the sample of testers, the greater the reliability of the self-assessment test (Miles, 1982).

This review summarizes some of the most recent findings concerning the validation of "homemade" placement tests to predict success in introductory college mathematics courses. The research cited discusses the controversy amoung educators as they seek an appropriate model for predicting mathematics achievement. Standardized tests, high school rank, high school grades, non-academic student traits, and demographic information have received conflicting accounts on their ability to predict performance in introductory college mathematics courses. This review of literature provides evidence to support the use of "context-specific" tests as predictors of academic performance. Although the test to be studied in this research is not a placement test in the strictest sense, it is a self-assessment tool; the aforementioned studies are relevant. The review also includes a description of the types of statistical procedures that will be used to evaluate a self-assessment test as a prediction tool.

Chapter III

Design of the Investigation

This study was conducted at Salisbury State College in Salisbury, Maryland. Its purpose is to evaluate the ability of a self-assessment test to predict student success in introductory college mathematics courses. The self-assessment test is a twenty question multiple choice test. It is administered to all students in six introductory courses on the first day of class. These courses are: Finite Mathematics (110), Introductory Statistics (113), Introduction to Nonparametric Statistics (114), Algebra and Trigonometry (121), Algebra with Calculus (150), and Elementary Probability and Statistics for Business (151). Several sections of each course are offered every Fall and Spring semester.

The data required for the analysis of the self-assessment test was taken from graded answer sheets of the students enrolled in the introductory courses during the semesters of 1982 and 1983. The graded answer sheets (see Appendix B) provide the following information for each student: name, instructor's name, and a summary of the mathematics courses taken in grades nine through twelve. The answer sheet is also a record of the student's responses to each multiple choice question, the correct response for any question incorrectly answered, and a score reported as the total number wrong on the test. Unanswered questions are counted as incorrect. All faculty members who were responsible for one or more sections of the introductory courses were asked at the beginning of the semester to keep the graded answer sheets and to add to them the students' final course grades or a "W" for students who withdrew during the semester. These answer sheets were collected and each one was assigned an identifying number. The number was composed of the student's score from the mathematics section of the Scholastic Aptitude Test (SAT-M), if available, and coded information identifying the course, whether a student had satisfied the prerequisite, the student's final course grade, and the student's score on the self-assessment test, converted to the number correct. The SAT-M scores were obtained from unofficial faculty advisory sheets for individual students. This identification number and a record of the stuents' responses to each question on the test were stored in a data file.

During the Spring semester of 1984, a survey (see Appendix D) was administered to students enrolled in the six introductory courses. The purpose of the survey was to obtain student reactions to the self-assessment test and the testing procedures. The surveys were distributed to the instructors of those courses who then administered them to their students. Nine of the questions on the survey were objective and required the student to choose the most suitable response of those provided. Four of these questions could be answered by choosing yes or no. The tenth question asked the student to speculate about their course grade at the time of the survey.

At the same time, a survey (see Appendix E) was also administered to the instructors of those mathematics courses. The instructors were asked to choose yes or no responses to several questions concerning the content of the self-assessment test and the procedures used to give the test. They were asked to judge the test's ability to predict success in introductory courses. The survey also tried to elicit from the faculty members any other observations, judgements, or comments they wanted to make concerning the test.

The subjects for the analysis of the self-assessment test were 484 students enrolled in one of the six introductory mathematics courses during the 1982 and 1983 academic years. In the Spring of 1984, 237 students from these courses responded to the survey. The majority of the students enrolled in sections of 150 and 151 are business majors. In 114 the majority seems to be nursing students. The sections of 110, 113 and 121 are populated by a more diverse group. Math 110 and Math 113 are probably being taken by students to satisfy a general education requirement. According to the information reported by the students on the self-assessment test answer sheet, most of the students have had Algebra I, Algebra II, and Geometry during their high school years. Many of the students have also had a high school trigonometry course. Some went on to a pre-calculus or calculus course by the twelth grade. A few students were enrolled in a business curriculum in high school and consequently studied business mathematics.

Table 1 shows the distribution of the 484 students in the sample over the courses studied and what percentage of those students satisfied course prerequisites. SAT-M scores were obtained for 148 students from the sample. The table provides a distribution for these students over the SAT-M scores grouped by hundreds. There is no SAT-M scores information for students from 151.

Table 1

Distribution of Students in the Sample by Number, Percent Satisfying Prerequisite, and SAT-M Score for Each Introductory Course

Course	N=	% sat. prereq.	% Distribution in SAT-M Groups 200-299	300-399	400-499	500-599	600-699
110	81	84	0	7	68	25	0
113	131	81	0	10	45	39	6
114	99	82	3	24	55	15	3
121	29	90	0	10	60	25	5
150	101	87	0	8	61	25	6
151	43	95	-	-	-	-	-

Prior to this study, the self-assessment test had been evaluated to determine its ability to predict academic achievement in sections of 110 and 113. This analysis was performed by Dr. David L. Parker, then an assistant professor in the Mathematical Sciences Department at Salisbury State College. Dr. Parker requested that instructors of the two courses keep the test answer sheets and submit them to him at the end of the semester with a record of the final grade for each student. Dr. Parker's analysis consisted of a talley of the scores achieved on the test and the students' corresponding grades. Probabilities for success in the respective courses were derived from these tallies. Dr. Parker repeated this procedure the following semester and reported similar findings. A summary of his findings are reproduced on the instructors' direction sheets that outlines the procedures for administering the self-assessment test (see Appendix C). These findings are also explained to the students after the graded answer sheets are returned to the class so that students may interpret their scores for possible success.

Description of Instruments

The self-assessment test (see Appendix A) which is the object of this study was designed by Dr. David L. Parker and first used at Salisbury State College in the Fall semester of 1977. This institutionally designed test was chosen over available commercial tests because it required only fifteen minutes to administer. For two reasons the implementation of such a test was thought necessary. First, students who had the required background but still lacked competency in those areas were enrolling in the introductory college mathematics courses. The "diagnostic" or self-assessment test would help to identify students with inadequate mathematics skills. Those students would be given the recommendation to enroll in Mathematics 100, a remedial course, or an intermediate algebra course. The second reason was that some of the students with only Algebra I background seemed competent enough to allow them admission into the introductory courses. The self-assessment test acts as an "on the spot" check of students' skills in mathematics regardless of their status with respect to prerequisites. The results of the test are used to advise students to take Mathematics 100, to get individual help during the semester, or to stay in the course.

The test is composed of twenty multiple-choice questions. Each question has five responses labelled A through E. The last response, choice E, is "none of these" for all of the questions. The students are instructed not to write on the test since the test copies are used repeatedly. Each student is given an answer sheet on which to indicate their choice for each question (see Appendix B).

The test is administered using the same procedure each time. Within a few minutes of the beginning of the first class meeting a student helper from the mathematics department brings copies of the test and answer sheets to the classroom. The instructor explains the self-assessment nature of the test and that therefore their performance on it is not part of their final grade. Students are given the answer sheets and asked to fill in the relevant information. Next, the tests are distributed and fifteen minutes are allowed to complete the test. At the end of that time, the answer sheets and tests are collected by the instructor and returned to the student helper. The tests are immediately graded, the number wrong written at the bottom of each test, and returned to the instructor before the end of the first class meeting. Using the probabilities on the direction sheet given to each instructor (see Appendix C), the instructor explains how the students should interpret their scores.

The test items follow a conventional mathematics pedagogical scheme. The first questions are related to arithmetic skills, are followed by algebraic expressions using one unknown, and end with higher degree equations and expressions using two or more unknowns. Specifically, questions one through three are computations with fractions. In question four a negative integer is raised to an odd power. Question five uses radical notation. Questions six and seven involve order of operations with whole numbers. A knowledge of fraction, decimal, and percent equivalents is tested in questions eight and nine. Questions ten through twelve introduce variables by requiring the students to solve equations with one unknown. In question thirteen an expression must be evaluated using the given substitution. The students must translate English instructions into appropriate mathematical expressions in questions fourteen and fifteen. Question sixteen seeks the solution of a system of two equations in two unknowns. In the next question an unfamiliar formula must be re-written for the required variable. Questions number eighteen and nineteen ask the students to multiply two binomials. The last question presents the equation of a line in the slope-intercept form. The students must choose the correct graph of the line from four graphed lines or choice E.

In the Spring semester of 1984, 237 students were asked to respond to a survey about the self-assessment test and the testing procedures (see Appendix D). This survey was designed by the researcher and administered with the cooperation of the mathematics faculty. The purpose of the survey was to try to determine what impact the self-assessment test had on students who remained in the introductory courses after taking the test. Question number one tried to determine if students were locked into the course for a requirement. Question two was asked to determine if the self-assessment testing procedure evokes undue anxiety that might affect the students' scores. Question number three is the most important question about the test in view of its self-assessment nature. Since the instructors may only advise students concerning their correct placement in a course, students must clearly understand the reason for taking the test. Question number four asked if they remembered their scores. Questions five through eight were intended to gain insight on the students' reactions to the test and the testing procedures as a "self-diagnostic" process. Question number nine was asked in anticipation of the analysis of the students who had satisfied the prerequisites versus those who had not. The purpose of question ten was to possibly reinforce information gained from question one i.e., some students must take a course to satisfy the requirements of their major and do so with little or no consideration of their mathematics ability. Also, if most of the students report they are successful in the course this may indicate that the self-assessment test screened the students effectively.

The instructors of these courses were also asked to respond to a survey (see Appendix E). On their survey, question one asked the instructors to judge the students' use of the test to determine their placement in an appropriate mathematics course. In questions two through four the instructors must evaluate the content of the test in view of its purpose to identify students with inadequate mathematics skills. The test's ability to predict success is being rated for each course in questions five and six. Questions seven and eight ask for the instructors' review of the testing procedures. The survey ends with an opportunity for the instructors to make any additional comments.

Statistical Techniques

The coded information in the student identification number and the record of the students' responses to the twenty questions on the self-assessment test were analyzed using a statistical package for SPSSX available on the VAX 11/780 at Salisbury State College. The same information was also analyzed by the program "Test Grader" which is also on the VAX 11/780.

The results of the student and faculty surveys were analyzed by tallying individual responses to each question and then computing the corresponding percentages.

Chapter IV

Analysis of the Data

The purpose of this study was to evaluate the ability of a self-assessment test to predict academic success in introductory mathematics course at Salisbury State College. The data used in this evaluation process was collected from surveys administered to students enrolled in those courses and from the instructors of these introductory courses. Past records of students' performances on the self-assessment test, final course grades, prerequisite information, and individual SAT-M scores were also used in the analysis. The data is presented in ten sections:

1. The results from the student survey

2. The results from the instructor survey

3. The results of the item analysis for the entire self-assessment test

4. The results of the item analysis for conspicuous subsections of the self-assessment test

5. An evaluation of the nature of good performance versus bad performance in areas of the self-assessment test

6. A review of the procedures used to administer

7. Correlations between the scores on the self-assessment test and SAT-M scores and between scores and final course grades

8. An analysis of the reliability of the self-assessment test as a predictor of student success given that the student has fullfilled the course prerequisites

9. An analysis of subsections of the self-assessment test that may predict success as well as the whole test

10. A summary that will provide the interpretation of student scores on the self-assessment test for each introductory course served

Student Survey

As described in Chapter III, the student survey was administered to 237 students enrolled in the six introductory mathematics courses in the Spring semester of 1984. The results of the survey are included with a copy of the survey (see Appendix D). The number in the blank before each response is the percentage of students responding to that question with that choice. Many students picked more than one response for question one. Some of the questions were not analyzed because, in retrospect, some of the questions were badly worded or the responses supplied were open to many interpretations.

The survey was conducted after the schedule adjustment period. At that point in the semester students must complete the course or receive an F. It was therefore not surprising that 88% of the students responded that they were taking the course to fullfill a requirement for their major, another course, or general education requirements. Only 24% of the students were worried about taking the test on the first day of class; only 8% reported being unsure about this procedure. Thirty six percent of the sample thought the test should be given prior to the first day of class. The scores on the test did not influence 64% of the students who made a decision to stay in the course. The results of question six seem to indicate that students don't use their instructors advice in conjunction with their test results to determine their correct placement.

Instructor Survey

The instructors of the introductory mathematics courses for the Spring semester of 1984 at Salisbury State College were asked to respond to an eight question survey. Six instructors returned completed surveys. Since that number is so small, percentages for the survey responses were not calculated. This was one problem encountered in the research. The survey should have been supplied to more instructors in the Mathematical Sciences Department. Like the student survey, this survey also had some weak items which will be omitted from the discussion.

Those instructors responding unaminously agreed that students use the results of the self-assessment test to judge their correct course placement. Four of the instructors responded that mastery of the skills presented on the test was necessary for success in introductory courses. The same number also suggested that skills in addition to those tested were necessary for success. The suggested additions were: absolute value, inequalities, simplification of expressions, geometry, set theory, math logic, number systems, and, specifically for 150, solving a quadratic equation. Four instructors agreed that the self-assessment test should be given prior to the first day of class. Only one instructor was dissatisfied with the procedures used to administer the test. There was a complaint that it takes too much class time to give the test.

<u>Item Analysis for the Whole Test</u>

Two important results of an item analysis for a multiple choice test are the easiness percentages for each question and the index of discrimination. Tables 2 and 3 include these results for the self-assessment test which is the subject of this study. Table 2 summarizes the easiness percentages for every item on the test in each course and for the total sample. For example, for question 1, 79% of the students in Math 110 got that question correct. When the sample is examined overall, 81% of the students taking the self-assessment test answered question one correctly.

Table 2

Easiness Percentages

	Course						
Question	110	113	114	121	150	151	Total
1	79	84	69	79	85	91	81
2	82	91	81	76	88	88	86
3	68	77	72	76	80	91	76
4	83	88	84	90	86	88	86
5	80	79	69	72	85	86	79
6	78	82	74	83	82	88	80
7	94	94	89	97	96	93	93
8	33	54	37	48	52	42	45
9	74	80	69	79	86	81	78

Question	110	113	114	121	150	151	Total
10	77	76	70	72	80	86	76
11	32	55	42	31	51	49	46
12	69	62	58	69	74	72	66
13	38	56	49	45	60	67	53
14	72	79	75	72	90	98	81
15	77	75	65	72	63	74	71
16	47	61	38	55	61	74	55
17	31	48	39	45	48	51	43
18	63	70	54	72	70	81	67
19	52	61	44	69	68	81	60
20	25	53	20	41	44	70	41

According to the information summarized in Chapter II most test questions should have an easiness percentage between 50% and 70%. Using this criterion, questions one through seven, nine, ten, and fourteen are above the range for the total sample and for each course with only four exceptions i.e., question one, five, and nine in Math 114 and question three in Math 110. Questions twelve, fifteen, eighteen and nineteen are consistenely closer to fitting this criterion. Questions thirteen and sixteen have low easiness percentages for students enrolled in 110, 114, and 121. The remaining questions, numbers eight, eleven, seventeen, and twenty have consistently low easiness percentages with the exception of question twenty for students in 151.

Table 3 presents the results of the point biserial correlation obtained from the 484 tests. This is a measure of the index of discrimination. The table shows that question seven had the lowest correlation with 0.24 and that question eighteen had the highest with 0.65.

Table 3

Point Biserial Correlation

Question	Correlation	Question	Correlation
1	0.42	11	0.51
2	0.32	12	0.54
3	0.46	13	0.57
4	0.36	14	0.44
5	0.27	15	0.28
6	0.31	16	0.50
7	0.24	17	0.56
8	0.39	18	0.65
9	0.37	19	0.60
10	0.51	20	0.59

None of the responses to the questions resulted in a negative point biserial correlation. Questions two, four through nine, and fifteen have low correlations. The higher the correlation the better the question discriminates information. Questions one, three, ten, eleven, fourteen, and sixteen have more desirable values. The remaining questions, twelve, thirteen, and seventeen through twenty, have very high point biserial correlations.

The item analysis also provided the data to examine the effectiveness of the distractors. Table 4 shows the percentage of the total students sampled that picked each of the five choices provided for each item. The last column is the percentage of students who did not respond to the question. The correct response is indicated by an asterick. For example, in question one D is the correct choice and received 81% of the responses. Only 1% of the students omitted this question. Each of the four distractors were picked by less than 8% of the students.

Table 4

Distribution of Responses

Quest.	A	B	C	D	E	Blank
1	4	3	8	81*	4	1
2	86*	1	3	6	4	1
3	6	4	76*	7	3	4

Quest.	A	B	C	D	E	Blank
4	6	1	6	86*	1	1
5	3	4	79*	10	4	2
6	2	6	12	1	80*	0
7	0	1	2	93*	3	0
8	31	17	1	3	45*	3
9	6	3	9	78*	2	1
10	76*	4	4	6	6	3
11	9	4	18	46*	12	12
12	3	66*	9	2	11	10
13	53*	10	10	2	17	7
14	13	81*	1	1	2	3
15	10	71*	10	1	3	5
16	1	3	6	55*	18	16
17	43*	11	3	7	14	22
18	3	3	10	67*	5	13
19	4	60*	5	10	7	16
20	8	7	41*	6	8	31

Item Analysis for Conspicuous Subsections

The test questions for the self-assessment test have been segregated into three catagories using the easiness percentages and ranges for those percentages suggested in Chapter II. Questions one through seven, nine, ten, and fourteen had very high easiness percentages. Questions twelve, fifteen, eighteen, and nineteen have easiness percentages that fall within the ideal range. The remaining questions, eight, eleven, thirteen, sixteen, seventeen and twenty, are more difficult as indicated by low easiness percentages.

Another pattern for these groups of questions is apparent when student responses to the questions are examined. Table 5 shows that students who are successful in the course choose the correct response for a more difficult question more often than they choose the correct response for a less difficult question. Question seven, with the highest easiness percentage, was answered correctly by 54% of the successful students. Question twenty, with the lowest easiness percentage, was answered correctly by 63% of the successful students.

Table 5

Percentage of Successful, Unsuccessful, and Withdraw Students Responding Correctly to a Test Question

Ques.	Suc.	Unsuc.	W	Ques.	Suc.	Unsuc.	W
1	56	15	29	3	56	17	28
2	56	16	28	4	55	17	28

Ques.	Suc.	Unsuc.	W	Ques.	Suc.	Unsuc.	W
5	56	15	30	13	64	16	20
6	55	16	29	14	57	17	26
7	54	16	30	15	53	17	31
8	57	18	25	16	60	14	26
9	53	17	30	17	66	16	19
10	56	17	27	18	58	18	24
11	63	15	22	19	61	16	22
12	59	17	24	20	63	16	21

Examination of the point biserial correlation divides the test items into slightly different groupings. As suggested in Chapter II, the higher the point biserial correlation the better the index of discrimination. With the exception of question three, the first nine questions fall at the lower end of a desired measure. The last eleven test items have higher point biserial correlations between 0.44 and 0.65, with the exception of question fifteen with a correlation of 0.28.

Good Performance versus Bad Performance

The following graphs given in Figures 1 through 7 illustrate the distribution of test scores in each of the six introductory courses and for the entire sample. The range of scores for students enrolled in 110, and 121 was from seven to nineteen.

Students enrolled in 113 and 114 scored between three and twenty questions correct on the self-assessment test. Math 150 students received scores of six to twenty correct. With the exception of only two students who got sixes, those enrolled in 151 earned scores of eleven to twenty correct on the test.

Table 6 provides a summary of the mean test scores and standard deviations for the test results of each of the introductory courses served by the self-assessment test. Students enrolled in 114 had the lowest mean test score and students enrolled in 151 had the highest mean test score. The mean for the total sample of test-takers was 13.8.

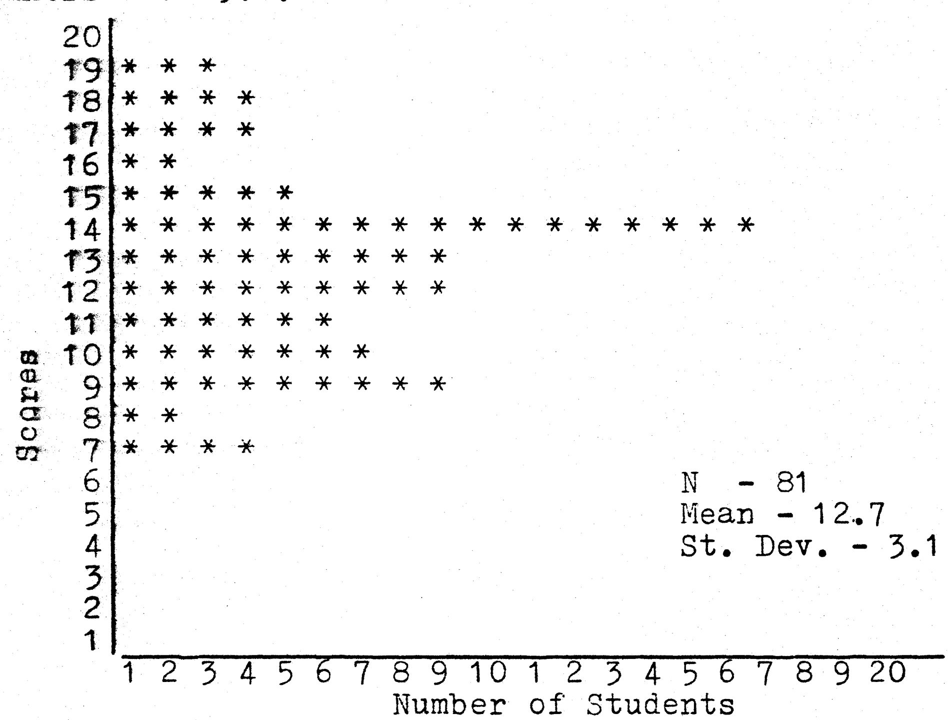


Figure 1. The distribution of the self-assessment test scores for students in Math 110.

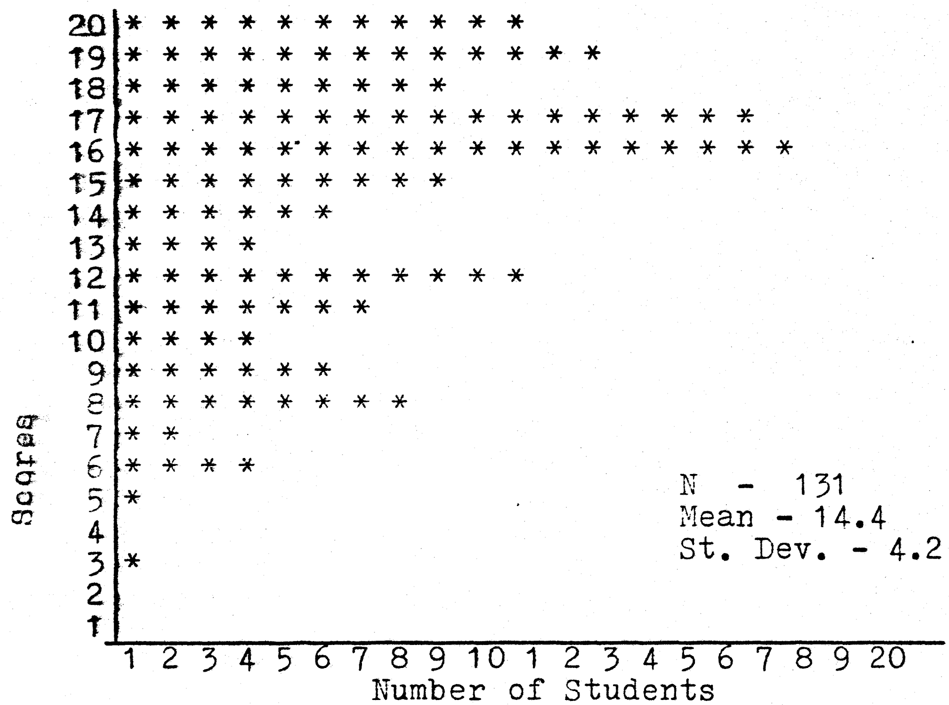


Figure 2. The distribution of the self-assessment test scores for students in Math 113.

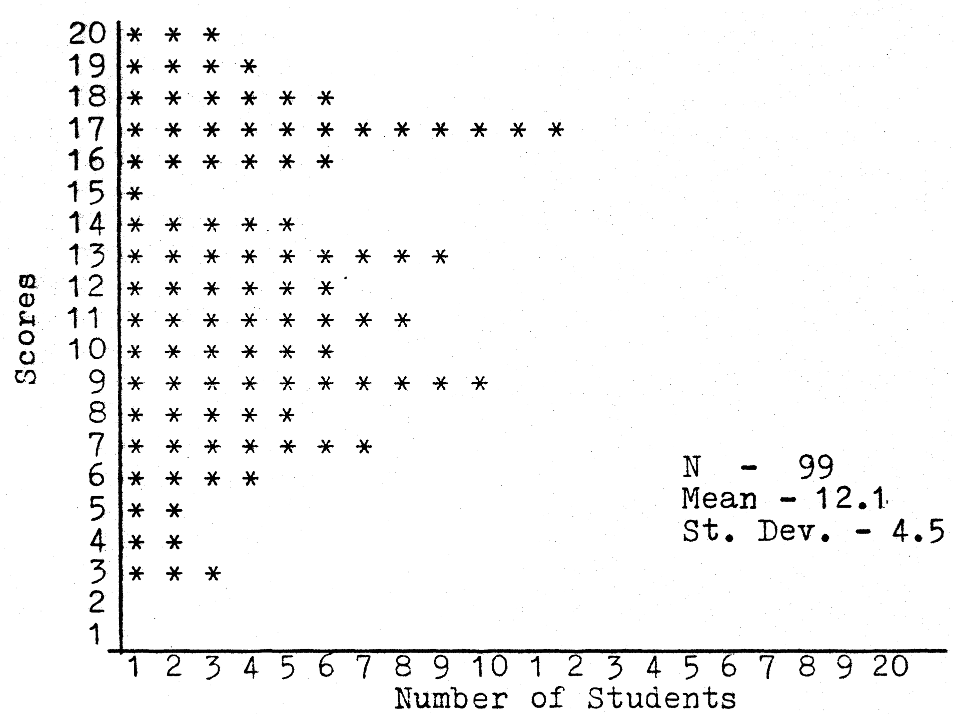


Figure 3. The distribution of the self-assessment test scores for students in Math 114.

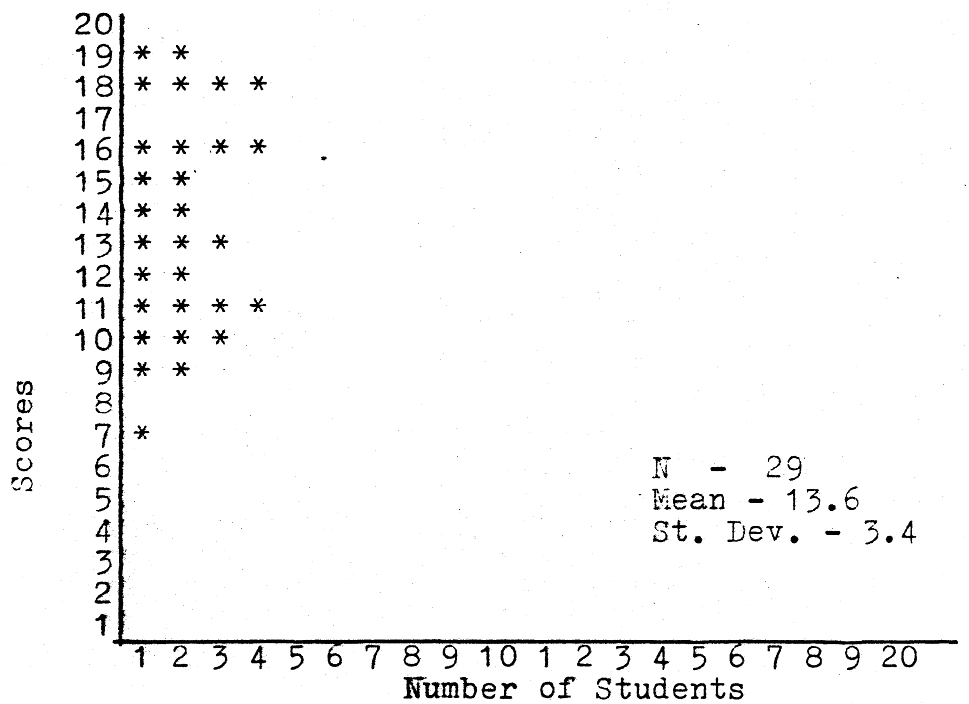


Figure 4. The distribution of the self-assessment test scores for students in Math 121.

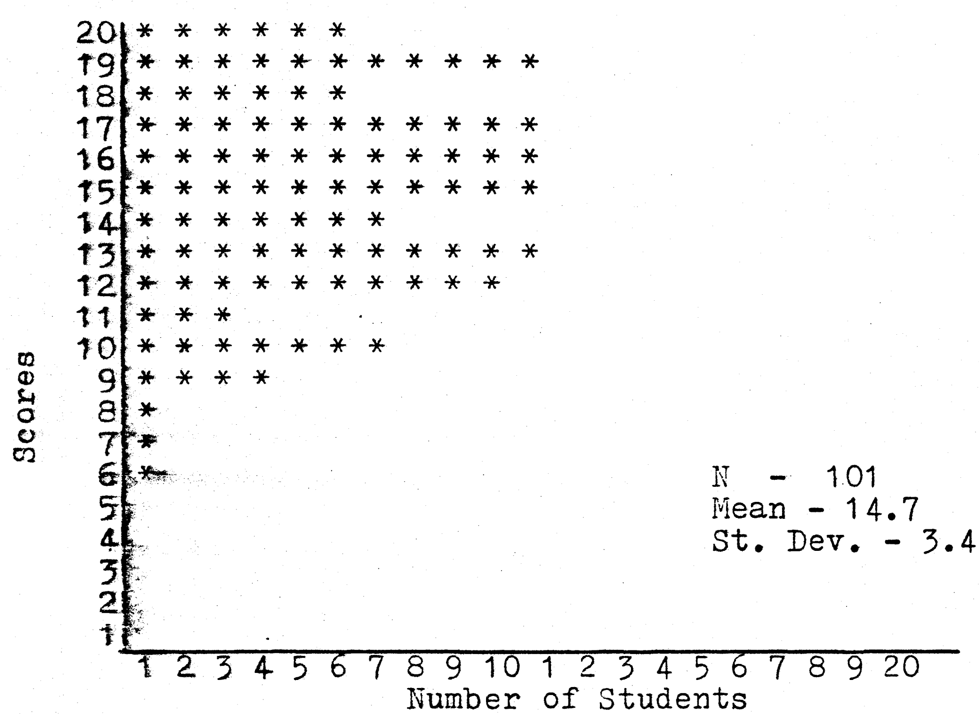


Figure 5. The distribution of the self-assessment test scores for students in Math 150.

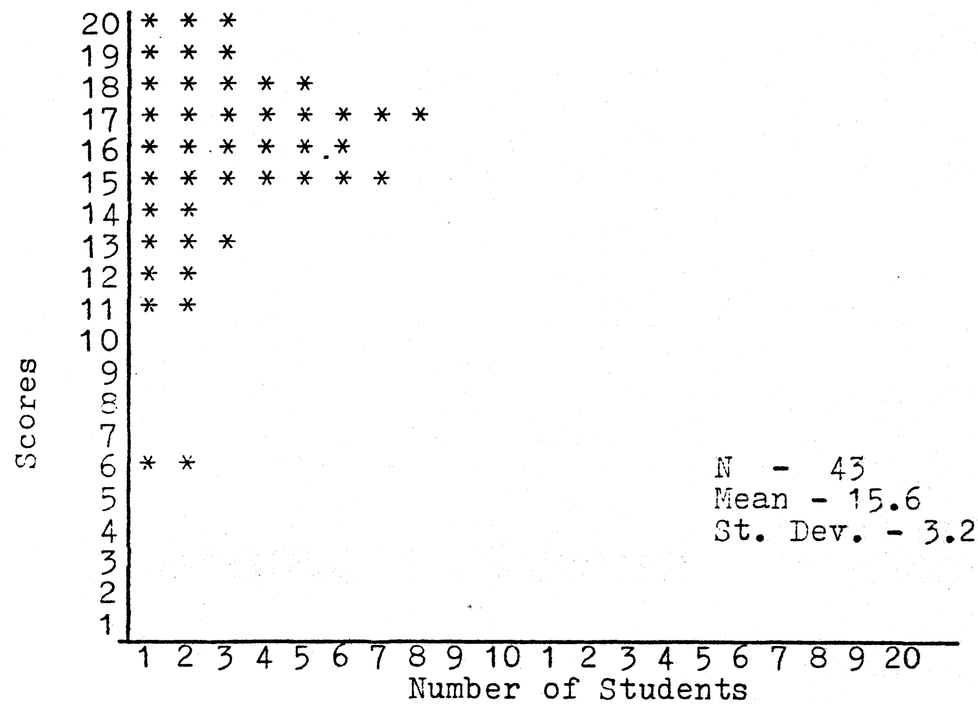


Figure 6. The distribution of the self-assessment test scores for students in Math 151.

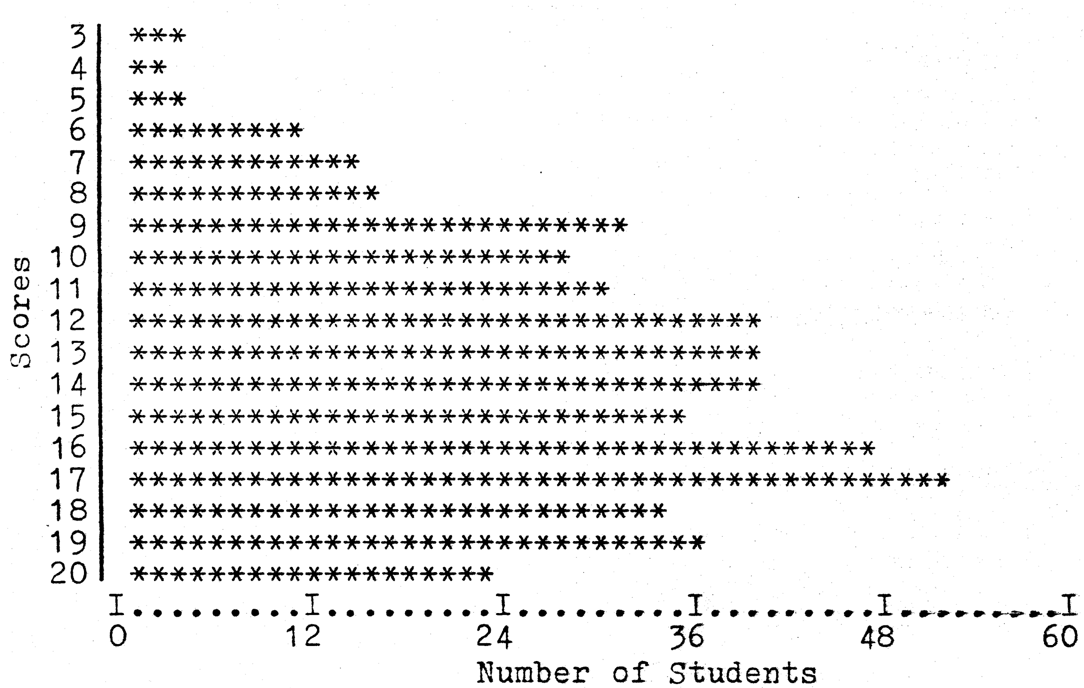


Figure 7. The distribution of the self-assessment test scores for the total sample.

Table 6

Means and Standard Deviations

Course	Mean	St. Dev.
110	12.7	3.1
113	14.4	4.2
114	12.1	4.5
121	13.6	3.4
150	14.7	3.4
151	15.6	3.2
over-all	13.8	4.0

The point biserial correlations which have been presented and discussed in an earlier section indicate that there are no questions that inaccurately appeal to students who do poorly on the test. That is, there are no questions that low scoring students get correct more often than students who do well on the test. Each item on the test contributes to discriminating poor performance on the test from good performance on the test.

Review of Testing Procedures

The procedures used to administer the self-assessment test to introductory mathematics students at Salisbury State College were described in Chapter III. Three questions from the student survey and two questions from the instructor survey were formulated to assist in reviewing these current practices. Both groups were asked if the test should be administered prior to the first day of class. The question also suggested the administration of the test during pre-registration. Of the students surveyed, 64% were opposed to changing this procedure and 70% reported feeling unconcerned about taking a test on the first day of class. However, four of the six instructors questioned were in favor of changing this practice. When the instructors were asked if they were satisfied with the procedures used to administer the self-assessment test only one responded negatively and added that the administration of the test takes too much time away from the first class meeting.

In an effort to standardize testing practices, the instructors are given a guide which outlines the procedures for administering the test (see Appendix C). The first step requires that the instructors explain the self-assessment nature of the test that the students will be given. Almost all of the students in the survey sample, 92%, understood why they were taking the test.

Correlations with SAT-M Scores and with Final Grades

A correlation coefficient which is used to compare the ranking of test-takers by two tests is a reliability coefficient. A standard test of known reliability is used to determine the reliability of a previously unexamined test. In this study, the scores from the mathematics section of the Scholastic Aptitude Test were used to determine the reliability of the scores from the self-assessment test which is the object of this research. The resulting reliability coefficient was 0.520. Coefficients close to positive one are considered good and thus indicate similar ranking by the two tests.

The validity coefficient described in Chapter II was also computed to determine the relationship between test scores and final course grades. The validity coefficient was found to be 0.350.

Predicting Success Given That the Student Has Satisfied Prerequisites

Table 7 reports the percentage of students enrolled in each introductory course who had satisfied the prerequisites for those courses. In all cases, the students are expected to have successfully completed an Algebra I and Algebra II sequence in high school or to have successfully completed Mathematics

100 at Salisbury State College or an equivalent course at another college. So few of the students, 15%, reported failure to satisfy this requirement that the research will not analyze the performance of those satisfying the prerequisite separately from those who did not.

Table 7

Percentage of Students

Satisfying Prerequisite

Course	% sat. prereq.
110	84
113	81
114	82
121	90
150	87
151	95

<u>Subsections of the Test as Predictors of Success</u>

In an earlier section of this chapter the test items were grouped according to their easiness percentages. Questions one through seven, nine, ten, and fourteen have very high easiness percentages. Questions twelve, fifteen, eighteen, and nineteen have easiness percentages between 50% and 70%. The questions with lower ratings, numbers eight, eleven, thirteen, sixteen, seventeen, and twenty were more difficult questions on the test.

The point biserial coefficient, which measures the degree to which an item contributes to the whole test, grouped the items in a slightly different arrangement. The higher the coefficient the better is the item's ability to discriminate information. Questions one, three, ten, eleven, fourteen, and sixteen had good biserial coefficients. Questions twelve, thirteen, and seventeen through twenty had even better coefficients.

Table 5 of this chapter showed that students who were successful in the course responded correctly to the more difficult questions more often than they did to the easier questions.

These three factors suggest that there may be a subsection of the test that predicts student success as well as the entire test. However, the analysis required to more accurately identify a subsection and to confirm its predictive ability is not in the scope of the present research.

Interpretation of Students' Scores

Table 8 is a summary that may be used to interpret the scores on the Screening and Self-Assessment Test. The scores are presented for five of the introductory courses served by the test. The sample size of the test results from students enrolled in Math 121 was too small, 29 testers, to allow proper interpretation. According to the table, any potential 110 student getting ten or more questions correct on the test has a 68% chance of succeeding in the course. If the student misses nine or more questions, his/her chance of success in the course is 40%.

Table 8

Interpretation of Scores from the Mathematics Screening and Self-Assessment Test

Course	Score	Prob. of Suc.	Prob. of Unsuc.	Prob. of Withd.
110	10 or more	68%	14%	18%
	9 or less	40%	20%	40%
113	12 or more	65%	7%	28%
	11 or less	45%	9%	45%
114	11 or more	65%	15%	20%
	10 or less	33%	23%	44%
150	14 or more	63%	22%	14%
	13 or less	24%	26%	50%
151	16 or more	60%	12%	28%
	15 or less	17%	44%	39%

Chapter V

Restatement of the Problem

It has been predicted that by 1990 almost one half of the population of the United States will have attended college. Career opportunities, parents' expectations, or the satisfaction of some personal goal are some possible motives for seeking an experience in higher education. Regardless of the motivation behind this swelling of the college bound population, college admissions must deal with the problems created by large numbers of applications. Potential students must be screened in order to assess their suitability to the programs offered at the institution of higher learning. Once an applicant has been accepted into the campus community he/she is faced with finding an appropriate course of study that suits the student's background and goals.

General education requirements for most colleges include the successful completion of a specified number of hours from the mathematical sciences. It is the problem of the student to select the mathematics course that is most appropriate. Ideally, the student should desire to avoid courses with content that he/she has already mastered. The student should select a course that is a challenge but is not too far beyond his/her abilities. It is the responsibility of the mathematics department to provide a tool or method to aid the student in selecting the appropriate course of study. The purpose of this research was to evaluate such a tool.

The research was conducted in the 1982-1984 academic years at Salisbury State College in Salisbury, Maryland. The purpose of the research was to evaluate the Screening and Self-Assessment Test administered by the mathematics department to students enrolled in the six introductory courses. The study was undertaken to determine the ability of the test to predict academic success in those introductory courses.

Data for the analysis of the self-assessment test was collected from the graded answer sheets from 484 students enrolled in 110, 113, 114, 121, 150, and 151 in the semesters of 1982 and 1983. Unofficial student advisory sheets were used to obtain a list of scores from the mathematics section of the Scholastic Aptitude Test which were also used in the analysis. Original surveys were designed, distributed, and administered to 237 students enrolled in introductory courses in the Spring semester of 1984 and to six instructors. The purpose of the surveys was to obtain student and instructor impressions of the self-assessment test and the testing procedures.

The results of the surveys were tallied and reported as percentages for each response. The analysis of the data from the graded test answer sheets was done using a statistical package for SPSSX available on the VAX 11/780.

Discussion of the Findings

The objective of the research was to evaluate the ability of a self-assessment test to predict success in introductory college mathematics courses at Salisbury State College. The discussion of the findings of this evaluation will be presented in two parts. The first part will be a summary of the information obtained from the student and instructor surveys administered in the Spring semester of 1984. The second part will present the findings based on the item analysis of the test and the correlation analysis.

Student and Faculty Survey Summary

The purpose of the student survey was to obtain students' reactions to the procedures for taking the self-assessment test and to evaluate their use of it for placement in appropriate mathematics courses at the college. Generally, students seem comfortable with or accepting of the current procedures for administering the test. From the sample of 237 students, 76% were unconcerned about taking the test on the first day and 64% would not suggest giving the test prior to the first day of class. As a self-assessment tool, the test was not highly rated. Two thirds of the students reported that their scores did not influence their decision to stay in the course. (Ironically, the six instructors surveyed unanimously agreed that students do use their scores to judge their correct placement.) A more compelling influence could be a student's need to satisfy a requirement for a major or for general education since a little more than 10% of the students enroll in one of the six introductory courses for reasons other than fullfilling requirements. Unfortunately, the sample surveyed did not include those who withdrew after taking the test. Their scores may have influenced that decision.

The instructors also seemed satisfied with the current testing procedures although four of the six responded that the test should be given prior to the first class meeting. The results of the questions requiring instructors to rate the self-assessment test as a predictor for student success in any of the introductory courses were inconclusive.

Item Analysis and Correlation Analysis

The item analysis of the test yielded more objective information. The easiness percentages, calculated from the number of students who answer the question correctly, reveal that questions one through seven, nine, ten, and fourteen are too easy. Questions that are too easy add little information to the test. Questions eight, eleven, thirteen, sixteen, seventeen, and twenty have lower easiness percentages but they are well above the 20% which might indicate a question that is too difficult. The remaining questions, twelve, fifteen, eighteen, and nineteen are within the range suggested for maximum reliability and dispersion of scores.

The analysis of the discrimination ability of the test revealed that there were no misleading or ambiguous questions on the test. That is, there is no question that low scoring test-takers get correct more often than high scoring test-takers. The point biserial correlation was used to determine the index of discrimination. The higher the point biserial correlation, the better the discriminating ability of the test item. Questions two, four through nine, and fifteen were the only questions with a correlation value below 0.4.

The responses for each item on the test were also examined to see how effective the distractors were. A distractor that is not selected by at least 5% of the test-takers is considered a poor alternative response. Only question twenty had all four distractors selected by more than 5% of the test-takers. The other extreme occurs in question seven, none of the four distractors draw more than 5% of the sample. Questions eleven, thirteen, and seventeen each have one poor distractor. The remaining fifteen questions have either two or three distractors that are chosen as correct responses by less than 5% of those tested (see Table 4).

The correlation coefficient for the Scholastic Aptitude Test Mathematics section scores and the self-assessment test scores was 0.520. This is a good reliability coefficient and indicates that the self-assessment test measures what it purports to measure i.e., mathematics skills. The validity coefficient, computed using the test scores and final grades, was lower, 0.350. As was discussed in the Related Literature, this lower measure may be the result of effective teaching and/or learning practices. Effective teaching and/or learning practices during the semester may have resulted in higher grades than the self-assessment scores indicated on the first day of class.

The analysis of those who correctly responded to each item reveals a possible subsection of the test that may predict student success as well as the whole test. Students who succeed choose the correct answers more often for the last ten questions, except number fifteen, than they do for the first ten questions.

Recommendations and Conclusions

Based on the findings of this study, the following recommendations are made:

1. The Screening and Self-Assessment Test that is currently administered by the Department of Mathematical Sciences at Salisbury State College has an acceptable degree of reliability to warrant its continued use. Its "on the spot" feature and the cut off points for predicting success derived from past student performances may help make it a desirable tool for student self-assessment.

2. In the event that the Screening and Self-Assessment Test will continue to be administered to

the six introductory courses, it may be improved with some changes. Upon interpretation of the item analysis, items one through seven, nine, and fourteen could be deleted from the test with little loss of information.

3. The current test or a shortened version of the self-assessment test could be improved by reducing the number of distractors for each item.

4. Question eight may be improved by providing the correct answer among the responses.

5. Question number fifteen and its responses should be re-examined to determine the cause of its low point biserial correlation.

6. The current procedures used to administer the test are satisfactory and should be continued.

7. Question eight (with its altered responses), eleven, twelve, thirteen, and sixteen through twenty should be evaluated to determine if they comprise a valid and reliable self-assessment test.

8. If the test is used as is, the information on the cut-off scores as given in this study can be used for the courses served by the test so that students will accurately interpret their scores.

BIBLIOGRAPHY

Bibliography

Books

Crary, D.T., Pfahl, J.K. & Donaldson, E.F. Personal Finance (7th ed.). New York: John Wiley and Sons, 1980.

Nunnally, J.C. Educational Measurement and Evaluation (2nd ed.). New York: McGraw-Hill, 1972.

Sattler, J.M. Assessment of Children's Intelligence and Special Abilities (2nd ed.). Boston: Allyn and Bacon, Inc., 1982.

Travers, R.M.W. An Introduction to Educational Research (3rd ed.). London: MacMillian Co., 1969.

Articles and Periodicals

Bone, M.A. A Comparison of Three Methods of Mathematics Placement for College Freshman (Doctoral dissertation, Michigan State University, 1981). Dissertation Abstracts International, 42/02-A, AAD81-17212.

Bray, D. Assessment Placement: A Design for Student Success and Institutional Planning for the 1980's. Association of California Community College Administrators, 1983. (ERIC Document Reproduction Service No. ED 230 234)

Crooks, T.J. Grade Predication: The Usefulness of Contest-Specific Predictors. Dunedin, New Zealand: Higher Education Development Centre University of Otago, 1980. (ERIC Document Reproduction Service No. ED 194 547)

Dennis, O.S.S. The Relationship of Attitude, Mathematics Background and Junior College Transfer Status in Entering Elementary Education Majors to Competency in Elementary Mathematics (Doctoral dissertation, University of Southern Mississippi, 1983). Dissertation Abstracts International, 44/05-A, AAD83-21481.

Diederich, P.B. Short-cut Statistics for Teacher-made Tests (2nd ed.). Princeton, New Jersey: Educational Testing Service, 1964.

Frerichs, A.H. & Eldersveld, P.J. Predicting Successful and Unsuccessful Developmental Mathematics Students in Community Colleges. Los Angles, Calif.: Paper presented at the Annual Meeting of the American Educational Research Association, 1981. (ERIC Document Reproduction Service No. ED 202 507)

Haase, M. & Caffery, P. Assessment and Placement at Sacramento City College. Sacramento, Calif.: Sacramento City College, 1983. (ERIC Document Reproduction Service No. ED 230 258)

Haase, M. & Caffery P. Assessment Procedures, Fall 1982 and Spring 1983 Semi Annual Research Report, Part I. Sacramento, Calif.: Sacramento City College, 1983. (ERIC Document Reproduction Service No. ED 231 494)

Hecht, L.W. Validation of the New Jersey College Basic Skills Placement Test. Trenton, N.J.: New Jersey State Dept. of Higher Education, 1980. (ERIC Document Reproduction Service No. ED 214 945)

Helmick, F.I. Evaluation of the Placement Test for First-Year Mathematics at the University of Akron (Doctoral dissertation, University of Akron, 1983). Dissertation Abstracts International, 44/02-A, AAD83-14828.

Kimes, B.A. A Comparison of Selected Characteristics of Developmental Mathematics Students at Eastfield College (Doctoral dissertation, East Texas State University, 1973). Dissertation Abstracts International, 1974, 34, 74-5766.

McComb, J.A. Mathematics Placement Procedures and Psychometric Decision Theory (Doctoral dissertation, Michigan State University, 1983). Dissertation Abstracts International, 44/09-A, AAD84-00599.

Miles, P.E. Reliability and Math Placement Tests (PTP News-letter Vol. 5 No. 1). Washington, D.C.: Mathematical Association of America, 1982.

Pearse, C.A., Agrella, R.F., & Powers, S. Identification and Placement of College Students in Developmental Education Programs. Sacramento, Calif.: A paper presented at the 61st annual meeting of the California Educational Research Association, 1982. (ERIC Document Reproduction Service No. ED 231 415)

Richards, J.M., Holland, J.L. & Lutz, S.W. The Prediction of Student Accomplishment in College (No. 13). Iowa City, Iowa: Research and Development Division American College Testing Program, 1966.

Salisbury State College Catalogue, 1983-1984.

Tobey, J. Concurrent Remediation of Essential Atithmetic Skills in a Developmental Algebra Course in the Community College (Doctoral dissertation, Boston University, 1980). Dissertation Abstracts International, 41/04-A, AAD80-24165.

Troutman, J.G. Cognitive Predictors of Final Grades in Finite Mathematics. Educational and Psychological Measurement, 1978, 38, 401-404.

Yellott, R.T. An Evaluation of the Developmental Mathematics Program at McNeese State University (Doctoral dissertation, McNeese State University, 1981). Dissertation Abstracts International, 42/06-A, AAD81-26987.

APPENDIX

Appendix A

Screening and Self-Assessment Test

SSC DEPARTMENT OF MATHEMATICAL SCIENCES

Screening and Self-Assessment Test A
F77DLP

Put all answers on answer sheet. Please do not mark on this test!

1) $\frac{2}{7} - \frac{1}{3} = ?$ A) $\frac{1}{4}$ B) $\frac{-1}{4}$ C) $\frac{1}{21}$ D) $\frac{-1}{21}$ E) None of these

2) $\frac{6}{5} * \frac{4}{7} = ?$ A) $\frac{24}{35}$ B) $\frac{35}{24}$ C) $\frac{42}{20}$ D) $\frac{20}{42}$ E) None of these

3) $\frac{2}{3}$ divided by $\frac{5}{7} = ?$
A) $\frac{10}{21}$ B) $\frac{21}{10}$ C) $\frac{14}{15}$ D) $\frac{15}{14}$ E) None of these

4) $(-2)^3 = ?$ A) -6 B) 6 C) 8 D) -8 E) None of these

5) $\sqrt{100 - 36} = ?$ A) 2 B) 64 C) 8 D) 4 E) None of these

6) 2 + 3*4 = ? A) 16 B) 24 C) 20 D) 22 E) None of these

7) 3*4 + 2 = ? A) 9 B) 18 C) 24 D) 14 E) None of these

8) $\frac{4}{5} = ?$ A) .8% B) 8% C) 12.5% D) 1.25% E) None of these

9) .28 = ? A) .28% B) 2.8% C) .0028% D) 28% E) None of these

10) $4x - 3 = 5x + 7$, so $x = ?$
A) -10 B) 4 C) -4 D) 10 E) None of these

11) $\frac{3}{7x} = 2$, so $x = ?$
A) $\frac{6}{7}$ B) $\frac{7}{6}$ C) $\frac{14}{3}$ D) $\frac{3}{14}$ E) None of these

12) $4x - 3 = 2(3x - 4)$, so $x = ?$
A) $\frac{-11}{2}$ B) $\frac{5}{2}$ C) $\frac{1}{2}$ D) $\frac{-7}{2}$ E) None of these

13) If $x = -1$, what is the value of $3x^3 - 2x^2 + x - 1$?
A) -7 B) -3 C) -1 D) 3 E) None of these

14) The product of x and y decreased by 14 may be written:
A) $x + y - 14$ B) $xy - 14$ C) $(x + y)/14$ D) $\frac{xy}{14}$ E) None of these

15) The number of days in x weeks may be expressed:

A) $x/7$ B) $7x$ C) $7/x$ D) $x + 7$ E) None of these

16) If $3x - y = 9$ and if $2x + y = 11$, then $x = ?$

A) 0 B) 5 C) 3 D) 4 E) None of these

17) If $v = \frac{r + s}{t}$, then $s = ?$

A) $vt - r$ B) $\frac{t + v}{r}$ C) $\frac{r + v}{r}$ D) $(v - r)t$ E) None of these

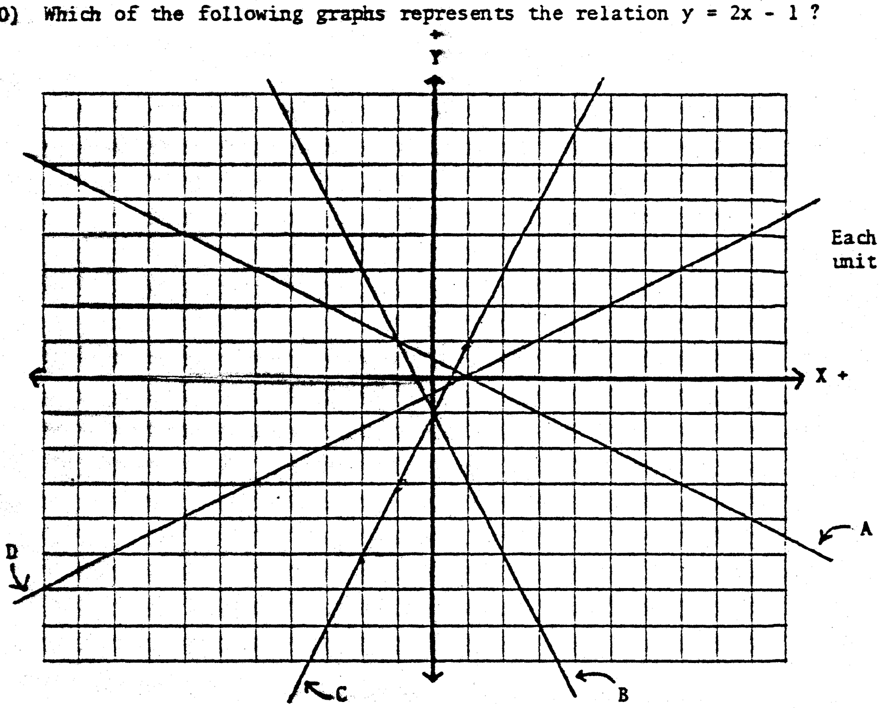
18) $(2x + 3)(3x - 2) = ?$

A) $11x - 6$ B) $5x + 1$ C) $6x^2 + 9x - 6$ D) $6x^2 + 5x - 6$ E) None of these

19) $(2x - 3)^2 = ?$

A) $4x^2 - 6x - 9$ B) $4x^2 - 12x + 9$ C) $4x - 6$ D) $4x^2 - 6x + 9$ E) None of these

20) Which of the following graphs represents the relation $y = 2x - 1$?



Each square is 1 unit square

E) None of these

Appendix B

Sample Answer Sheet

SSC DEPARTMENT OF MATHEMATICAL SCIENCES

Screening and Self-Assessment Answer Sheet

	(A)	(B)	(C)	(D)	(E)
1.	A	B	C	D	E
2.	A	B	C	D	E
3	A	B	C	D	E
4.	A	B	C	D	E
5.	A	B	C	D	E
6.	A	B	C	D	E
7.	A	B	C	D	E
8.	A	B	C	D	E
9.	A	B	C	D	E
10.	A	B	C	D	E
11.	A	B	C	D	E
12.	A	B	C	D	E
13.	A	B	C	D	E
14.	A	B	C	D	E
15.	A	B	C	D	E
16.	A	B	C	D	E
17.	A	B	C	D	E
18.	A	B	C	D	E
19.	A	B	C	D	E
20.	A	B	C	D	E
21.	A	B	C	D	E
22.	A	B	C	D	E
23.	A	B	C	D	E
24.	A	B	C	D	E
25.	A	B	C	D	E

Last Name ______ First Name ______

Social Security Number ______

Course Number ______ Section Number ______

Instructor ______

What mathematics classes did you take during each of the following years?

9th grade ______

10th grade ______

11th grade ______

12th grade ______

PLEASE DO NOT MARK ON THE TEST; use a sheet of scratch paper. The symbol "*" will be used to indicate multiplication. For example, 3 * 4 = 12 is read "3 times 4 equals 12".

MARK ONLY ONE ANSWER FOR EACH QUESTION

If you do not know the answer to a question, do not guess - just leave the answer blank. As an example of marking, if the answer to a question is "D", mark your sheet as follows:

(A)	(B)	(C)	(D)	(E)
A	B	C	■	E

TEST RESULTS

Number wrong: ______

Recommendation: ______

Appendix C

Procedures Guide

DIAGNOSTIC TEST FOR MATH 110, 113, 114 and 150

Procedure

1. A student will bring a set of tests and answer sheets to your first class meeting.

2. Explain that the test is not part of the grade, but is an attempt to be certain that each student is in the correct class relative to his abilities.

3. Hand out the answer sheets (see copy attached). Have students fill out the top third and read the directions for the test. Tell them that they can use the answer sheet for all scratch work.

4. Hand out the test and give 15 minutes to complete them. PLEASE ASK STUDENTS TO REFRAIN FROM WRITING ON THE TEST!!! Each test will be used about 10 times.

5. Collect the tests.

6. Collect the answer sheets.

7. As soon as the tests have been administered, the student who brought the tests to your class will pick them up and check the tests, scoring the number wrong at the bottom of the page. These answer sheets will be returned to you before the end of this first class meeting in order that you might appropriately advise students. Answer sheets for those students missing 10 or more items will be placed in a seperate stack.

Interpretation of Test Results

From previous experience, results for MATH 110, 113 and 150 can be interpreted as follows:

MATH 110

Number Wrong	Probability of Success
0-4	67%
5-6	50%
7+	33%

MATH 113

Number Wrong	Probability of Success
0-6	67%
7+	50%

MATH 150 *

Number Wrong	Probability of Success
0-6	64%
10+	14%

* Thses statistics have been added as a result of the concurrent research.

DCC/lsa 8/84

Appendix D

Student Survey

STUDENT SURVEY

It is not necessary to write your name on the questionnaire. Please respond to as many questions as possible.

1. Why are you taking this course?
   - 67 Requirement of a major
   - 5 Prerequisite for another course
   - 16 Fullfills general education requirement
   - 2 Liked the instructor
   - 9 General interest in the course
   - 4 Other. Specify ______

2. How did you feel about taking the diagnostic test on the first day of class?
   - 24 Worried
   - 70 Unconcerned
   - 7 Don't remember

3. Was it clear to you why you were taking a test on the first day of class?
   - 92 Yes
   - 8 No

4. What was your score on the diagnostic test?
   - ____ Score
   - 51 Don't remember

5. How do you feel about your score on the diagnostic test?
   - 7 Shocked
   - 31 Not surprised
   - 5 Relieved
   - 25 Confident
   - 32 Neutral

6. Did you talk to your instructor about your performance on the diagnostic test?
   - 7 Yes
   - 93 No

7. How did your performance on the diagnostic test influence your decision to stay in this course?
   - 8 Strongly
   - 28 Some
   - 64 Not at all

8. Should the diagnostic test be given prior to the first day of class, i.e., during preregistration?
   36 Yes
   64 No

9. Were you aware of or informed about any prerequisite skills necessary for enrolling in this course?
   61 Yes
   39 No

10. What do you think your course grade is at the present?
   ______

Appendix E

Instructor Survey

INSTRUCTOR SURVEY

1. Do students, from your experience, use the results of the diagnostic test to judge their correct placement in a course?
   _____ Yes
   _____ No

2. Is mastery of all of the skills presented on the diagnostic test necessary for success, a "C" or better grade, in introductory courses?
   _____ Yes
   _____ No

3. Given a student of at least average motivation and seriousness, is mastery of all of the skills presented on the diagnostic test sufficient for success in introductory courses?
   _____ Yes
   _____ No

4. Are there particular skills that should be included on the diagnostic test?
   _____ Yes
   _____ No
   If yes, specify: ______________________
   ____

5. The skills presented on the diagnostic test make it best suited as a predictor of student success in (more than one response may be appropriate):
   ___110 ___113 ___114 ___121 ___150 ___151

6. The skills presented on the diagnostic test make it least suited as a predictor of student success in (more than one response may be appropriate):
   ___110 ___113 ___114 ___121 ___150 ___151

7. Should the diagnostic test be given prior to the first day of class (i.e., during pre-registration)?
   _____ Yes
   _____ No

8. Are you satisfied with the procedures used to administer the diagnostic test?
   ______ Yes
   ______ No
   If no, explain: ______________________________

   ____

9. Any further comments: