AN EXPERIMENTAL STUDY IN TEACHING MATHEMATICAL
CONCEPTS UTILIZING COMPUTER-ASSISTED
INSTRUCTION IN BUSINESS MACHINES

DISSERTATION

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By

Robert J. Hughes, B.S., M.B. Ed.
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The problem of this study was an analysis of results obtained by a computer-assisted instructional approach and a lecture-demonstration instructional approach of teaching mathematical concepts in the area of office machines at the community college level.

The purposes of this study were as follows: (1) to determine which method, the lecture-demonstration or computer-assisted instruction, will produce the better mathematical skill in office machines; (2) to determine the effectiveness of computer-assisted instruction as compared to the lecture-demonstration approach on the student's attitude toward office machines, as measured by the Purdue attitude scale; (3) to compare the correlation between attitude and achievement for the computer-assisted instruction group and the lecture-demonstration group; and (4) to compare the correlation between attitude and achievement for high-ability students and low-ability students, based on scores obtained from the Otis-Lennon Mental Ability Test.

Information was gathered from students enrolled in four business machines classes on the Richland College campus during the spring semester of 1976. A table of random
numbers was used to determine which two classes would receive the computer-assisted approach. The factors for college admission, course content, course objectives, evaluation, and available business machines were the same for all classes involved in the experiment.

The Otis-Lennon Mental Ability Test, a mathematical pretest, a mathematical posttest, and the Purdue Master Attitude Scale, A Scale to Measure Attitude Toward Any School Subject were administered to all students in both the computer-assisted group and the lecture-demonstration group.

The analysis of covariance statistical technique was used to determine if a significant difference existed between the mathematical achievement scores for the two groups. The analysis of variance statistical technique was used to determine if a significant difference existed between the attitude scores for the two groups. The correlations between attitude and achievement for students in the computer-assisted group, the lecture-demonstration group, and various sub-groups were compared. A Pearson Product Moment Correlation Coefficient was calculated to measure the relationship between attitude and achievement for all groups.

The findings in this study indicate that there were no significant differences in mathematical achievement, attitude scores, or the correlation between attitude and achievement between students in the computer-assisted group and students in the lecture-demonstration group.
The following conclusions were formulated from an analysis of this study.

1. Based on the mathematical achievement scores and the statistical analysis presented in this study, it is concluded that there are no demonstrated differences between the computer-assisted instructional approach and the lecture-demonstration approach for teaching applied mathematical concepts to business machines students.

2. Based on the attitude scores presented in this study, students in both groups appear to have a favorable attitude toward the business machines course. Attitude scores for students in the computer-assisted group were not significantly different from scores for students in the lecture-demonstration group.

3. The integration of business machines and applied mathematics, in addition to developing speed and accuracy on electronic calculators and adding machines, produces increased achievement in mathematics.

Recommendations were made on the basis of the findings and conclusions of this study. In addition, certain implications which relate to effective instruction in business machines and business mathematics were also included.
# TABLE OF CONTENTS

LIST OF TABLES .................................................. v

Chapter

I. INTRODUCTION ........................................... 1

   Statement of the Problem
   Purposes
   Hypotheses
   Significance of the Study
   Definition of Terms
   Delimitations
   Assumptions

II. RELATED LITERATURE ................................. 11

   Introduction
   Instructional Methodology in Business Machines
   Relationship Between Business Machines and Applied Mathematics
   Research Efforts in the Business Mathematics Area
   Recent Developments in Computer-Assisted Instruction
   Summary of Related Literature

III. PROCEDURES FOR COLLECTING AND TREATING THE DATA .......... 43

   Setting of the Experiment
   Population of the Experiment
   Instructional Procedures
   Testing Procedures
   Analysis Procedures

IV. PRESENTATION AND ANALYSIS OF THE DATA .... 64

   Introduction
   Mathematical Achievement of Students in Business Machines
   Attitude of Students Toward Business Machines
   Comparison of Correlations Between Attitude and Achievement
## Analysis of Achievement Gain Scores

Summary of the Data

### V. SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary</td>
<td>78</td>
</tr>
<tr>
<td>Conclusions</td>
<td></td>
</tr>
<tr>
<td>Recommendations</td>
<td></td>
</tr>
<tr>
<td>Implications</td>
<td></td>
</tr>
</tbody>
</table>

### APPENDIX A

88

### APPENDIX B

141

### APPENDIX C

144

### APPENDIX D

164

### APPENDIX E

185

### APPENDIX F

194

### APPENDIX G

198

### BIBLIOGRAPHY

203
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Response of Panel Members Regarding Validity of Measuring Instruments</td>
<td>58</td>
</tr>
<tr>
<td>II. Summary of the Data Related to the Covariants of Initial Mathematical Ability and Mental Ability</td>
<td>66</td>
</tr>
<tr>
<td>III. Summary of the Data Related to the Mean Scores on the Business Mathematical Posttest</td>
<td>66</td>
</tr>
<tr>
<td>IV. Summary of the Analysis of Covariance of the Business Mathematics Achievement Test Scores</td>
<td>67</td>
</tr>
<tr>
<td>V. Summary of the Data Related to the Mean Scores on the Purdue Master Attitude Scale, A Scale to Measure Attitude Toward Any School Subject</td>
<td>69</td>
</tr>
<tr>
<td>VI. Summary of the Analysis of Variance for the Attitude Scale Scores</td>
<td>69</td>
</tr>
<tr>
<td>VII. Statistical Measures Relating to Experimental Group and Control Group Attitude and Achievement Test Score Correlations</td>
<td>71</td>
</tr>
<tr>
<td>VIII. Statistical Measures Relating to Experimental Group and Control Group Attitude and Achievement Test Score Correlations when Sub-Grouped at or Above the Sixtieth Percentile</td>
<td>72</td>
</tr>
<tr>
<td>IX. Statistical Measures Relating to Experimental Group and Control Group Attitude and Achievement Test Score Correlations when Sub-Grouped at or Below the Fortieth Percentile</td>
<td>73</td>
</tr>
<tr>
<td>X. Summary of the Data Related to the Covariate of Mental Ability</td>
<td>74</td>
</tr>
</tbody>
</table>
XI. Summary of the Data Related to the Mean Gain Scores on the Business Mathematical Posttest ......... 75

XII. Summary of the Analysis of Covariance of the Business Mathematics Gain Scores ... 75
CHAPTER I

INTRODUCTION

One of the major objectives of an office machines course is to equip the student with the mathematical skill needed to make intelligent decisions as required in everyday life. Yet, as essential as applied mathematics is to both the individual and the business community, a number of problems are present to inhibit quality instruction in this area.

Four problem areas contribute to inadequate instruction in applied mathematics at the community college level. First, the background and achievement levels of students enrolling in office machines must be considered as a major problem. Many students are deficient in the basic skills needed for this course, while others are capable of doing acceptable work.

Second, the open-door policy popular in today's community college movement interacts with the first problem to create a more complicated situation. The open-door policy does not usually permit the screening or grouping of students according to ability levels.

Third, the traditional office machine classroom is organized around the semester time frame. Regardless of how good or bad a student may be, he must be finished at the conclusion of the semester.
Finally, many students need positive reinforcement for remedial work that they require in order to experience success in office machines.

Developments employing the use of individualized instruction are attempts to solve problems like those encountered in office machines. The Policies Commission for Business and Economic Education has stated that

1. Individualization of instruction is psychologically sound and educationally valid.
2. Individualization of instruction has particular merit for all subject areas in business education.
3. The success of efforts to individualize instruction depends upon the commitment and interaction of administrators and supervisors, teachers, teacher educators, students, and parents.¹

Computer-assisted instruction provides a possible solution to the four problem areas in the office machines course. According to Hedges, the computer-assisted approach to learning provides (1) a method that allows the student to proceed at his own rate, (2) practice materials designed at different levels of difficulty, (3) more efficient use of teacher time, (4) a method of maintaining records of student achievements, (5) immediate reinforcement, and (6) a new and interesting approach for the student.² Since the final goal


is better student achievement, the instructor needs to carefully evaluate computer-assisted instruction as a solution to instructional problems in this area.

Statement of the Problem

The problem of this study was an analysis of results obtained by a computer-assisted instructional approach and a lecture-demonstration instructional approach of teaching mathematical concepts in the area of office machines at the community college level.

Purposes

The purposes of this study were as follows: (1) to determine which method, the lecture-demonstration or computer-assisted instruction, will produce the better mathematical skill in office machines; (2) to determine the effectiveness of computer-assisted instruction as compared to the lecture-demonstration approach on the student's attitude toward office machines, as measured by the Purdue attitude scale; (3) to compare the correlation between attitude and achievement for the computer-assisted group and the lecture-demonstration group; and (4) to compare the correlation between attitude and achievement for high-ability students and low-ability students based on scores obtained from the Otis-Lennon Mental Ability Test.
Hypotheses

The following hypotheses were tested in this study.

I. Students taught by the computer-assisted instructional approach will achieve significantly higher adjusted achievement posttest scores than students taught by the lecture-demonstration approach. This hypothesis was statistically tested using the analysis of covariance. Scores obtained from the mathematical pretest and the Otis-Lennon Mental Ability Test were used as covariates.

II. Students taught by the computer-assisted instructional approach will achieve significantly higher attitude scores than students taught by the lecture-demonstration approach. This hypothesis was statistically tested using the analysis of variance.

III. The correlation between attitude and achievement will be significantly higher for the computer-assisted instruction group than for the lecture-demonstration group. This hypothesis was statistically tested by calculating a Pearson Product Moment Correlation for each group. The significance between correlation was determined by the Fisher z technique.

IV. Based on scores at or above the sixtieth percentile on the Otis-Lennon Mental Ability Test, the correlation between attitude and achievement scores will be significantly higher for students in the computer-assisted group than for
students in the lecture-demonstration group. This hypothesis was statistically tested by the procedure outlined in the third hypothesis.

V. Based on scores at or below the fortieth percentile on the Otis-Lennon Mental Ability Test, the correlation between attitude and achievement scores will be significantly higher for students in the computer-assisted group than for students in the lecture-demonstration group. This hypothesis was statistically tested by the procedure outlined in the third hypothesis.

VI. Students taught by the computer-assisted instructional approach will achieve significantly higher pretest-posttest gain scores than students taught by the lecture-demonstration approach. This hypothesis was statistically tested using the analysis of covariance. Scores obtained from the Otis-Lennon Mental Ability Test were used as a covariate.

Significance of the Study

The traditional procedure for teaching office machines consists of (1) stressing the textbook approach, (2) explaining mathematical concepts to the class as a group, (3) limited practice in class on the more difficult problem areas, and (4) homework assignments that are designed for average students. Two problems are apparent in the typical office machines classroom. First, not all students are at the same ability level. Second, there is little provision for
individual help when students encounter difficulty in the traditional class.

Often, courses in office machines are a dumping ground for all types of students. Students with above average abilities are grouped with average or low-ability students. This creates a problem for both the teacher and the student. The fact that most students are at different levels of skill development is complicated by most schools purchasing different types of calculators and adding machines. This creates a situation where only a small group of students are working on the same machine during the typical class period in the semester time frame.

Some type of individualized progress method is needed to teach not only the manipulative skills, but also the mathematical applications included in the typical office machines class. In the past, much of the research effort in machines instruction on individualized progression methods has emphasized skill development, not the mathematical application of concepts needed for mastery of subject content. For effective mathematical instruction in a machines class, an approach is needed that will enable the student to get help on the mathematical concept when he encounters difficulty.

When the student cannot understand the mathematical concept involved, he needs a method that will explain the concept, illustrate the idea through an example, and provide
practice materials to reinforce the procedure in a short period of time. One promising innovation for instruction in business machines is computer-assisted instruction. Since 1966, considerable research effort has been made in the area of computer-assisted instruction. Most of the work connected with mathematics instruction has involved elementary school students. It is evident from the research reports that students tend to achieve better results when computer-assisted instruction is used. Also, students show attitude improvement and encounter no difficulty working with the computer and the computer terminal. Computer-assisted instruction has been successfully used in other areas of mathematics instruction, yet no thorough evaluation of the potential of computer-assisted instruction has been completed in applied mathematics for business machines students.

Questions posed in the present study need to be answered. Formal research and evaluation is needed to determine if students using the computer-assisted approach can obtain a significantly higher level of mathematical achievement. In addition, study and evaluation is needed to determine the effect of computer-assisted instruction on the student's attitude. The problems that are encountered with traditional methods of instruction coupled with the promise of computer-assisted instruction to alleviate basic problem areas necessitate a thorough investigation of both approaches to instruction in office machines.
Definition of Terms

Achievement refers to the composite raw score obtained from the mathematics achievement posttest.

Applied mathematics refers to the following mathematical topics: (1) percents to a decimal, (2) decimals to a percent, (3) complement, (4) round off, (5) fractions to a decimal, (6) cash discount, (7) markdown, (8) commission, (9) cost markup, (10) retail markup, (11) simple interest, (12) distribution of expenses, (13) proration, (14) series discounts, and (15) percentage of increase or decrease.

Attitude refers to the score obtained from the Purdue Master Attitude Scale, A Scale to Measure Attitude Toward Any School Subject.

Business machines class refers to a freshman/sophomore course designed to provide the student with skill in the operation of such machines as adding machines, printing calculators, and electronic calculators. Emphasis is placed on the applied mathematics area.

Computer-assisted instruction refers to instruction consisting of an explanation, example(s), and practice material with immediate reinforcement and help via the computer terminal.

Computer package refers to the total program including the explanation, example(s), and practice or reinforcement materials.
Computer printout refers to the hard copy provided by the computer terminal for student use and review.

Gain score refers to the difference between pretest and posttest achievement raw scores.

Lecture-demonstration approach refers to traditional methods for presentation of new topics coupled with homework problems to reinforce the concept. The student progresses through activities on a fixed time basis.

Mental ability score refers to the raw score obtained from the Otis-Lennon Mental Ability Test. This score is used to define high and low-ability groups and as a covariate in the analysis of covariance statistical treatment of the data.

Open-door policy refers to the college's policy of admitting anyone over eighteen years of age who applies for admission.

Positive reinforcement refers to terms that students receive for correct answers to practice problems.

Sub-groups refers to smaller groups resulting when the computer-assisted instruction group and the lecture-demonstration group are divided on the basis of scores obtained from the Otis-Lennon Mental Ability Test.

Delimitations

This study included those students enrolled in business machines classes on the Richland Community College campus in the Dallas metropolitan area. The campus involved in this
study had an enrollment of approximately 10,000 students. This delimitation insured control of mathematical topics studied in the respective classes. In addition, this study was limited to computer-assisted instruction in the applied mathematics area in business machines.

Assumptions

It was assumed that the students would respond honestly and carefully to the instruments used to measure mathematical ability, mental ability, and attitude. It was further assumed that there would be a similar initial interest in mathematical topics involved in this study between the experimental and control groups.
CHAPTER II

RELATED LITERATURE

Introduction

The ultimate test of instruction in business machines is the student's ability to transform basic facts and information into a defensible conclusion and apply the decision to a real-life situation. Instruction in the classroom usually consists of (1) emphasizing a textbook to accompany a particular adding machine or calculator, (2) explaining mathematical concepts to either individual students or to the entire class, (3) offering practice designed to reinforce the concepts and skills considered necessary for completion of the course, and (4) providing individual assignments designed to meet the average student's needs. At least two problems are present to hinder quality instruction. First, not all students who enroll in a business machines class are at the same ability level. Second, the teacher cannot give students the individual attention needed for quality instruction in the normal business machines classroom.

In this review of the literature, the following four areas will be examined in an attempt to find a solution to the problems previously described: (1) Instructional Methodology in Business Machines, (2) Relationship Between Business Machines and Applied Mathematics, (3) Research Efforts in
the Business Mathematics Area, and (4) Recent Developments in Computer-Assisted Instruction.

Instructional Methodology in Business Machines

A great deal of research effort has been expended on instructional methods currently used in the business machines area. Two problems are of particular interest to this study. First, because of different types of calculators and adding machines currently available, some type of individualized progress method is needed. Second, students continue to experience problems in the application of mathematical concepts. This area continues to dominate a large part of the class period in the majority of business machines classes.

The McKenzie study.—Realizing the need for effective classroom instruction, McKenzie developed a learning systems approach for individualized instruction in a business machines course. This instructional approach involved identifying objectives, learning activities, and opportunities for self-evaluation. Instruction for the experimental group consisted of slide-tape presentations and eight millimeter filmloops. Slide-tape series, one for each machine, were developed to supplement the learning packages. In addition, four film-loops were made for each machine.

Filmloops were used to demonstrate correct psycho-motor movement and machine manipulation. Finally, this type of instructional material made it possible for the student to work at his own pace. The lecture-demonstration-rotation group received instruction in the same areas, but was locked into a fixed rotation plan. The control group also received a more traditional presentation of instructional information. Questions concerning achievement, self-pacing, and previous experience with calculating machines were examined in connection with the learning-systems approach. As a result of this study, McKenzie concluded that

1. Achievement on office machines, especially for the lower ability student, is significantly affected favorably through the use of the learning systems approach.
2. The self-pacing aspect of the learning systems approach permits students to complete course requirements in significantly less time without achievement being adversely affected.
3. Previous training or experience on office machines does not necessarily enable a student to achieve at a higher level than a student with no previous training or experience on office machines.

The Edwards study.—Additional work was done in the area of individualized instruction utilizing eight millimeter filmloops by Edwards. Edwards found that students using an audio-visual-tutorial approach learned more effectively than

Ibid., p. 81.

students taught by a traditional approach. Twenty-two eight-millimeter filmloops were developed for instructional purposes in office machines. In addition to the demonstration filmloops, assignment sheets were given each student to accompany individual filmloops. The classroom and laboratory assistants were available for nine hours a day. The only exception to this time schedule occurred when traditional classes were in session.

At the conclusion of the semester, Edwards administered a final examination to students in both groups. The post-test revealed that students in the experimental group achieved at a significantly higher level (.025) than students in the control group. In addition, Edwards concluded as a result of an informal questionnaire, that students enjoyed the audio-visual-tutorial approach and the majority would prefer it to a scheduled class, if a choice were available.

The work of McKenzie and of Edwards supports the concept of individualized learning in business machines. Students involved in both studies preferred self-paced classes over a more traditional approach. Achievement scores for groups receiving the audio-visual-tutorial approach were higher than scores obtained by the traditional groups. Yet, an important point is that neither study employed computer-assisted material to concentrate student attention on mathematical concepts while at the same time enabling students to

\[4^{\text{i}} \text{Ibid., abstract.} \quad 5^{\text{i}} \text{Ibid.}\]
progress at their own rate. Possibly, computer-assisted instruction is another method of achieving self-paced instruction in business machines. Furthermore, neither study examined the impact of providing the student with immediate reinforcement, which is possible with computer-assisted materials.

The Zahn study.—The purpose of this study was to compare achievement of students exposed to audio-visual equipment and materials designed for individual study with achievement of students who used a flowcharted method of instruction. Materials presented to the group of students who experienced the flowcharted method of instruction consisted of an introduction to each mathematical application, performance objective for each topic, flow charts that diagrammed the process for working the problems, and materials for reinforcement. Students who used the audio-visual materials received essentially the same information, but the method of presentation was different.

As a result of information found by Zahn, no significant difference was found between achievement for students in the flowchartered group and students who received the slide-tape

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7Ibid., p. 42.
presentation. According to Zahn, students had a favorable attitude toward the audio-visual method of instruction.

The Zahn study examined a number of factors similar to the present study. Instructional materials were presented from a source other than the teacher. Both the audio-visual approach and the flowcharted approach examined by Zahn are easily adapted to self-pacing. In addition, many of the same guidelines for development of successful audio-visual materials are essential to effective computer-assisted instruction. Although these factors were presented in Zahn's study of the audio-visual approach and flowcharted approach, there is still need for an evaluation of computer-assisted instruction. Computer-assisted instruction does provide students with immediate feedback and evaluation. Finally, the computer can be programmed to make decisions regarding the level of difficulty for the practice materials that students receive.

The Walters study.—A study was conducted by Walters to compare the results of students using audio tapes for machine instruction and students using a traditional rotation approach. Both the experimental group and the control

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8 Ibid., p. 77.  
9 Ibid.  
group followed the same course outline, used the same textbook, and experienced identical assignments and tests. All audio tapes used in the experimental classes were written and produced by Walters.

At the conclusion of the experiment, there was no significant difference at the .05 level in achievement between the group that experienced the audio taped approach and the group that used the traditional rotation approach. An informal questionnaire indicated that student attitude was favorable toward the audio-taped instructional approach.\(^1\)

A number of factors emerged as a result of the Walters study. First, Walters recommended that a teacher should be present in the classroom to give additional help and reinforcement if students encountered difficulty. Second, students using audio tapes did progress at their own pace through the typical office machines course. Third, the experimental group used slightly less time in completing their assignment.\(^2\)

Although Walters found no significant statistical difference between groups, the experimental group did obtain a slightly higher mean score. Audio-taped instruction did replace the teacher as the dominant factor in the experimental class. It is possible that combining the computer-assisted instructional approach with the presence of a teacher in the classroom will improve student achievement.

\(^{11}\)Ibid., abstract. \(^{12}\)Ibid.
Walter's recommendation for self-pacing and keeping the teacher in the classroom must be evaluated. These factors are explored in the present study.

A review of research in the business machines area demonstrates the need for some method of individualizing instruction. This study will help resolve questions in this area by comparing the achievement of business machines students utilizing different instructional methods not yet evaluated. This study will differ from those in this area because of the addition of computer-assisted instruction in the applied mathematics area. As in most studies, this study will compare student attitude in each treatment group.

Relationship Between Business Machines and Applied Mathematics

The question of what to teach in business machines has always been a difficult question to answer. Some teachers stress skill development, while others concentrate on the mathematical competencies needed for successful completion of this course. A number of research studies have tried to answer questions about the relationship between mathematical instruction in a business machines course.

The Stutsman study.—The purpose of Stutsman's study was to determine if students received adequate training in
school on adding and calculating machines. Stutsman used a questionnaire to survey employers concerning the status of machine operators in companies in a selected area. In addition, a questionnaire was developed and administered to employees.

Stutsman sought answers to at least two questions that have implications for this study. First, he tried to determine what are the deficiencies in knowledge of operation of machines exhibited by operators. Second, he attempted to measure if operators demonstrated any arithmetical deficiencies when using adding and calculating machines. Stutsman found the major difficulty of machine operators was due to weakness in arithmetical knowledge. As a result of the questionnaire sent to employers, he concluded, "if schools desire to provide some familiarity with adding and calculating machines, they might profitably provide such instruction in connection with a review course in business arithmetic."

The fact that Stutsman's study was completed in 1950 does not necessarily indicate a solution has been found to the perplexing problem of business arithmetic in office machines. Stutsman's research did not involve computer-assisted instruction, but it does lend support to the need for effective mathematical instruction in business machines.

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14 Ibid., p. 194.

15 Ibid., p. 127.
The Carver study.--The Carver experiment was conducted during the spring semester, 1969, at Southeastern Louisiana College, Hammond, Louisiana. The sample consisted of ninety students who were divided into three sections. Group I included thirty students enrolled in a Mathematics of Finance course in which calculators were furnished as an instructional tool for problem solving. Group II was composed of thirty students enrolled in a Mathematics of Finance course in which pencil and paper techniques were used to solve arithmetic computations. Group III included thirty students enrolled in a Business Machines Class. Six professors were involved in the experiment.

Group I and Group II were compared to determine if business mathematics achievement was increased with the use of a calculator as a computational tool. Group I and III were compared to determine if skill development was significantly better for one group of students. The tests used to measure skill were lists of arranged numerical problems.

According to results of this study, college students enrolled in the Mathematics of Finance class who used calculators as a computational tool did not achieve significantly higher achievement scores than students who worked

without calculators enrolled in the same course. In addition, students did not achieve significantly higher skill scores in the business machines course in which instruction was given on four types of calculators than students in the Mathematics of Finance course in which instruction was given on one type of calculator.

The fact that Carver explored the relationship between student achievement in business mathematics and office machines makes his study similar to the present study. One suggestion made by Carver supports more evaluation of mathematics instruction in office machines. Carver states,

A research study at the College level in which business mathematics word problems are used in addition to skill development problems in the business machines area to determine how this technique influences machine-skill and business mathematics achievement would be appropriate.

The Page study.—Similar results were found by Page in an experimental study that involved students at Colorado State College. This study was conducted to determine the effectiveness of teaching calculating machines and business arithmetic as an integrated course.

17 Ibid., p. 65.  
18 Ibid., p. 66.  
19 Ibid., p. 69.  
Eighty-five students were divided into three groups for experimental purposes. Group I consisted of twenty-nine students that received instruction in business mathematics. This group did not use calculating machines. Classroom procedure consisted of a traditional lecture and illustration approach for each mathematical concept studied. Group II consisted of twenty-nine students who received instruction in class on the calculating machines. This group did not receive any information concerning the mathematical concepts involved in a formal classroom presentation. Students in this group received handouts designed to explain the mathematical theory needed to work the application problems.

Group III included twenty-seven students that received instruction on the calculating machines and the mathematical problems. The materials used in this study consisted of different textbooks for each class, but only topics common to each book were used in the study.

According to the results of this study, the students who used calculating machines did not obtain significantly higher achievement test scores than students who did not use calculating machines.\(^{21}\) Although the advantage was not statistically significant, a small advantage was reported to accrue to the students in the calculating machine and business mathematics group.

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\(^{21}\)Ibid., pp. 65-66.
Two observations are reported by Page as a result of his study. First, the use of calculating machines seemed to motivate students. Second, students in the calculating machine business mathematics group took less time to complete assignments. In addition, Page makes one recommendation which has interesting implications for the present study. He states, "Can other machines such as the computer be effectively utilized in other business subjects? If the computer could be successfully integrated with other courses, it could improve the instruction of these courses."

The fact that both Carver and Page compared mathematical achievement in a business machines course makes their research similar to the present study. The Carver study compared students in a mathematics of finance course and students in a business machines course on a skill basis. No attempt was made to compare mathematical comprehension for students in office machines. The Page study included students in a business mathematics course and a calculating machines course. Presentation for both the control group and the experimental group consisted of a traditional classroom approach. The treatment in the Page study consisted of the same methods of presentation, but different content and instructions for working the problems. The present study compares two instructional procedures designed to reinforce

22 Ibid., p. 50. 23 Ibid., p. 51. 24 Ibid., p. 55.
applications for a business machines course in an attempt to find a superior method of instruction.

Other studies.—A number of studies comparing achievement for business mathematics students and office machines students have been completed at the master's level. The studies of Helquist, Trochlil, and Crawford are related to the present study.

Helquist investigated the mathematical proficiency changes in office machines students as a result of taking a course in calculating and posting machines.25 She used the same pretest and posttest to determine if there was significant difference in achievement. As a result of this study, Helquist concluded there was a definite relationship between student understanding of mathematical principles and the ability to apply those concepts using various office machines.26 Students in this study demonstrated improved mathematical skill as a result of completing a course in calculating and posting machines, but not to the point that remedial mathematics could be deleted from the course outline.27

The purpose of Trochlil's work was to determine if a significant difference in mathematical achievement existed


26Ibid., pp. 3-4.

27Ibid., p. 55.
between business mathematics students who used calculators and business mathematics students who did not use calculators. In addition, the operational skill obtained by students in the business mathematics group was compared with the operational skill obtained by students in the office machines group. The experimental group and the control group were equated in terms of IQ and Iowa test scores. Trochlil concluded that

1. Business machines do not significantly aid the learning of business mathematics.
2. Only one business mathematics achievement test indicated a significant gain in achievement in favor of the experimental group.
3. Achievement in machines usage seems to be the same in a business machines class as a business mathematics class.
4. It would be possible to combine the two courses of business mathematics and business machines.

A similar study was conducted by Crawford comparing the mathematical achievement of business arithmetic students using calculators with business arithmetic students not using calculators. The difference between pretest scores and posttest scores was calculated for each student. The gain scores were used to compute the statistical z-test to

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29 Ibid.

determine if there was significant difference between the groups. After nine weeks of business mathematics instruction with the aid of calculators, students were not significantly better than students who studied business mathematics in a more traditional manner without the aid of calculators.\textsuperscript{31}

Three doctoral dissertations and three master's theses were reported that evaluated the relationship between business mathematics and business machines. Five of the studies indicated that no significant difference of achievement was found for students studying business mathematics in conjunction with calculating machines. In all the experiments reported, classroom presentation consisted of a traditional approach, usually a lecture and a demonstration. No attempt was made to use instructional methods other than the typical classroom approach. The fact that five studies found an insignificant statistical difference between groups indicates another method must be evaluated. This study employed a new instructional approach not yet tried in a business machines course. Computer-assisted instruction could be the instructional method needed to provide quality mathematical instruction in applied mathematics for business machine students on an individualized basis.

\textsuperscript{31}\textit{Ibid.}, p. 27.
Research Efforts in the Business Mathematics Area

A number of problems abound in the business mathematics area, but only a few solutions seem to be attainable. Meyers states,

> It's obvious that something must be wrong with business mathematics because of the number of complaints we hear concerning the subject. I maintain there is very little inherently wrong with the subject per se, but there are things wrong with the way we in education are using the subject.32

Often, courses in business machines are a dumping ground for all types of students. Students with above-average abilities are grouped with average or low-ability students. This creates a problem for both the teacher and the student.

Satlow points out a number of problems that inhibit quality instruction in the applied mathematics area. Student purpose, motivation, and reasoning must be challenged if the teacher expects quality instruction.33 In addition, he indicates that practice or drill material is important to understanding the mathematical concepts and that practice problems should be developed according to order of graduation.34 Most of the studies surveyed in business mathematics

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involve either different methods of instruction or measurement of student achievement. Research studies in business mathematics with characteristics similar to factors in the present study are presented here.

The Krueger study.—The purpose of Krueger's study was to evaluate student achievement as a result of student participation in a business mathematics course. A mathematical pretest was administered to all students who enrolled in a business mathematics course. At the completion of the course, a posttest was administered to all students in the class. As a result of information obtained by Krueger, appropriate changes were made in the business mathematics course.

Krueger concluded that students must receive more effective instruction and practice interpreting and solving problems in the business mathematics area. He noted at least three observations which are applicable to the present study. First, on the basis of the pretest, students were ill-prepared in business mathematics. Second, students encountered difficulties choosing the appropriate process needed to obtain a correct answer. Third, additional research was

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36 Ibid., p. 45.
needed to evaluate instructional methods and materials currently available in the business mathematics area.

The Swindle study.—In an effort to improve student performance through individualized instruction, Swindle conducted an experiment at Phoenix College. Students in the individualized class were given a course outline consisting of fifteen mathematical topics. A twenty-minute quiz was administered to students in the experimental group when they had completed the necessary preparatory work on each topic. A student helper and an instructor were available for help when students encountered difficulty. The instructor spent the majority of his time helping individual students or working with small groups of students. Students in the individualized instruction group were free to leave class when all assignments were completed. Students in the traditional group experienced the same fifteen mathematical topics. In addition, they took identical examinations for each of the fifteen topics.

As a result of this experiment, Swindle concluded that students in the individualized progression class experienced higher mean scores on an achievement posttest than students in the traditional class. Also, students in the

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38 Ibid., p. 240.
experimental group experienced lower dropout rates. Finally, Swindle suggested there is need for further research to examine the effect of individualized progress methods in business mathematics.

The Meyers study.—A study was conducted by Meyers to compare the effectiveness of teaching business mathematics to college students by programmed-learning methods with a more traditional approach. Topics included in this study were the following: (1) simple interest and applications, (2) distribution of ownership and profits, (3) merchandising mathematics, and (4) depreciation. A programmed mathematics book served as a textbook for the experimental group. Individual assignments were completed by students in class and as homework. The non-programmed group used a traditional textbook. Classroom procedures included lectures, explanations, demonstrations, discussions, and question and answer sessions.

As a result of his work in programmed instruction, Meyers concluded that

1. Students taught business mathematics by programmed-learning methods achieve higher scores than students taught by non-programmed-learning methods.

39 Ibid.

2. Time and score findings indicated that students taught business mathematics by the programmed-learning methods can achieve significantly higher achievement scores in a shorter time period than a comparable group of students taught by non-programmed-learning methods.\(^{41}\)

The Judson study.—Research was conducted by Judson to compare the effectiveness of the programmed textbook method of reviewing fractions with a non-programmed method.\(^{42}\) Two high school general business classes were used in this study. Students in one class were designated as the experimental group and used a programmed textbook. Students in the traditional section experienced a lecture-chalkboard demonstration approach. Assignments in the traditional group were in the form of mimeographed handouts.

A mathematical posttest was used to determine achievement for each group. No significant difference was found between students in the programmed group and students in the traditional group.\(^{43}\)

The Musick study.—In research conducted by Musick, programmed instructional materials developed for post-high school business mathematics students were adapted to junior
and senior high school students.\textsuperscript{44} The basis for material used in this study was the original 198 frames of a programmed unit on interest developed by Huffman.

Musick found that the materials could be successfully used with the addition of 36 percent more material.\textsuperscript{45} The author recommended that programmers need to devise some means to counteract the boredom factor that is present when students work on programmed materials for long periods of time.

The combination of the desirable attributes of programmed instruction with computer-assisted instruction could provide a workable solution to the problems mentioned by Musick. In addition, Musick's work involved only programmed instruction in the area of calculating interest. This study examined not only interest, but also fourteen other concepts.

Each study examined answered fundamental questions about instruction in applied mathematics similar to questions in the present study. There were many problems that still need solutions. In research completed by Krueger, it was determined that students need additional work in interpreting and problem-solving for improved instruction in business.


\textsuperscript{45}Ibid., p. 66.
mathematics. The work of Satlow supported Krueger's findings. Swindle found students using individualized instructional materials obtained higher achievement and experienced lower dropout rates than students in a traditional class.

One method of providing the desired additional practice while achieving the needed individualized progress method was examined by Musick and Meyers. They found significantly better results for students using programmed instruction. Yet, Judson concluded that there was no significant difference between achievement scores of students using programmed materials and students using traditional methods.

Computer-assisted instruction could reduce the problem of boredom mentioned by Musick. Furthermore, each of the studies employing programmed instruction involved only a limited segment of the practical mathematics area. This study examined fifteen areas needed for competency in either business mathematics or office machines. In addition, this study employed a method that has been used successfully with other types of mathematical instruction, but not yet tried in applied mathematics.

Recent Developments in Computer-Assisted Instruction

Computer-assisted instruction has become increasingly popular since the original educational application of computer technology for learning purposes at Harvard University in 1966. In a recent survey of schools surrounding Temple
University, Schrag indicates that four of five schools contacted had computer terminals available for student and teacher use.  

Most educators feel that students are capable of greater achievement than they actually acquire. Ianni states five assumptions which support investigation of computer-assisted instruction. They are as follows:

1. Man is capable of learning much more than he is asked to learn.
2. There are a number of manageable different approaches to instruction that can be tailored to individual differences among students.
3. Through careful diagnosis, insight can be gained on how one ought to go about individualizing instruction.
4. Reinforcement and feedback should be immediate during instruction.
5. In each instance, the quality of the education that a person receives ought to be the highest possible.

West states, "More generally, full individualization of the rate of instruction in accordance with differences in abilities is quite impossible in mass instruction, but it is one of the built-in characteristics of programmed instruction and of computer-assisted instruction." The computer

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can perform in four different ways to aid education. First, it can provide basic drill work for the students. Second, the computer is able to direct learning through a tutorial approach. Third, the computer is capable of developing a dialogue with students. Fourth, games and simulations are possible with the aid of computer technology. Since 1966, a number of studies examining the potential of computer-assisted instruction and mathematical instruction have been completed. Research studies similar to the present study are included in this section of Chapter II.

The McCool study.—McCool examined the effectiveness of a computer-assisted instructional program and a traditional lecture method in terms of student achievement and student attitude toward mathematics. This experimental study was conducted during the spring semester, 1973. Forty-four students enrolled in three sections of Mathematics 112 at Mountain View College of the Dallas County Community College District were involved in this experiment. Mathematics 112 is a required course for business and economic majors in most colleges and universities in the state of Texas.

All material taught in class was presented in organized units for both experimental and control groups. Students in

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the experimental group experienced the computer as a teaching-learning aid. The computer served two purposes in this study. First, the computer served as a course supplement to classroom instruction. Second, the computer terminal was used as a computational aid for students in the experimental group.

At the conclusion of this study, an achievement test and an attitude scale were administered to all students in the experiment. McCool concluded there was no significant difference between the two teaching methods.\(^{50}\) He did point out that students in the experimental group learned not only calculus concepts as well as students in the traditional method, but they also learned a computer programming language.\(^{51}\)

The study by McCool presented at least four factors similar to the present study. First, the computer terminal was used as an instructional source. Second, the experiment involved instruction in the mathematics content area. Third, community college students were used for the experimental and traditional groups. Fourth, attitude and achievement were measured for all students in the experiment. Although these factors are similar to characteristics in the present study, there are a number of obvious differences. Students who participated in the present study were enrolled in a business machines course, not Mathematics 112. Also, the

\(^{50}\)Ibid., pp. 70-71. \(^{51}\)Ibid., p. 74.
applied mathematics topics in this study were completely different from the topics explored by McCool in connection with instruction in calculus. Finally, a large number of students enrolled in business machines have no intention of continuing their education after they obtain a two-year degree at a community college. The majority of students enrolled in the Mathematics 112 course took the course because it is required by most four-year colleges and universities in Texas.

The work of Suppes, Jerman, and Groen.—The researchers involved in this study developed a series of computer programs to teach basic number facts as a supplement to the teacher's daily instruction at the fourth grade level. The authors stated that "Given a computer-based instructional program and a school in which to work, it is possible to supplement or enrich the teacher's instruction by taking over the more routine daily tasks, presenting special materials, or giving the daily lesson itself." Drills for this project were from three to six minutes and contained from five to thirty problems. Although this project was conducted at the fourth-grade level, the authors indicated that students encountered no difficulty in mastering the

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53 Ibid., p. 303.
simple operations required for efficient use of the computer terminal. As a result of this study, the authors concluded that computer-assisted drill materials could be used to overcome the large percentage of typical errors in arithmetic. The authors stated that "The data included in the present report represent a very superficial beginning and are intended only to give a sense of the methods and procedures that may be used for extensive pedagogical and psychological investigation of arithmetic skills."55

The work of Suppes, Jerman, and Groen examined some factors quite similar to the present study. Students in both studies experienced mathematical instruction by utilizing a computer terminal in a six- to eight-minute time period. In the study by Suppes, Jerman, and Groen, students worked from five to thirty problems. Students in the present study worked ten problems, but were free to work through individual computer packages as many times as they deemed necessary. Although a number of characteristics were similar, two factors were different. First, the work of Suppes, Jerman, and Groen involved fourth-grade students. The present study involved older students in a community college environment. Second, mathematical topics involved in each study are different. The present study stressed business applications, while Suppes, Jerman, and Groen emphasized the fundamentals needed by elementary school students.

54 Ibid., p. 304. 55 Ibid., p. 309.
Other work.—A number of studies have been completed in the broad spectrum of computer-assisted instruction, but re-search efforts in the area of mathematical fundamentals are limited. Brief summaries of the work of Fejfar and Crawford are reported in this section.

Fejfar experimented with a teaching system designed to enhance speed and accuracy with the addition of multiplication facts for elementary school students. This system combined randomly selected practice problems with immediate student feedback. Students were presented necessary mathematical concepts through classroom activities and then worked assignments using the computer terminal. A computer print-out was provided by the terminal for each student. Each lesson was continued until the student operator either terminated the program or responded correctly ten consecutive times.

This program has been used in a teaching environment approximately two hundred times by elementary school children throughout the nation. Fejfar, as a result of work in the area of computer-assisted instruction and multiplication, found that

1. Students had little difficulty communicating with the computer through the typewriter console.
2. Students were very enthusiastic about this kind of instruction.

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3. Use of computer-assisted instruction does lead to improvement of multiplication skills.\textsuperscript{57}

In a study conducted by Crawford, achievement of students using computer-assisted instruction in the area of basic arithmetic was compared with student achievement in controlled classes.\textsuperscript{58} Material for this study was developed by Suppes and involved addition, subtraction, multiplication, and division. Crawford found that seventh-grade students in the experimental computer-assisted mathematical group demonstrated significant gain scores on the Wide Range Achievement Test when measured from pretest to posttest.\textsuperscript{59} In this study, no significant differences were found using posttest scores between the experimental group and the control group.\textsuperscript{60} In addition, students in the computer group did experience attitude improvement as a result of computer-assisted instruction. No concepts usually found in a business mathematics or office machines course were included in this study. Crawford concluded there is need for a formal evaluation of student attitudes concerning computer-assisted instruction.

\textsuperscript{57}Ibid., p. 187.
\textsuperscript{59}Ibid., p. 179.
\textsuperscript{60}Ibid.
Summary of Related Literature

Since 1966, much research effort has been expended in the area of computer-assisted instruction. A large portion of the work connected with mathematical instructions has involved elementary school students. It is evident from the studies reported, students tend to achieve better results when computer-assisted instruction is used. Also, students show attitude improvement and encounter no difficulty working with the computer and the computer terminal. Finally, more research is needed to evaluate computer-assisted instruction in applied mathematics instruction. Questions presented in this study need to be answered. Attitude and achievement need to be evaluated when computer-assisted instruction is used with older or post-secondary students.

The present study used computer-assisted instruction for mathematical instruction with business machines students. No thorough examination of the potential of computer-assisted instruction has been completed in this area.

This study was different from other studies involving business machines and applied mathematics in the following ways: (1) achievement for the computer-assisted group was compared with achievement for the lecture-demonstration group, (2) attitude for the computer-assisted group was compared with attitude for the lecture-demonstration group, (3) the correlation between achievement and attitude was examined for all groups, and (4) the correlation between
attitude and achievement was compared on the basis of high and low intelligence scores to determine if one method was superior to the other method for low-ability or high-ability students.
CHAPTER III

PROCEDURES FOR COLLECTING AND TREATING
THE DATA

This experimental study was designed to compare achievement for students who were using a computer-assisted instructional approach and students who were using a more traditional lecture-demonstration approach. An understanding of the procedures used in this experimental study is essential to accurate interpretation of the findings and conclusions.

Setting of the Experiment

Despite the emphasis on mathematics, business machines students are still deficient in the applied mathematics area. To help solve the problem, computer-assisted instruction was developed to supplement learning in business machines. This experiment was completed in business machines classes on the Richland College campus in the Dallas-Fort Worth, Texas, metropolitan area during the spring semester of 1976. Monetary support necessary for development of instructional materials and equipment was provided by the Richland College administration. Students in four business machines classes received either the computer-assisted instructional approach or the lecture-demonstration approach.
The factors for college admission, course content, course objectives, evaluation, and available business machines were the same for all classes involved in the experiment.

Population of the Experiment

The population of this experiment consisted of those students enrolled in business machines classes during the spring semester of 1976. A total of 122 students were enrolled in four classes assigned to one instructor. A table of random numbers was used to determine which two classes would receive the computer-assisted instructional treatment approach. The remaining two classes received the lecture-demonstration approach. All students enrolled in business machines classes were to receive two hours of credit. Class time was devoted to one-third lecture and two-thirds laboratory experience. Class periods were either fifty minutes in length or one hour and fifteen minutes in length. As a result of the randomized selection of classes for the computer-assisted approach or the lecture-demonstration approach, both the fifty-minute period and the one hour and fifteen-minute period were used for each treatment group.

Instructional Procedures

There were six different machines available for student use in the business machines classes that received either

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the computer-assisted treatment or the lecture-demonstration treatment. Machines available for student use were the following: Monroe 620 Electronic Display Calculator, Monroe 950 Electronic Display Calculator, Monroe 1320 Electronic Printing Calculator, SCM 414 Cogito Electronic Display Calculator, Sharp 642-B Electronic Printing Calculator, and Singer 211 Adding Machine. All students were required to complete lessons on at least one ten-key adding machine, one electronic printing calculator, and one electronic display calculator. In addition, students were able to improve their grade by completing lesson material on a different brand electronic printing calculator or electronic display calculator. Textbook materials to accompany each machine were identical for the lecture-demonstration group and the computer-assisted group. Individual textbooks used with each machine provided explanations and problems designed for that particular machine. Today's Basic Business Mathematics Through Electronics was used to accompany the Monroe 620 and Monroe 1320 Electronic Calculators. College Business Education Using Electronic Calculators by Gary Berg was used with the Sharp Electronic Printing Calculator. The fourth edition of the Office Machines Course by Cornelia, Pasewark,

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and Agnew provided the instructional materials for the Monroe 950 Calculator, the SCM 414 Calculator, and the Singer 211 Adding Machine. Two examinations were used as the basis for determining accuracy and speed on each machine. The first test was administered after half of the lesson material for each machine was completed. The second test was taken when the student completed the lesson material for each machine. Examinations and evaluation procedures were the same for all groups involved in the experiment.

**Computer-Assisted Approach**

A record of questions concerning applied mathematics asked by business machines students was kept during the spring semester of 1975. Approximately seventy students took part in this part of the experiment. As a result of questions asked by students in this group, the following fifteen programs or packages were developed during the summer of 1975.

1. **Percents to a decimal.**—Two methods of converting a percent to a decimal were presented in this package. One method involved dropping the percent sign and dividing the number by 100. The second method consisted of moving the decimal two places to the left and dropping the percent sign.

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2. **Decimals to a percent.**—Two methods were presented in this program. The first method involved multiplying the decimal by 100 and adding a percent sign. The second method consisted of moving the decimal two places to the right and adding a percent sign.

3. **Complement.**—The material for complement explained the rationale of why a complement is sometimes easier to use than a discount. One basic rule (100 Percent - Discount = Complement) was included in the explanation. A detailed example was included to illustrate the concept.

4. **Round off.**—The 5/4 round off was illustrated in this package. In addition to the rationale for rounding off numbers, the following rule needed for rounding off numbers was included in the package.

   When rounding off decimals, consider the number to the right of the last digit to be retained. If this digit is 5 or more, add 1 to the previous digit; if the number is 4 or less, drop it.

5. **Fractions to a decimal.**—Students were shown how to convert a common fraction to a decimal by dividing the numerator by the denominator.

6. **Cash discounts.**—The most common cash discounts were examined. Each term in the cash discount was defined. In addition, the rationale of why a firm would grant a cash discount received major emphasis in this program.
7. Markdown.—A three-step procedure was given students in this program. The steps involved in the markdown package were (1) change the markdown percentage to a decimal, (2) multiply the decimal equivalent by the original price, and (3) subtract the amount of markdown from the original amount.

8. Commission.—This package explained the type of workers who received compensation on a commission basis. Commission was determined by multiplying the dollar amount of sales by the commission percentage.

9. Cost markup.—In addition to background information, two steps were used to explain cost markup. The first step presented was to multiply the original cost by the markup percentage. The second step involved adding the original cost and the markup amount to obtain the sales price.

10. Retail markup.—A two-step procedure was used to explain retail markup. The first step was to determine the complement of the markup percentage. The second step was to divide the original cost by the complement.

11. Simple interest.—The basic formula, \( I = PRT \) (Interest = Principal \times Rate \times Time), was presented in this package. Special emphasis was given to the factor of time.
12. Distribution of expense.--The problem of determining each department's share of indirect expense was explained by allocating the expense on the basis of each department's square footage.

13. Proration.--The problem of determining each department's share of indirect expense was explained by obtaining an expense factor. To obtain an expense factor, students were told to divide total expense by total sales. Then, the student was told to multiply the expense factor by each department's sales to arrive at the department's share of expense.

14. Series discount.--Both the discount method and the complement method of working with series or trade discounts were explained in this package. Students were given the catalog or retail price and the discounts. They were asked to determine the net price or wholesale price.

15. Percentage of increase or decrease.--A three-step procedure was used to determine the percentage of increase or decrease. The steps were as follows: (1) determine the amount of change; (2) divide the amount of change by the previous period amount; and (3) convert the decimal answer to a percentage.

Each program contained an explanation, example(s), and problems that were divided into two levels of difficulty. The explanations, while brief and to the point, were
developed to help students understand the mathematical concepts involved.

An example, stressing the business application, was available to further illustrate the idea. Problems were selected on a random basis which provided the student with different problems each time he worked through the computer package.

A student was given two chances to work each problem. If he obtained a correct answer the first time, the computer responded with positive reinforcement. If the student arrived at an incorrect response, he was given a second chance. If, after two attempts, the student could not obtain a correct response, the computer responded with the correct response and an explanation of how to work the problem. At the conclusion of the program, the computer informed the student of the number of problems attempted and the number that he answered correctly. Average time per computer package was approximately eight minutes. Shorter programs took about three to four minutes, while longer programs took about fifteen minutes. Naturally, student time per program varied depending on how much difficulty the student encountered working the problems in each package.

Three basic commands were available to students to facilitate the use of computer materials. First, the student could type the term, HELP, if he encountered difficulty with a mathematical problem. The computer responded with
an explanation that demonstrated how to work the problem. After the explanation, the student was automatically given another problem to reinforce the explanation.

Second, the student could type the term, CALC, into the terminal keyboard. This command allowed the student to add, subtract, multiply, or divide using the computer terminal.

Third, the student could type the term, STOP, into the terminal keyboard. This command automatically stopped the program regardless of the number of problems that the student had completed. In addition, the computer automatically printed out the number of questions the student answered correctly.

The IBM Communications Terminal was used in this study. With the use of this terminal, students were provided a hard copy (printout). Each student in the computer-assisted group had access to the terminals seventy-five hours each week. An assistant was available forty-five hours a week. Terminals were located in the business machines classroom and also in the library.

Program development.--During the summer of 1975, the fifteen computer programs utilized in this experimental study were developed. The following steps were involved in the development of the computer packages. Mathematical topics included in the computer packages were determined as a result of questions asked by students enrolled in business machines classes during the spring of 1975. It was decided
after consultation with a media expert and a professional computer programmer that the packages should contain only one mathematical concept per program. It was also decided that the packages should be as short as possible, with a maximum time per program of approximately fifteen to twenty minutes.

Explanations, examples, and sample problems were then written in manuscript form. Each computer package was reviewed by at least two students before any attempt was made to enter the material into the computer. Students chosen for this part of the project had no background in business mathematics or business machines. Changes necessitated by student input were made in manuscript form. After the corrections were made, students were asked to review the materials again.

The revised materials were then given to a professional computer programmer employed by the college administration. Each package was then entered in the computer. All programs were entered using A Programming Language (APL). The text, APL/360 An Interactive Approach, was used as a reference source. Both the programmer and the instructor worked through each package for initial revision and editing. In addition to the instructor's and programmer's revisions, students were used for revision of the material before the

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programs were used in the classroom. At least two students were used for revision at this stage of development. The last revision involved approximately sixty students enrolled in business machines classes during the fall semester, 1975. Students in this group were required to work through all fifteen computer programs as part of their normal course requirements. Provision was made for student comment about any program in which they encountered difficulty. A complete set of computer programs in revised form is included in Appendix A.

Orientation and teaching.—During the first week of the spring semester of 1976, students completed the mathematical pretest. In addition, students were introduced to the computer programs and procedures for operation of the computer terminals. A detailed handout was furnished each student (Appendix B). During the thirty-minute orientation session, the instructor demonstrated to groups of eight to ten students how to gain access or enter the computer system, how to use the basic commands, and how to correct mistakes or typographical errors. In addition, at least two programs were used for demonstration purposes. Computer terminals were available in the business machines classroom and the library.

During the spring semester, students were required to complete one program or package a week. An assignment sheet explaining due dates for each of the computer programs was
given to all students in the computer group. At the student's option, computer programs could be completed before the required due date. Each week students turned in the hard copy (printout) provided by the computer. The computer printout informed the student of the number of problems attempted, the problems answered correctly on the first attempt, and the problems answered correctly on the second attempt. In addition, the instructor examined each program to determine if students were encountering difficulty. The instructor maintained a record of programs completed by all students. Once the student's work was recorded, the programs were returned to the student. In addition, students completed the Otis-Lennon Mental Ability Test during the tenth week of the spring semester.

The mathematical posttest and the Purdue attitude scale were administered to all students during the last week of the spring semester. Students who completed the course requirements before the last week of the spring semester were administered the posttest and the attitude scale during a regular class period. This requirement was necessitated by the school's commitment to flexible or early exit in self-paced instructional programs.

Lecture-Demonstration Approach

The students in the lecture-demonstration group completed the mathematics pretest during the first week of the spring semester, 1975.
During the semester, the instructor for the lecture-demonstration group covered the following fifteen mathematical areas: (1) percents to a decimal, (2) decimals to a percent, (3) complement, (4) round off, (5) fractions to a decimal, (6) cash discount, (7) markdown, (8) commission, (9) cost markup, (10) retail markup, (11) simple interest, (12) distribution of expense, (13) proration, (14) series discount, and (15) percentage of increase or decrease.

A summary of information presented to the lecture-demonstration group is presented in Appendix C. The instructor used handouts, transparencies, the chalkboard, examples, and applications to supplement the lecture presentation. All lectures were presented at the beginning of the class period. After classroom presentation of the concept, students were given an assignment sheet consisting of ten problems. In an attempt to equate the material received by both groups, students in the lecture-demonstration group received problems containing two different levels of difficulty. A complete set of assignment sheets used in this experiment is included in Appendix D.

Assignment sheets were due at the beginning of the next class period. The instructor graded the student assignment sheets and returned them at the beginning of the following class period. Students were told the number of problems answered correctly and the number of problems answered incorrectly. The instructor wrote correct answers beside
incorrect student responses when necessary. A record of assignments completed by all students was maintained by the instructor. In addition, students completed the Otis-Lennon Mental Ability Test during the tenth week of the spring semester.

During the last week of the semester, students completed the mathematics posttest and the Purdue attitude measure. Students who completed the course requirements before the last week of the semester were administered the posttest and the attitude measure during a regular class period in order to provide for early exit from the course. This procedure was the same for both the experimental group and the control group.

Testing Procedures

Achievement

After extensive examination, no appropriate published instrument was found to measure mathematical concepts examined in this study. It was necessary to develop both the mathematical pretest and posttest that were used to obtain achievement scores needed for this study.

Problems for both the pretest and the posttest were selected from the applied mathematical concepts under evaluation. A total of forty-six problems were included in each test. Both the pretest and posttest used to measure achievement are included in Appendix E.
In order to establish reliability for the examinations, the pretest and the posttest were administered to students enrolled in two business machines classes during the fall semester of 1975. Students in each class took either the pretest or the posttest as part of the normal evaluation procedure for all students. Scores obtained for each test were divided into split halves. Then Pearson Product Moment Correlation Coefficients were determined for each test. The Spearman Brown Prophecy formula was used to determine the adjusted reliability correlation coefficient for each test. The adjusted reliability correlation coefficient for the pretest was .98, and for the posttest the adjusted reliability correlation coefficient was .94.

The validity of the achievement pretest and posttest was determined by a panel of seven judges. All judges received the same material, which included the following: a letter of explanation, a description of instructional materials used in the experiment, a copy of the pretest, a copy of the posttest, a response form, and a return envelope. All judges were asked the following question to establish the validity for each test.

Will this test adequately determine whether a student can correctly work problems in the mathematical areas under evaluation in this experimental study?

The response sheet did contain space for judges to make any comments that they deemed appropriate. An affirmative
response by five of the seven judges was considered sufficient to indicate validity for each test.

The panel of seven judges was composed of the following: three community college instructors, three professors at a four-year university, and one editor in the field of business mathematics and business machines for a national publishing company. Each panel member had at least six years of experience in the business mathematics/business machines subject area. In addition, five of the panel members had published at least one book in the field of business machines or business mathematics.

All panel members returned response forms after the first mailing. Their responses are included in Table I.

![Table I](image)

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<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>Mathematical Pretest</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Mathematical Posttest</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

Both the pretest and the posttest received more than the necessary five votes needed to indicate validity; therefore, the tests were accepted as valid measuring instruments.

The mathematics pretest was administered to all students enrolled in business machines classes during the first week of the spring semester, 1976. The mathematical posttest
was administered during the last week of the semester. Students who completed all course requirements before the last week of the semester were administered the posttest during a normal class period. This requirement was necessary because of the school administration's commitment to flexible exit in self-paced instructional programs. All students were given the same amount of time to complete the pretest and the posttest. In addition, the instructor was present when each test was administered to all students.

**Intelligence**

The *Otis-Lennon Mental Ability Test* was administered to all students in the experiment. There are six levels of the *Otis-Lennon Mental Ability Test*. Selection of items for the various forms of the test was the result of research that involved more than 20,000 pupils. In addition, two parallel forms are available. Form J of the Advanced Level was used in this study. Finally, one of the suggested uses for scores obtained from this test was the matching and equating of experimental groups.

The results of the mental ability test were used to place students in either high-ability groups or low-ability groups for analytical purposes. In addition, scores obtained

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7 Ibid., p. 19.
from this test were used as covariates in the statistical treatment required by Hypotheses I and VI. Milholland states, "The construction and norming of this test bespeaks adherence to the highest level of current standards." Reliability coefficients were calculated using both the split-half method and Kuder-Richardson Formula 20. The split-half reliability coefficients were corrected by use of the Spearman-Brown Prophecy formula. Established reliability coefficients that range from .93 to .95 have been obtained on the various forms of the test. According to Milholland, validity is organized in accordance with the content, criterion related and construct categories of the 1966 Standards for Educational and Psychological Tests and Manuals.

The Otis-Lennon Mental Ability Test was administered to all students in the experiment during the tenth week of the semester. The directions included in the Manual for Administration were read to students in each group. Students were given the suggested forty-minute time period to complete the test. At the conclusion of forty minutes, all examination booklets were closed and immediately collected by the instructor.

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9Otis and Lennon, pp. 20-21.

10Buros, p. 690.
Attitude

The Purdue Master Attitude Scale, A Scale to Measure Attitude Toward Any School Subject was administered to all students in the experiment. Two forms of the Purdue scale area available for research purposes. Form A was used in connection with this study.

Remmers states, "The scaling procedure for each of the scales is the psychophysical principle that equally often observed differences are equal, often referred to as the Thurstone attitude scaling technique."\(^1^1\) Reliabilities of the original full-length scales for samples ranged from .71 to .92.\(^1^2\) The scales have demonstrated validity when compared to the Thurstone attitude scale.\(^1^3\)

The attitude scale was administered after students completed all course requirements, including the mathematical posttest. All students were asked to place a plus sign before each statement with which they agreed. All attitude scores were transformed into scale values as suggested by Remmers.\(^1^4\)

\(^1^2\)Ibid., p. 5. \(^1^3\)Ibid., p. 2.
\(^1^4\)Ibid., p. 6.
Analysis Procedures

In this study, the null hypotheses were tested at the .05 level of significance. The following statistical methods were used to analyze the data.

1. The analysis of covariance was used to test for significant differences in measurement of achievement between the experimental and control groups. Scores obtained from the mathematical pretest and the *Otis-Lennon Mental Ability Test* were used as covariates.

2. The analysis of variance was used to test for significant differences in measurement of attitude between the experimental and control groups. Scores obtained from the *Purdue Master Attitude Scale, A Scale to Measure Attitude Toward Any School Subject* were used to test this hypothesis.

3. The relationship between attitude and achievement was determined by calculating Pearson Product Moment Correlation Coefficients. Scores needed for this procedure were obtained from the mathematical posttest and the Purdue attitude measure. Sub-groups were formed on the basis of scores obtained from the *Otis-Lennon Mental Ability Test*. The significance between correlations for each group was determined by using the Fisher $z_r$ technique. $^{15}$ Each correlation coefficient was converted to a Fisher $z_r$ by use of the appropriate table. $^{16}$

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$^{16}$Ibid., p. 456.
The following formula was used to determine the value of $z$:

$$z = \frac{z_{r_1} - z_{r_2}}{\sqrt{1/(N_1 - 3) + 1/(N_2 - 3)}}.$$

The significance of $z$ was determined by consulting an appropriate table.\(^\text{18}\)

4. The analysis of covariance was used to test for significant differences of pretest-posttest gain scores between groups. Gain scores, as used in this study, referred to the difference between pretest and posttest achievement raw scores. Scores obtained from the Otis-Lennon Mental Ability Test were used as the covariate.

\(^{17}\text{Ibid., p. 171.}^{18}\text{Ibid., p. 450.}\)
CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

Introduction

An experimental study was conducted to analyze results obtained by a computer-assisted instructional approach (experimental group) and a lecture-demonstration approach (control group). Ninety-one students enrolled in four sections of business machines at Richland College during the spring, 1976, semester participated in the study. The computer-assisted group was composed of forty-five students. The lecture-demonstration group was composed of forty-six students.

The information obtained for statistical treatment was related to mathematical achievement and student attitude toward business machines as a school subject. The mathematical achievement was measured by administering a posttest to all students who were involved in the experiment. Attitude was measured with the Purdue Master Attitude Scale, A Scale to Measure Attitude Toward Any School Subject. In addition, all students took a mathematical pretest and the Otis-Lennon Mental Ability Test. Scores for all measurements were tabulated for each student who completed the course and who took all the tests. The data used in the statistical analysis are included in Appendix F. Raw scores obtained from
students who participated in the experiment were divided into the following four areas: (1) mathematical achievement of students in business machines, (2) attitude of students toward business machines, (3) comparison of correlations between attitude and achievement, and (4) analysis of achievement gain scores.

The level of significance is reported for all statistical treatment of the data. All hypotheses were tested in the null form.

Mathematical Achievement of Students in Business Machines

It was not feasible to randomly assign students to the computer-assisted group and the lecture-demonstration group. Therefore, the analysis of covariance was used to statistically control initial differences between groups. Scores from the mathematical pretest and the Otis-Lennon Mental Ability Test were used as covariates. Data related to the covariates are reported in Table II.

The experimental group had a mathematical pretest mean score of 1.75 points higher than the control group. In addition, students in the experimental group had a mean score of 5.64 points higher on the Otis-Lennon Mental Ability Test than students in the control group.

The scores presented in Table II reflect higher levels of initial ability among students in the computer-assisted group when compared with students in the lecture-demonstration
TABLE II

SUMMARY OF THE DATA RELATED TO THE COVARIANTS OF INITIAL MATHEMATICAL ABILITY AND MENTAL ABILITY

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean Pretest Score</th>
<th>S.D.</th>
<th>Mean Ability Score</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>45</td>
<td>22.84</td>
<td>9.28</td>
<td>54.71</td>
<td>11.67</td>
</tr>
<tr>
<td>Control</td>
<td>46</td>
<td>21.09</td>
<td>10.92</td>
<td>49.07</td>
<td>13.44</td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>21.96</td>
<td>10.12</td>
<td>51.86</td>
<td>12.84</td>
</tr>
</tbody>
</table>

group. This information was used to equate statistically the groups.

At the completion of course requirements, all students in the experiment took a posttest consisting of forty-six mathematical problems. Students were given fifty minutes to complete the examination. In addition, students were free to use calculators and adding machines to facilitate mathematical computations. Scores for each student were determined by the number of problems answered correctly. The mean score, standard deviation, and the adjusted mean score for the mathematical posttest are reported in Table III.

TABLE III

SUMMARY OF THE DATA RELATED TO THE MEAN SCORES ON THE BUSINESS MATHEMATICAL POSTTEST

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean Score</th>
<th>S.D.</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>45</td>
<td>40.31</td>
<td>5.52</td>
<td>39.59</td>
</tr>
<tr>
<td>Control</td>
<td>46</td>
<td>37.72</td>
<td>6.94</td>
<td>38.42</td>
</tr>
</tbody>
</table>
The mean posttest score for the experimental group was 2.59 points higher than the control group. Yet, when the analysis of covariance statistical technique was used to adjust for initial differences, the experimental group's score was only 1.17 points higher than the control group's mathematical posttest score.

The residuals of the analysis of covariance used to test achievement scores are presented in Table IV.

**TABLE IV**

**SUMMARY OF THE ANALYSIS OF COVARIANCE OF THE BUSINESS MATHEMATICS ACHIEVEMENT TEST SCORES (N = 91)**

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>88</td>
<td>2145.91</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
</tr>
<tr>
<td>Within</td>
<td>87</td>
<td>2116.46</td>
<td>24.33</td>
<td>. . .</td>
<td>. . .</td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>29.46</td>
<td>29.46</td>
<td>1.21</td>
<td>0.27</td>
</tr>
</tbody>
</table>

The analysis of covariance of the mean posttest scores yielded an $F$ value of 1.21. The probability of obtaining an $F$ as large as 1.21 is .27. Since the results could be due to chance twenty-seven times out of one hundred, the following research hypothesis was not accepted:

I. Students taught by the computer-assisted instructional approach will achieve significantly higher adjusted achievement posttest scores than students taught by the lecture-demonstration approach.
Attitude of Students Toward Business Machines

It was hypothesized that students taught by the computer-assisted instructional approach (experimental group) would achieve higher attitude scores than students taught by the lecture-demonstration approach (control group). After completion of all course requirements and the mathematics posttest, students completed the Purdue Master Attitude Scale, A Scale to Measure Attitude Toward Any School Subject. Two forms of the Purdue scale are available for research purposes. Form A was used in connection with this study. All students were asked to place a plus sign before each statement with which they agreed. Scores above 6.0 on the attitude scale indicate a favorable attitude, and scores below 6.0 indicate an unfavorable attitude.

There are seventeen items included in this attitude scale. Raw scores are determined by the median scale value of the total items with a plus sign.

From Table V, it can be seen that both the experimental and the control group had a favorable attitude toward the business machines course.

The control group scored .04 points higher than the experimental group. The analysis of variance was used to treat statistically the attitude scores. The residuals for this procedure are presented in Table VI.
TABLE V

SUMMARY OF THE DATA RELATED TO THE MEAN SCORES ON THE PURDUE MASTER ATTITUDE SCALE, A SCALE TO MEASURE ATTITUDE TOWARD ANY SCHOOL SUBJECT

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean Attitude Score</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>45</td>
<td>8.18</td>
<td>0.44</td>
</tr>
<tr>
<td>Control</td>
<td>46</td>
<td>8.22</td>
<td>0.41</td>
</tr>
</tbody>
</table>

The analysis of variance of mean attitude scores yielded an F value of .22. The probability of obtaining an F value of .22 is .64. An F value of .22 occurring by chance is quite likely.

TABLE VI

SUMMARY OF THE ANALYSIS OF VARIANCE FOR THE ATTITUDE SCALE SCORES (N = 91)

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>Sums of Squares</th>
<th>Variance Estimate</th>
<th>F Value</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>90</td>
<td>16.0299</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
</tr>
<tr>
<td>Within</td>
<td>89</td>
<td>15.9903</td>
<td>0.1797</td>
<td>. . .</td>
<td>. . .</td>
</tr>
<tr>
<td>Between</td>
<td>1</td>
<td>0.0396</td>
<td>0.0396</td>
<td>0.22</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Based on the data presented in Table VI, the following research hypothesis was not accepted:

II. Students taught by the computer-assisted instructional approach will achieve significantly higher attitude scores than students taught by the lecture-demonstration approach.
Comparison of Correlations Between Attitude and Achievement

The relationship between achievement and attitude was determined by calculating a Pearson Product Moment Correlation. Scores needed for this procedure were obtained from the mathematical posttest and the Purdue attitude scale. The significance between correlation coefficients for each group was determined by using the Fisher $z_r$ technique. Each correlation coefficient was converted to a $z_r$ by use of the appropriate table.\(^1\) The following formula\(^2\) was then used to determine the value of $z$ for the difference between the correlation coefficients for the computer-assisted group and the lecture-demonstration group:

$$z = \frac{z_{r_1} - z_{r_2}}{\sqrt{1/(N_1 - 3) + 1/(N_2 - 3)}}.$$

The significance of $z$ was determined by consulting the appropriate table.\(^3\)

Statistical information related to the correlation between attitude and achievement for the computer-assisted group and the lecture-demonstration group is presented in Table VII.

The value of the $z$ obtained failed to exceed the required 0.05 level of significance of 1.96. Based on this

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\(^1\)Ferguson, p. 456.  
\(^2\)Ibid., p. 171.  
\(^3\)Ibid., p. 450.
TABLE VII

STATISTICAL MEASURES RELATING TO EXPERIMENTAL GROUP AND
CONTROL GROUP ATTITUDE AND ACHIEVEMENT TEST
SCORE CORRELATIONS

<table>
<thead>
<tr>
<th>Group</th>
<th>r</th>
<th>z_r</th>
<th>N</th>
<th>z</th>
<th>LS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>-0.19</td>
<td>-0.19</td>
<td>45</td>
<td>-0.97</td>
<td>NS</td>
</tr>
<tr>
<td>Control</td>
<td>0.02</td>
<td>0.02</td>
<td>46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

information, the following research hypothesis was not
accepted:

III. The correlation between attitude and achievement
will be significantly higher for the computer-assisted in-
structional group than for the lecture-demonstration group.

Scores obtained from the Otis-Lennon Mental Ability
Test were used to sub-group students in the experimental
group and the control group on the basis of ability. The
statistical procedure for determining the sub-group correla-
tions and $z_r$ function was identical to that used for the
experimental and control group. In addition, the z test was
again used for sub-group comparisons to determine if a sig-
nificant difference existed between the correlations for
each group.

It was hypothesized that, based on scores at or above
the sixtieth percentile on the Otis-Lennon Mental Ability
Test, the correlation coefficient for attitude and achieve-
ment scores would be significantly higher for students in
the computer-assisted group than for students in the lecture-demonstration group.

Statistical data related to the correlation between attitude and achievement when sub-grouped at or above the sixtieth percentile are presented in Table VIII.

**TABLE VIII**

**STATISTICAL MEASURES RELATING TO EXPERIMENTAL GROUP AND CONTROL GROUP ATTITUDE AND ACHIEVEMENT TEST SCORE CORRELATIONS WHEN SUB-GROUPED AT OR ABOVE THE SIXTIETH PERCENTILE**

<table>
<thead>
<tr>
<th>Group</th>
<th>r</th>
<th>(z_r)</th>
<th>N</th>
<th>z</th>
<th>LS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>-0.11</td>
<td>-0.11</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>-0.33</td>
<td>-0.34</td>
<td>13</td>
<td>0.60</td>
<td>NS</td>
</tr>
</tbody>
</table>

The value of the \(z\) obtained failed to exceed the required .05 level of significance of 1.96. Based on this information, the following research hypothesis was not accepted:

**IV.** Based on scores at or above the sixtieth percentile on the Otis-Lennon Mental Ability Test, the correlation between attitude and achievement scores will be significantly higher for students in the computer-assisted group than for students in the lecture-demonstration group.

In addition, it was also hypothesized that the correlation for students who scored at or below the fortieth percentile would be significantly higher for students in the computer-assisted instructional group than for students in
the lecture-demonstration group. Again, the z test was used to determine whether a significant difference existed between the correlations for each group.

Information related to the correlation between attitude and achievement for students who scored at or below the fortieth percentile is presented in Table IX.

TABLE IX

STATISTICAL MEASURES RELATING TO EXPERIMENTAL GROUP AND CONTROL GROUP ATTITUDE AND ACHIEVEMENT TEST SCORE CORRELATIONS WHEN SUB-GROUPED AT OR BELOW THE FORTIETH PERCENTILE

<table>
<thead>
<tr>
<th>Group</th>
<th>r</th>
<th>z&lt;sub&gt;r&lt;/sub&gt;</th>
<th>N</th>
<th>z</th>
<th>LS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>-0.07</td>
<td>-0.07</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>0.37</td>
<td>0.39</td>
<td>23</td>
<td>-1.32</td>
<td>NS</td>
</tr>
</tbody>
</table>

The value of the z obtained failed to exceed the required .05 level of significance of 1.96. Based on this information, the following research hypothesis was not accepted:

V. Based on scores at or below the fortieth percentile on the Otis-Lennon Mental Ability Test, the correlation between attitude and achievement scores will be significantly higher for students in the computer-assisted group than for students in the lecture-demonstration group.
Analysis of Achievement
Gain Scores

It was hypothesized that students taught by the computer-assisted instructional approach would achieve significantly higher pretest-posttest gain scores than students taught by the lecture-demonstration approach.

Because of the impossibility of random assignment of students to the computer-assisted group or the lecture-demonstration group, the analysis of covariance procedure was used to control initial differences between groups.

Scores from the Otis-Lennon Mental Ability Test were used as the covariate. Information related to the ability covariate is reported in Table X.

TABLE X
SUMMARY OF THE DATA RELATED TO THE COVARIATE OF MENTAL ABILITY

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean Ability Score</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>45</td>
<td>54.71</td>
<td>11.67</td>
</tr>
<tr>
<td>Control</td>
<td>46</td>
<td>49.07</td>
<td>13.44</td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>51.86</td>
<td>12.84</td>
</tr>
</tbody>
</table>

The experimental group had a mean ability score of 5.64 points higher than students in the control group. The scores reported in Table X indicate higher initial ability for students in the experimental group when compared with students in the control group. These data were used to equate statistically the groups.
Gain score refers to the difference between pretest and posttest achievement raw scores. The mean gain score, standard deviation, and adjusted mean gain score are presented in Table XI.

**TABLE XI**

SUMMARY OF THE DATA RELATED TO THE MEAN GAIN SCORES ON THE BUSINESS MATHEMATICAL POSTTEST

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean Gain Score</th>
<th>S.D.</th>
<th>Adjusted Mean Gain Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>45</td>
<td>17.47</td>
<td>7.89</td>
<td>18.03</td>
</tr>
<tr>
<td>Control</td>
<td>46</td>
<td>16.63</td>
<td>9.03</td>
<td>16.08</td>
</tr>
</tbody>
</table>

The experimental group had a mean gain score of 0.84 points higher than the control group. However, when the gain scores were adjusted for initial differences, the experimental group scored only 1.95 points higher than the control group. The residuals for this procedure are presented in Table XII.

**TABLE XII**

SUMMARY OF THE ANALYSIS OF COVARIANCE OF THE BUSINESS MATHEMATICS GAIN SCORES (N = 91)

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>89</td>
<td>5942.20</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
</tr>
<tr>
<td>Within</td>
<td>88</td>
<td>5859.68</td>
<td>66.59</td>
<td>. . .</td>
<td>. . .</td>
</tr>
<tr>
<td>Difference</td>
<td>1</td>
<td>82.52</td>
<td>82.52</td>
<td>1.24</td>
<td>0.27</td>
</tr>
</tbody>
</table>
The analysis of covariance of the mean gain scores yielded an F value of 1.24. The probability of obtaining an F value of 1.24 is .27. An F value of 1.24 occurring by chance is quite likely.

Based on the data presented in Table XII, the following research hypothesis was not accepted:

VI. Students taught by the computer-assisted instructional approach will achieve significantly higher pretest-posttest gain scores than students taught by the lecture-demonstration approach.

Summary of the Data

The data presented in this chapter attempted to accomplish three purposes. First, achievement was compared for students in the computer-assisted group and the lecture-demonstration group. The analysis of covariance technique was used to determine if a significant difference existed between the achievement scores for the two groups. Second, student attitude toward business machines was compared for students in the computer-assisted group and the lecture-demonstration group. The analysis of variance technique was used to determine if a significant difference existed between the attitude scores for the two groups. Third, the correlations between attitude and achievement for students in the computer-assisted group, the lecture-demonstration group, and various sub-groups were compared. A Pearson Product
Moment Correlation Coefficient was calculated to measure the relationship between attitude and achievement for all groups.

The findings presented in this chapter indicate that there were no significant differences between students in the computer-assisted group and the lecture-demonstration group. Since no significant differences were found, the research hypotheses were not accepted.
CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS

Summary

The problem of this study was an analysis of two different approaches to teaching applied mathematical concepts in business machines. The results obtained by a computer-assisted instructional approach (experimental group) and a lecture-demonstration approach (control group) were the basis for statistical comparisons.

The purposes of this study were as follows: (1) to determine which method, the lecture-demonstration or the computer-assisted instruction, would produce the better mathematical skill in office machines; (2) to determine the effectiveness of computer-assisted instruction as compared to the lecture-demonstration approach on the student's attitude toward office machines, as measured by the Purdue attitude scale; (3) to compare the correlation between attitude and achievement for the computer-assisted instruction group and the lecture-demonstration group; and (4) to compare the correlations between attitude and achievement for high-ability students and low-ability students, based on scores obtained from the Otis-Lennon Mental Ability Test.
To accomplish these purposes, an experimental study was conducted during the spring semester of the 1975-1976 school year. Students enrolled at Richland College of the Dallas County Community College District were selected as experimental participants. The factors for college admission, course content, course objectives, evaluation, and available business machines were the same for all classes involved in the experiment. All students who completed the business machines course received two hours of credit. Class periods were either fifty minutes in length or one hour and fifteen minutes in length.

A total of ninety-one students, who were enrolled in four business machines classes, completed all course requirements. A table of random numbers was used to determine which two classes would receive the computer-assisted instructional treatment. The remaining two classes received the lecture-demonstration approach. As a result of the randomized selection of classes for the computer-assisted approach or the lecture-demonstration approach, both the fifty-minute period and the one-hour and fifteen-minute period were used for each treatment group.

Students in the experimental group received instruction for fifteen mathematical concepts by completing a computer package on individual topics. Each package contained an explanation, example(s), and practice problems. Problems were selected by a random selection procedure which provided
the student with different problems each time he worked through the computer package. Students in the experimental group received two chances to work all problems. If after two attempts, students could not obtain a correct response, the computer responded with the correct answer and an explanation of how to work the problem. At the completion of the package, all students were informed of the number of problems attempted and the number answered correctly. During the semester, students were required to complete one package a week. Students did have the option of completing computer packages before the required due date. Each week, students turned in the computer printout. Then, the instructor examined each program to determine if students encountered difficulty. In addition, a record of programs completed by all students was maintained by the instructor.

Students in the control group received instruction on the same mathematical concepts as the experimental group. The lecture-demonstration approach was supplemented by the use of handouts, transparencies, the chalkboard, examples, and applications. After each topic was presented in class, students were given an assignment sheet consisting of ten problems. All assignment sheets were due at the beginning of the next class period. The instructor graded student assignment sheets and returned them at the beginning of the following class period. A record of assignments completed by all students was maintained by the instructor.
Both groups completed the same achievement, attitude, and mental ability tests. A mathematical pretest and posttest were constructed to measure mathematical concepts examined in this study. Validity and reliability were established for each test. The pretest was administered during the first week of classes and the posttest was administered to all students when course requirements were completed.

The **Purdue Master Attitude Scale, A Scale to Measure Attitude Toward Any School Subject** was used to measure attitude toward business machines as a school subject. The attitude scale was administered after students completed all course requirements.

The **Otis-Lennon Mental Ability Test** was administered to all students in the experiment. High-ability and low-ability groups were based on scores obtained by students who completed the mental ability test. In addition, the mental ability test scores were needed for statistical treatment of the data.

Statistical procedures employed in this experimental study were the following: (1) the analysis of covariance technique was used to determine if a significant difference existed between the experimental and control group with regard to mathematical achievement, (2) the analysis of variance technique was used to determine if a significant difference existed between the experimental group and control
group with regard to student attitude toward the business machines course, and (3) a Pearson Product Moment Correlation Coefficient was calculated to measure the relationship between attitude and achievement for the experimental group, the control group, and various sub-groups.

Hypothesis I stated that the computer-assisted group would achieve significantly higher adjusted achievement post-test scores than the lecture-demonstration group. The difference between the adjusted mean achievement scores for the two groups yielded an F value of 1.21, which is not significant at the .05 level of significance. Therefore, Hypothesis I was not accepted.

Hypothesis II stated that the computer-assisted group would obtain higher attitude scores than the lecture-demonstration group. The difference between the mean attitude scores for the two groups yielded an F value of .22, which is not significant at the .05 level of significance. Therefore, Hypothesis II was not accepted.

Hypothesis III stated that the correlation between attitude and achievement would be significantly higher for the computer-assisted group than for the lecture-demonstration group. The value of the z obtained was -.97, which failed to exceed the required .05 level of significance of 1.96. Therefore, Hypothesis III was not accepted.

Hypothesis IV stated that, based on scores at or above the sixtieth percentile on the Otis-Lennon Mental Ability
Test, the correlation between attitude and achievement would be significantly higher for the computer-assisted group than for the lecture-demonstration group. The value of the $z$ obtained was .60, which failed to exceed the required .05 level of significance of 1.96. Therefore, Hypothesis IV was not accepted.

Hypothesis V stated that, based on scores at or below the fortieth percentile on the Otis-Lennon Mental Ability Test, the correlation between attitude and achievement would be significantly higher for the computer-assisted group than for the lecture-demonstration group. The value of the $z$ obtained was -1.32, which failed to exceed the required .05 level of significance of 1.96. Therefore, Hypothesis V was not accepted.

Hypothesis VI stated that the computer-assisted group would achieve significantly higher pretest-posttest gain scores than the lecture-demonstration group. The difference between the adjusted mean gain scores for the two groups yielded an $F$ value of 1.24, which is not significant at the .05 level of significance. Therefore, Hypothesis VI was not accepted.

Conclusions

The following conclusions were formulated from an analysis of this study.
1. Based on the mathematical achievement scores and the statistical analysis presented in this study, it is concluded that there are no demonstrated differences between the computer-assisted instructional approach and the lecture-demonstration approach for teaching applied mathematical concepts to business machines students.

2. Based on the attitude scores presented in this study, students in both groups appear to have a favorable attitude toward the business machines course. Attitude scores for students in the computer-assisted group were not significantly different from scores for students in the lecture-demonstration group.

3. The integration of business machines and applied mathematics, in addition to developing speed and accuracy on electronic calculators and adding machines, produces increased achievement in mathematics.

Recommendations

It is evident from the results reported in this study that there are no demonstrated differences between the computer-assisted method and the lecture-demonstration method for presenting mathematical concepts to students enrolled in a business machines course. In addition, student attitude appears to be favorable for the business machines course regardless of which instructional method was used.

As a result of this study, a recommendation for use of computer-assisted instruction must be justified on factors
other than student mathematical achievement and student attitude toward the business machines course. The following five recommendations are made on the basis of the findings and conclusions of this study.

1. Since most business machines students are at different stages of skill development, it is recommended that computer-assisted instruction be adopted as a method of individualizing instruction and providing remedial help where needed.

2. Based on the fact that more businesses are utilizing the computer for various routine applications, it is recommended that the computer-assisted instructional approach be utilized not only to teach applied mathematics, but as a method of exposing students to the computer and computer terminals in the business machines course.

3. It is recommended that computer-assisted instruction be used not only as a procedure for initiating flexible entry for students in the business machines course, but as a method for improving teacher efficiency and utilizing classroom space more effectively.

4. It is recommended that future research should be undertaken which will compare the computer-assisted instructional approach and more traditional methods in the following five areas:

   a. A study should be conducted to determine the effectiveness of computer-assisted instruction
in a business mathematics course at the community college level.

b. A study should be conducted in which an alternate method of individualizing instruction is compared with computer-assisted instruction.

c. Additional research is needed to determine the correlation between student exposure to the computer terminal in the business machines course and achievement in subsequent introductory computer courses.

d. Research is needed to measure the amount of mathematical retention at the conclusion of the semester when the computer-assisted materials are used as a mathematical review at the beginning of the business machines course.

e. A similar study is needed to determine the effects of less structured instructional materials for traditional students and the use of more than one instructor in the experiment.

Implications
As a result of conducting the experiment, certain implications which relate to effective instruction in business machines and business mathematics are apparent. The observations listed below are not statistical findings; however, the study would be incomplete if they were omitted.
1. The self-pacing aspect of computer-assisted instruction does provide students with a more individualized instructional method than is currently possible in the traditional classroom setting.

2. When students encounter difficulty with a mathematical concept, it is possible to provide remedial work coupled with immediate reinforcement by utilizing the computer-assisted approach.

3. Business machines students encounter no difficulty mastering the operations needed for efficient use of the computer terminals. Initially, students were hesitant to use the computer terminal, but this reluctance seemed to disappear after their first computer package was completed. A thorough demonstration of the computer terminal for small groups of students does reduce student anxiety.

4. The computer-assisted instructional programs such as those in this study, provide practice materials for students coupled with immediate reinforcement. Problems were selected on a random basis which provided the student with different problems each time he worked through the computer program. A number of students who encountered difficulty worked through the computer programs a second and a third time for additional practice.
APPENDIX A

The computer programs used by students in the computer-assisted group for instructional purposes are presented in Appendix A.
GENERAL INSTRUCTIONS

DIRECTIONS: THIS PROGRAM IS DESIGNED TO HELP YOU WORK WITH VARIOUS APPLICATIONS OF BUSINESS SITUATIONS. YOU ARE FIRST GIVEN AN EXPLANATION, AND THEN PROBLEMS TO DETERMINE IF YOU UNDERSTAND THE GIVEN CONCEPT.

YOU WILL BE GIVEN TWO CHANCES TO WORK THE PROBLEM. IF YOU MISS THE ANSWER TWICE YOU WILL AUTOMATICALLY RECEIVE A DETAILED SOLUTION.

TYPE: HELP... IF YOU DO NOT WISH TO GUESS AT THE ANSWER, AND YOU WILL BE GIVEN A DETAILED SOLUTION TO THE PROBLEM.

TYPE: CALC... IF YOU WISH TO DO A SIMPLE CALCULATION (EX: AFTER THE PROBLEM HAS BEEN STATED YOU WISH TO MULTIPLY TWO NUMBERS; SAY 79 x .02) IN ORDER TO DO THIS YOU WOULD FIRST TYPE: CALC THE MACHINE SHOULD RESPOND WITH: ENTER CALCULATION... YOU THEN TYPE: 79 x .02 THE COMPUTER RESPONS WITH THE ANSWER: 1.58 FOLLOWED BY THE WORDS: YOUR ANSWER... MEANING THAT THE TERMINAL NOW WISHES YOU TO GIVE THE ANSWER TO THE PRIOR PROBLEM, YOU MAY NOW EITHER ENTER THE PROBLEM'S SOLUTION OR ENTER ANOTHER COMMAND.)

TYPE: STOP... IF YOU WISH TO LEAVE BEFORE THE PACKAGE IS COMPLETED.

WOULD YOU LIKE A LIST OF AVAILABLE PROGRAMS...? YES
PERCENTS TO A DECIMAL
DECIMALS TO A PERCENT
COMPLEMENT
ROUND OFF
FRACTIONS TO A DECIMAL
CASH DISCOUNT
MARKDOWN
COMMISSION
COST MARKUP
RETAIL MARKUP
SIMPLE INTEREST
DISTRIBUTION OF EXPENSE
PRORATION
SERIES DISCOUNT
PERCENTAGE OF INCREASE OR DECREASE

TYPE THE NAME OF THE PROGRAM YOU WISH TO USE...
PERCENTS TO A DECIMAL

OFTEN IT IS EASIER TO WORK WITH THE DECIMAL EQUIVALENT OF A PERCENT THAN THE PERCENTAGE ITSELF. FOR EXAMPLE, ALL CALCULATORS CAN MULTIPLY A NUMBER BY THE DECIMAL EQUIVALENT OF A PERCENT, BUT ONLY THE NEVER, MORE EXPENSIVE MACHINES HAVE A PERCENT KEY FOR MULTIPLICATION PURPOSES.

THERE ARE TWO METHODS OF CHANGING A PERCENT TO A DECIMAL. ONE METHOD IS MORE THEORETICAL WHILE THE OTHER IS A MORE PRACTICAL APPROACH. EITHER METHOD IS PRETTY EASY - SO IT'S YOUR CHOICE.

METHOD ONE - TO CHANGE A PERCENT TO A DECIMAL

A. DROP THE PERCENT SIGN
B. DIVIDE THE NUMBER BY 100
C. EXAMPLE: 43 PERCENT = 43 ÷ 100 = .43

METHOD TWO - TO CHANGE A PERCENT TO A DECIMAL

A. MOVE THE DECIMAL POINT TWO PLACES TO THE LEFT AND DROP THE PERCENT SIGN.
B. EXAMPLE: 75 PERCENT = .75

USING THE METHOD THAT IS EASIEST FOR YOU, TRY THE FOLLOWING PROBLEMS. . . .

1) 32 PERCENT CONVERTED TO A DECIMAL IS...

.32

STUPENDOUS

2) 77 PERCENT CONVERTED TO A DECIMAL IS...

.77

FAR OUT

3) 28 PERCENT CONVERTED TO A DECIMAL IS...
That's right

4) 47 percent converted
to a decimal is...

.47

Right!!

5) 50 percent converted
to a decimal is...

.50

Far out

6) 9 percent converted
to a decimal is...

.09

Good work!

7) 10.5 percent converted
to a decimal is...

.105

Nice job

8) 1 percent converted
to a decimal is...

.01

That's right

9) 6.5 percent converted
to a decimal is...

Help
The correct response is 0.065
And was arrived at this way...
6.5 percent ÷ 100 = 0.065

10) 14 percent converted
to a decimal is...

XXX

Try again
XXXX
THE CORRECT RESPONSE IS 0.14
AND WAS ARRIVED AT THIS WAY...
14 PERCENT + 100 = 0.14

OF THE 16 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 0 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: )OFF... IF YOU ARE FINISHED
DECIMALS TO A PERCENT

A LOT OF TIMES THE ANSWERS THAT WE END UP WITH WOULD BE MORE MEANINGFUL IF WE CONVERTED THE DECIMAL ANSWER TO A PERCENTAGE.

THERE ARE TWO METHODS OF CHANGING A DECIMAL TO A PERCENT. EITHER METHOD IS OK, SO PICK THE ONE THAT IS EASIEST FOR YOU.

METHOD ONE - TO CONVERT A DECIMAL TO A PERCENT:

A. MULTIPLY THE DECIMAL ANSWER BY 100
B. ADD A PERCENT SIGN
C. EXAMPLE: .56 = .56 \times 100 = 56 \text{ PERCENT}

METHOD TWO - TO CONVERT A DECIMAL TO A PERCENT:

A. MOVE THE DECIMAL POINT TWO PLACES TO THE RIGHT
B. ADD A PERCENT SIGN
C. EXAMPLE: .83 = 83 \text{ PERCENT}

USING THE METHOD THAT IS EASIEST FOR YOU, TRY THE FOLLOWING PROBLEMS...

1) 0.39 CONVERTED TO A PERCENT IS...
   39 \text{ FANTASTIC}

2) 0.77 CONVERTED TO A PERCENT IS...
   77 \text{ BULLY GOOD}

3) 0.51 CONVERTED TO A PERCENT IS...
STUPENDOUS

4) 0.86 CONVERTED TO A PERCENT IS...

CAPITAL...

5) 0.78 CONVERTED TO A PERCENT IS...

RIGHT ON

6) 0.19 CONVERTED TO A PERCENT IS...

GOT IT!

7) 0.01 CONVERTED TO A PERCENT IS...

STUPENDOUS

8) 0.19 CONVERTED TO A PERCENT IS...

EXCELLENT

9) 0.185 CONVERTED TO A PERCENT IS...
HELP
THE CORRECT RESPONSE IS 16.5
AND WAS ARRIVED AT IN THIS WAY,...
0.185 \times 100 = 16.5 \text{ PERCENT}

10) 0.16 CONVERTED TO A PERCENT IS...

XXXX

HOPE-HERE'S ANOTHER CHANCE
THE CORRECT RESPONSE IS 16
AND WAS ARRIVED AT IN THIS WAY...
0.16 × 100 = 16 PERCENT

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 2 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: YOFP... IF YOU ARE FINISHED
COMPLEMENT

Often, it is easier to work with the complement instead of the discount when you are trying to determine the selling price.

For example: A dress that costs $100 is marked down 10 percent. What is sales price?

The Long Method
A. $100 \times .10 = $10 discount.
B. $100 - $10 = $90 sale price

The Short Method
A. Mentally subtract the discount from 100 percent
100 percent - 10 percent = 90 percent (complement)
B. Multiply the original cost by the complement (90 percent)
$100 \times .90 = $90 sale price

When trying to determine the complement, the basic rule is:
100 percent (original) - discount = complement

Example 1-- 20 percent discount
100 percent - 20 percent = 80 percent (complement)

Example 2-- 27 percent discount
100 percent - 27 percent = 73 percent (complement)

In the following problems you will be given the discount. you then type in the correct complement... (good luck)

1) 33 percent discount--
What is the complement...
ALRIGHT!!

2) 26 PERCENT DISCOUNT--
   WHAT IS THE COMPLEMENT...

GREAT

3) 42 PERCENT DISCOUNT--
   WHAT IS THE COMPLEMENT...

PRECISELY

4) 39 PERCENT DISCOUNT--
   WHAT IS THE COMPLEMENT...

THAT'S RIGHT

5) 16 PERCENT DISCOUNT--
   WHAT IS THE COMPLEMENT...

GOT IT!

6) 23.2 PERCENT DISCOUNT--
   WHAT IS THE COMPLEMENT...

EXCELLENT

7) 2.9 PERCENT DISCOUNT--
   WHAT IS THE COMPLEMENT...

WELL DONE

8) 33.8 PERCENT DISCOUNT--
   WHAT IS THE COMPLEMENT...
66.2
THAT'S RIGHT

9) 14.9 PERCENT DISCOUNT--
WHAT IS THE COMPLEMENT...
HELP
THE CORRECT RESPONSE IS 85.1 PERCENT
ARRIVED AT IN THIS MANNER...
100 PERCENT - 14.9 PERCENT = 85.1 PERCENT

10) 11.3 PERCENT DISCOUNT--
WHAT IS THE COMPLEMENT...
XXXX
HOPE-TRY AGAIN
XXXX
THE CORRECT RESPONSE IS 88.7 PERCENT
ARRIVED AT IN THIS MANNER...
100 PERCENT - 11.3 PERCENT = 88.7 PERCENT

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 0 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: )OFF... IF YOU ARE FINISHED
ROUND OFF

WHEN Rounding off Numbers, the First Step is to Determine the Number of Decimals You Desire in Your Final Answer.

Decimals May Be Rounded to One, Two, Three, Four, or More Places—The Decision Is Yours. Probably Two Places or Hundredths Is the Most Popular Application Because That Is Needed When Working With Money.

When Rounding Off Decimals by Hand, Consider the Number to the Right of the Last Digit to Be Retained. If This Digit Is 5 or More, Add 1 to Previous Digit; If It Is 4 or Less, Drop It. For Example:

.457 ROUNDED TO TWO PLACES BECOMES .46
.453 ROUNDED TO TWO PLACES BECOMES .45
.455 ROUNDED TO TWO PLACES BECOMES .46

HOW GIVE THE OLD COLLEGE TRY TO THE FOLLOWING PROBLEMS TO REINSURE THIS CONCEPT.

1) 0.846 ROUNDED OFF
   TO 2 PLACES IS...
   .85
   COOL MAN

2) 0.428 ROUNDED OFF
   TO 2 PLACES IS...
   .43
   FAR OUT

3) 0.578 ROUNDED OFF
   TO 2 PLACES IS...
   .58
   STUPENDOUS

4) 0.858 ROUNDED OFF
   TO 2 PLACES IS...
.87

OK...

5) 0.637 ROUNDED OFF
   TO 2 PLACES IS...

THAT'S RIGHT

6) 0.4795 ROUNDED OFF
   TO 3 PLACES IS...

THAT'S RIGHT

7) 0.422988 ROUNDED OFF
   TO 3 PLACES IS...

THAT'S RIGHT

8) 0.178652 ROUNDED OFF
   TO 2 PLACES IS...

WELL DONE

9) 0.5799 ROUNDED OFF
   TO 3 PLACES IS...

HELP
0.5799 BECOMES 0.580
(THE 9 IS IMPORTANT BECAUSE
IT CAUSES A 1 TO BE ADDED TO THE 9.
WHEN THIS 1 IS ADDED TO THE 9, IT
CHANGES IT TO A 0 AND CAUSES A 1 TO
BE ADDED TO THE NEXT NUMBER TO THE
LEFT)

10) 0.27758 ROUNDED OFF
    TO 3 PLACES IS...
FRACTIONS TO A DECIMAL

TODAY, THE MOST IMPORTANT REASON FOR CHANGING A FRACTION TO A DECIMAL IS THAT ELECTRONIC CALCULATORS CAN NOT WORK WITH NUMBERS IN FRACTIONAL FORM.

WHEN FACED WITH THIS PROBLEM, YOU CAN DO ONE OF TWO THINGS. FIRST, THERE ARE FRACTION-DECIMAL EQUIVALENT TABLES. THE PROBLEM WITH MOST TABLES IS THAT THEY DON'T CONTAIN ALL FRACTIONS THAT YOU MIGHT NEED, PLUS YOU MUST MEMORIZE THE TABLE.

SECOND, ANY FRACTION CAN BE CHANGED TO A DECIMAL BY DIVIDING THE NUMERATOR (TOP) NUMBER BY THE DENOMINATOR (BOTTOM) NUMBER. FOR EXAMPLE:

\[
\frac{1}{2} = 1 \div 2 = .50 \\
\frac{2}{5} = 2 \div 5 = .40
\]

SOME FRACTIONS DON'T WORK OUT EXACTLY. IN THIS CASE ROUND YOUR ANSWERS TO FOUR PLACES, UNLESS OTHERWISE SPECIFIED. FOR EXAMPLE:

\[
\frac{2}{3} = 2 \div 3 = .6667
\]

IN THE FOLLOWING PROBLEMS YOU WILL BE GIVEN THE FRACTION. YOU THEN TYPE IN THE CORRECT DECIMAL... (GOOD LUCK)

1) CONVERT THE FRACTION 
\[
\frac{1}{4}
\] TO A DECIMAL...

.25

FANTASTIC

2) CONVERT THE FRACTION 
\[
\frac{1}{5}
\] TO A DECIMAL...
20

VERY GOOD

3) CONVERT THE FRACTION
   1/2 TO A DECIMAL...
   .50
   RIGHT ON

4) CONVERT THE FRACTION
   3/4 TO A DECIMAL...
   .75
   RIGHT ON

5) CONVERT THE FRACTION
   1/3 TO A DECIMAL...
   .3333
   GOOD WORK!

6) CONVERT THE FRACTION
   7/34 TO A DECIMAL...
   .2059
   FANTASTIC

7) CONVERT THE FRACTION
   25/36 TO A DECIMAL...
   .6944
   FIRST RATE

8) CONVERT THE FRACTION
   19/35 TO A DECIMAL...
   .5429
   COOL MAN!

9) CONVERT THE FRACTION
   11/15 TO A DECIMAL...
HELP
THE CORRECT RESPONSE IS 0.7333
AND WAS ARRIVED AT THIS WAY...
11 ÷ 15 = 0.733333333

10) CONVERT THE FRACTION
   1/7 TO A DECIMAL...
XXX
PLEASE TRY AGAIN
XXX
THE CORRECT RESPONSE IS 0.1429
AND WAS ARRIVED AT THIS WAY...
1 ÷ 7 = 0.1428571429

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 0 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: 3OFF... IF YOU ARE FINISHED
CASH DISCOUNT

TO ENCOURAGE PROMPT PAYMENT OF AN INVOICE, MANY BUSINESSES OFTEN GRANT WHAT IS KNOWN AS A CASH DISCOUNT. CASH DISCOUNTS LOOK LIKE THIS:

2/10, N/30

THE CASH DISCOUNT CAN BE EXPLAINED AS: 2/10 MEANS 2 PERCENT DISCOUNT IF THE INVOICE AMOUNT IS PAID WITHIN 10 DAYS OF THE INVOICE DATE; N/30 MEANS NO DISCOUNT AFTER THE FIRST 10 DAYS, BUT THE ENTIRE AMOUNT OF THE INVOICE IS DUE WITHIN 30 DAYS OF THE INVOICE DATE.

WOULD YOU LIKE AN EXAMPLE...? YES

IN THE FOLLOWING PROBLEM, THE INVOICE PRICE IS $1600. TERMS ARE 2/10, N/30. WE DECIDE TO PAY THE INVOICE AMOUNT WITHIN 10 DAYS AND TAKE ADVANTAGE OF THE DISCOUNT.

FIRST STEP

$1600 LESS 2/10, N/30

\[ \times 0.02 \]

\[ \text{\$32.00 AMOUNT OF DISCOUNT} \]

SECOND STEP

$1600 ORIGINAL AMOUNT

\[ \text{\$32 DISCOUNT AMOUNT} \]

\[ \text{\$1568 AMOUNT TO BE PAID} \]

ARE YOU READY TO WORK SOME PROBLEMS...? YES

1) THE INVOICE AMOUNT IS $2500.
   THE TERMS ARE 2/10, N/30.
   HOW MUCH IS THE DISCOUNT AMOUNT...?
A-OK!

2) THE INVOICE AMOUNT IS $3500.
THE TERMS ARE 3/10, N/30.
HOW MUCH IS THE DISCOUNT AMOUNT...?

RIGHT ON

3) THE INVOICE AMOUNT IS $4500.
THE TERMS ARE 3/10, N/30.
HOW MUCH IS THE DISCOUNT AMOUNT...?

WELL DONE

4) THE INVOICE AMOUNT IS $2000.
THE TERMS ARE 2/10, N/30.
HOW MUCH IS THE DISCOUNT AMOUNT...?

CORRECT

5) THE INVOICE AMOUNT IS $3500.
THE TERMS ARE 1/10, N/30.
HOW MUCH IS THE DISCOUNT AMOUNT...?

ALRIGHT!!

6) THE INVOICE AMOUNT IS $6500.
THE TERMS ARE 1/10, N/30.
WHAT IS THE AMOUNT THAT IS PAID IF
THE DISCOUNT IS TAKEN...?

OK...

7) THE INVOICE AMOUNT IS $2800.
THE TERMS ARE 3/10, N/60.
WHAT IS THE AMOUNT THAT IS PAID IF
THE DISCOUNT IS TAKEN...?
8) The invoice amount is $8000.  
The terms are 2/10, n/30.  
What is the amount that is paid if 
the discount is taken...?

Correct

9) The invoice amount is $185000.  
The terms are 2/10, n/30.  
What is the amount that is paid if 
the discount is taken...?

Help  
The correct response is $181300.00  
And was worked in the following manner  
$185000 \times 0.02 = \$3700.00  
$185000 - $3700.00 = $181300.00

10) The invoice amount is $15000.  
The terms are 1/20, n/60.  
What is the amount that is paid if 
the discount is taken...?

Wrong - Try Again

The correct response is $14950.00
And was worked in the following manner
$15000 \times 0.01 = \$150.00  
$15000 - $150.00 = $14850.00

Of the 10 attempted, you got 8 right on the 
first try, and 0 on the other.  
This package is now completed...

Type: Go ... to do something else, or
Type: )off... if you are finished
MARKDOWN

SOMETIMES IT IS NECESSARY FOR RETAILERS TO LOWER THE PRICE ON CERTAIN MERCHANDISE IN ORDER TO DISPOSE OF IT.

THIS IS EASILY ACCOMPLISHED BY USING A MARKDOWN PERCENTAGE SUCH AS 10 PERCENT OR 20 PERCENT. OFTEN, THE RETAILER WILL ADVERTISE THE SALE AS 10 OR 20 PERCENT OFF THE NORMAL PRICE.

TO FIND THE SALE PRICE WHEN THE ORIGINAL AMOUNT AND MARKDOWN PERCENTAGE ARE KNOWN, FOLLOW THESE STEPS:

1. CHANGE THE MARKDOWN PERCENTAGE TO A DECIMAL. (REMEMBER - MOVE THE DECIMAL TWO PLACES TO THE LEFT.) FOR EXAMPLE: 20 PERCENT = .20

2. MULTIPLY THE DECIMAL EQUIVALENT BY THE ORIGINAL PRICE.

3. SUBTRACT THE AMOUNT OF MARKDOWN FROM THE ORIGINAL AMOUNT. THIS RESULTS IN THE SALE PRICE.

WOULDN'T YOU LIKE AN EXAMPLE...? YES

EXAMPLE--A POWER SAW WAS ORIGINALLY PRICED AT $35. IN ORDER TO INCREASE SALES, THE MERCHANT REDUCES THE PRICE BY 10 PERCENT. WHAT IS THE SALE PRICE OF THE SAW?

FIRST STEP  10 PERCENT = .10
SECOND STEP  $35 \times .10 = $3.50
THIRD STEP  $35 - .50 = $31.50 SALE PRICE

HERE ARE SOME PROBLEMS... GOOD LUCK ! ! !

1) A CHAIR
   ORIGINALLY PRICED AT $50.00 IS MARKED DOWN 30 PERCENT. WHAT IS THE AMOUNT OF DISCOUNT...?
RIGHT!!

2) A TELEVISION
   ORIGINALLY PRICED AT
   $140.00 IS MARKED DOWN
   35 PERCENT. WHAT IS THE
   AMOUNT OF SAVINGS...?

CORRECT

3) A TAPE RECORDER
   ORIGINALLY PRICED AT
   $30.00 IS MARKED DOWN
   10 PERCENT. WHAT IS THE
   AMOUNT OF SAVINGS...?

CAPITAL...

4) A TAPE RECORDER
   ORIGINALLY PRICED AT
   $90.00 IS MARKED DOWN
   50 PERCENT. WHAT IS THE
   AMOUNT OF DISCOUNT...?

BULLY GOOD

5) A BEDROOM SUIT
   ORIGINALLY PRICED AT
   $100.00 IS MARKED DOWN
   30 PERCENT. WHAT IS THE
   AMOUNT OF SAVINGS...?
GOT IT!

6) A BASKETBALL
   ORIGINALLY PRICED AT
   $120.00 IS MARKED DOWN
   25 PERCENT. WHAT IS THE
   SALE PRICE...?

CAPITAL...

7) A LIVING ROOM SUIT
   ORIGINALLY PRICED AT
   $110.00 IS MARKED DOWN
   10 PERCENT. WHAT IS THE
   SALE PRICE...?

YEP- YOU GOT IT

8) A TABLE
   ORIGINALLY PRICED AT
   $100.00 IS MARKED DOWN
   45 PERCENT. WHAT IS THE
   SALE PRICE...?

FIRST RATE

9) A COAT
   ORIGINALLY PRICED AT
   $140.00 IS MARKED DOWN
   35 PERCENT. WHAT IS THE
   SALE PRICE...?
HELP

THE CORRECT RESPONSE IS $91.00
AND WAS ARRIVED AT IN THIS MANNER...
$140.00 \times 0.35 = 49.00
$140.00 - $49.00 = $91.00

10) A DRESS
ORIGINALLY PRICED AT
$70.00 IS MARKED DOWN
35 PERCENT. WHAT IS THE
SALE PRICE...?

XXXX
NO-HERE'S ANOTHER CHANCE
XXXX
THE CORRECT RESPONSE IS $45.50
AND WAS ARRIVED AT IN THIS MANNER...
$70.00 \times 0.35 = 24.50
$70.00 - $24.50 = $45.50

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 0 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: )OFF... IF YOU ARE FINISHED
COMMISSION

COMMISSION IS A FORM OF COMPENSATION FOR PERFORMING A BUSINESS SERVICE, SUCH AS BUYING OR SELLING MERCHANDISE. THE TYPE OF COMMISSION THAT MOST PEOPLE ARE FAMILIAR WITH IS THAT PAID TO THE SALESMAN.

A SALESMAN'S COMMISSION IS USUALLY IN THE FORM OF A GIVEN PERCENT OF THE VALUE OF GOODS OR SERVICES SOLD. NATURALLY, COMMISSION IS PAID ON ACTUAL SALES ONLY. RETURNED GOODS OR FREIGHT CHARGES ARE NOT INCLUDED FOR COMMISSION PURPOSES.

COMMISSION IS DETERMINED BY MULTIPLYING THE DOLLAR AMOUNT OF SALES BY THE COMMISSION PERCENTAGE. FOR EXAMPLE:

JOE BARNHAPG SELLS $20,000 WORTH OF MERCHANDISE DURING THE MONTH OF OCTOBER. JOE RECEIVES A 3 PERCENT COMMISSION ON ALL SALES. HOW MUCH DID HE RECEIVE IN COMMISSION?

\[ 20,000 \times 0.03 = 600.00 \]

READY TO TRY SOME PROBLEMS? HERE'S ONE...

1) 30 PERCENT COMMISSION
   ON $700 SALES...

2) 7000 SALES AT
   2 PERCENT COMMISSION...

3) 30 SALES AT
   3 PERCENT COMMISSION...

4) 20 SALES AT
   30 PERCENT COMMISSION...
6.00
NICE JOB

5) $700 SALES AT
   30 PERCENT COMMISSION...
210
GOT IT!

6) $500 SALES AT
   12.2 PERCENT COMMISSION...
51
VERY GOOD
7) 2 1/2 PERCENT COMMISSION
   ON $6000 SALES...
172.50
GOOD...
8) 13.1 PERCENT COMMISSION
   ON $200 SALES...
26.20
GOOD...
9) 14 1/2 PERCENT COMMISSION
   ON $220 SALES...
HELP
THE CORRECT RESPONSE IS 31.90
AND WAS ARRIVED AT THIS WAY...
$220.00 × 0.145 = $31.90

10) $68 SALES AT
    5 1/2 PERCENT COMMISSION...
XXXX
PLEASE RECHECK AND TRY AGAIN
XXXX
THE CORRECT RESPONSE IS 3.74
AND WAS ARRIVED AT THIS WAY...
$68.00 × 0.055 = $3.74

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 2 ON THE OTHER.
   THIS PACKAGE IS NOW COMPLETED...
   TYPE: GO ... TO DO SOMETHING ELSE, OR
   TYPE: )OFF... IF YOU ARE FINISHED
COST MARKUP

ONE METHOD OF DETERMINING THE SELLING PRICE OF AN ARTICLE IS BASED ON THE ORIGINAL COST OF THE ARTICLE. MOST SMALL STORES USE THE COST METHOD.


WHEN USING THE COST METHOD, THE SELLING PRICE IS DETERMINED BY MULTIPLYING THE COST OF THE ARTICLE BY THE DESIRED MARKUP PERCENTAGE. THE MARKUP PERCENTAGE IS DETERMINED BY EITHER PAST EXPERIENCE OR INDUSTRY AVERAGES. THIS IDEA IS MORE EASILY UNDERSTOOD IF THE FOLLOWING FORMULA IS USED.

\[
\text{ORIGINAL COST} \times \text{MARKUP PERCENTAGE} = \text{MARKUP AMOUNT}
\]

A SECOND STEP IS NECESSARY TO DETERMINE THE SELLING PRICE.

\[
\text{ORIGINAL COST} + \text{MARKUP AMOUNT} = \text{SELLING PRICE}
\]

WOULD YOU LIKE AN EXAMPLE...? YES

IN THE FOLLOWING EXAMPLE, A RETAILER BUYS A RADIO FOR $22.00. THE RETAILER KNOWS THAT HIS MARKUP PERCENTAGE MUST BE 40 PERCENT (BASED ON COST) TO COVER THE ORIGINAL COST OF THE ARTICLE, EXPENSES, AND PROVIDE A REASONABLE PROFIT. AT WHAT PRICE MUST HE SELL THE RADIO? TWO STEPS ARE NEEDED TO SOLVE THIS PROBLEM.

\[
\begin{align*}
\text{FIRST STEP} & \quad \text{ORIGINAL COST} \times \text{MARKUP PERCENTAGE} = \text{MARKUP AMOUNT} \\
& \quad \$22.00 \times \text{40 PERCENT} = \text{MARKUP} \\
& \quad \$22.00 \times .40 = \$8.80 \\
\text{SECOND STEP} & \quad \text{ORIGINAL COST} + \text{MARKUP AMOUNT} = \text{SELLING PRICE} \\
& \quad \$22.00 + \$8.80 = \$30.80
\end{align*}
\]
1) THE ORIGINAL COST IS $10.00, AND THE MARKUP IS 40 PERCENT. WHAT IS THE MARKUP AMOUNT...?

FA R OUT

2) THE ORIGINAL COST IS $20.00, AND THE MARKUP IS 15 PERCENT. WHAT IS THE MARKUP AMOUNT...?

FA R OUT

3) THE ORIGINAL COST IS $30.00, AND THE MARKUP IS 15 PERCENT. WHAT IS THE MARKUP AMOUNT...?

G O O D W ORK!

4) THE ORIGINAL COST IS $50.00, AND THE MARKUP IS 42 PERCENT. WHAT IS THE MARKUP AMOUNT...?

F I R S T R A T E

5) THE ORIGINAL COST IS $20.00, AND THE MARKUP IS 5 PERCENT. WHAT IS THE MARKUP AMOUNT...?

W E L L D O N E

6) THE ORIGINAL COST IS $300.00, AND THE MARKUP IS 45 PERCENT. WHAT IS THE RETAIL SALES PRICE...?

435 G O T I T!

7) THE ORIGINAL COST IS $3000.00, AND THE MARKUP IS 33 PERCENT. WHAT IS THE RETAIL SALES PRICE...?
GOOD...

8) THE ORIGINAL COST IS $3000.00, AND
   THE MARKUP IS 41 PERCENT.
   WHAT IS THE RETAIL SALES PRICE...?

GOOD

9) THE ORIGINAL COST IS $1000.00, AND
   THE MARKUP IS 47 PERCENT.
   WHAT IS THE RETAIL SALES PRICE...?

HELP
THE CORRECT RESPONSE IS $1470.00
AND WAS ARRIVED AT THIS WAY...
$1000.00 \times 0.4700 = \$470.00
$1000.00 + \$470.00 = \$1470.00

10) THE ORIGINAL COST IS $30.00, AND
    THE MARKUP IS 46 PERCENT.
    WHAT IS THE RETAIL SALES PRICE...?

XXXX
PLEASE RECHECK AND TRY AGAIN
XXXX
THE CORRECT RESPONSE IS $43.80
AND WAS ARRIVED AT THIS WAY...
$30.00 \times 0.4600 = \$13.80
$30.00 + \$13.80 = \$43.80

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 2 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE:  GO ... TO DO SOMETHING ELSE, OR
TYPE: )OFF... IF YOU ARE FINISHED
RETAIL MARKUP

A BUSINESSMAN MAY WISH TO BASE HIS MARKUP ON THE SELLING PRICE OF AN ARTICLE. MOST LARGE DEPARTMENT AND CHAIN STORES USE THIS METHOD. THE MARKUP AMOUNT IS NECESSARY TO RECOVER THE OPERATING EXPENSES OF THE BUSINESS, THE COST OF GOODS SOLD, AND A PROFIT FOR THE OWNERS.

WHEN USING THE RETAIL METHOD, THE SELLING PRICE IS DETERMINED BY DIVIDING THE ORIGINAL COST OF THE ARTICLE BY THE COMPLEMENT OF THE DESIRED Markup PERCENTAGE.

AN EXAMPLE IS NECESSARY TO UNDERSTAND THE RETAIL METHOD: TOM REICH, A CLOTHING MERCHANT, BUYS A SHIPMENT OF SPORT COATS. EACH COAT COST REICH $60.00. FROM PAST EXPERIENCE, TOM KNOWS HE MUST OBTAIN A 40 PERCENT Markup BASED ON THE SELLING PRICE METHOD. TO DETERMINE THE SALES PRICE WHEN ORIGINAL COST AND Markup PERCENTAGE ARE KNOWN:

1. DETERMINE THE COMPLEMENT OF THE Markup PERCENTAGE

   100 PERCENT - 40 PERCENT = 60 PERCENT (ORIGINAL COST OR COMPLEMENT)

2. DIVIDE THE ORIGINAL COST BY THE COMPLEMENT.

   $60.00 / .60 = $100.00 SELLING PRICE

SEE IF YOU CAN APPLY THE RETAIL METHOD OF Markup TO THE FOLLOWING PROBLEMS. I'LL GIVE YOU THE ORIGINAL COST AND THE Markup PERCENTAGE. YOU DETERMINE THE COMPLEMENT AND THE SELLING PRICE.

OK - LET'S GO.

1) THE COST OF AN ARTICLE IS $6.00, AND THE Markup BASED ON RETAIL IS 20 PERCENT. WHAT IS THE RETAIL SALES PRICE...?
2) The cost of an article is $60.00, and the markup based on retail is 60 percent. What is the retail sales price...?

GOT IT!

3) The cost of an article is $4.00, and the markup based on retail is 60 percent. What is the retail sales price...?

STUPENDOUS

4) The cost of an article is $50.00, and the markup based on retail is 70 percent. What is the retail sales price...?

COOL MAN

5) The cost of an article is $20.00, and the markup based on retail is 80 percent. What is the retail sales price...?

RIGHT!!

6) The cost of an article is $15.00, and the markup based on retail is 80 percent. What is the retail sales price...?

37.50
7) THE COST OF AN ARTICLE IS $12.00, AND THE MARKUP BASED ON RETAIL IS 57 PERCENT. WHAT IS THE RETAIL SALES PRICE...?

27.91
A-OK!

8) THE COST OF AN ARTICLE IS $18.53, AND THE MARKUP BASED ON RETAIL IS 67 PERCENT. WHAT IS THE RETAIL SALES PRICE...?

56.06
COOL MAN

9) THE COST OF AN ARTICLE IS $6.00, AND THE MARKUP BASED ON RETAIL IS 21 PERCENT. WHAT IS THE RETAIL SALES PRICE...?

HELP
THE CORRECT RESPONSE IS $6.33
AND WAS ARRIVED AT IN THIS MANNER...
100 PERCENT - 21 PERCENT = 79 PERCENT
$6.00 / 0.79 = $6.33

10) THE COST OF AN ARTICLE IS $4.00, AND THE MARKUP BASED ON RETAIL IS 80 PERCENT. WHAT IS THE RETAIL SALES PRICE...?

XXXX
SORRY-ONE MORE CHANCE
XXXX
THE CORRECT RESPONSE IS $20.00
AND WAS ARRIVED AT IN THIS MANNER...
100 PERCENT - 80 PERCENT = 20 PERCENT
$4.00 * 0.20 = $20.00

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE FIRST TRY, AND 0 ON THE OTHER.
SIMPLE INTEREST

INTEREST IS THE CHARGE WHICH IS PAID FOR THE USE OF BORROWED MONEY. BANKS, SAVINGS AND LOAN ASSOCIATIONS, FINANCE COMPANIES, AND CREDIT UNIONS ARE IN BUSINESS PRIMARILY TO LEND MONEY.

THE AMOUNT BORROWED IS THE PRINCIPAL. THE RATE IS THE PERCENT OF THE PRINCIPAL THAT IS CHARGED AS INTEREST. THE TIME IS THE PERIOD OF BORROWING AND MAY BE EXPRESSED IN DAYS, MONTHS, YEARS, OR A COMBINATION OF THESE FORMS BEGINNING ON THE DATE THE NOTE IS SIGNED.

THE AMOUNT OF INTEREST IS FOUND BY MULTIPLYING THE PRINCIPAL BY THE RATE BY THE TIME. THIS CAN BE EXPRESSED IN A FORMULA

\[ I = P \times R \times T \]

IF THE TIME IS GIVEN AS A CERTAIN NUMBER OF DAYS, THE NUMBER OF DAYS MUST BE PLACED OVER THE NUMBER OF DAYS IN ONE YEAR. FOR TIME PURPOSES, 360 DAYS IS CONSIDERED A BANKER'S YEAR.

WOULD YOU LIKE AN EXAMPLE...? YES
EXAMPLE:

FIND THE INTEREST ON A LOAN OF $525.57 AT 9 PERCENT FOR 75 DAYS.

INTEREST = PRINCIPAL × RATE × TIME

INTEREST = $525.57 × .09 × 75/360

INTEREST = $9.85

NOTE THAT Rounding IS NOT DONE UNTIL THE LAST STEP.

NOW... USING THE FORMULA (I=P×R×T) TRY THE FOLLOWING PROBLEMS...

1) $200 PRINCIPAL AT 8 PERCENT
   FOR 1 YEAR...

   16
   ALRIGHT!!

2) $5000 AT 15 PERCENT
   FOR 1 YEAR...

   750
   CORRECT

3) $200 LOAN AT 5 PERCENT
   FOR 1 YEAR...

   10
   OH...

4) $200 PRINCIPAL AT 10 PERCENT
   FOR 1 YEAR...

   20
   ALRIGHT!!

5) $2000 LOAN AT 5 PERCENT
   FOR 1 YEAR...
OK...

6) $6000 PRINCIPAL AT 8.1 PERCENT
   FOR 1 YEAR...

   29.61
   A-OK!

7) $4740 AT 9.9 PERCENT
   FOR 11 MONTHS...

   430.16
   GOOD WORK!

8) $84000 AT 10.2 PERCENT
   FOR 2 MONTHS...

   THAT'S RIGHT

9) $7000 LOAN AT 9.7 PERCENT
   FOR 10 MONTHS...

   HELP
   THE CORRECT RESPONSE IS $565.83
   AND WAS ARRIVED AT THIS WAY...
   $7000 x 0.097 x 300 / 360 = $565.83
   (PRINCIPAL) x (RATE) x (TIME-RATIO) = (INTEREST)

10) $8200 LOAN AT 10.3 PERCENT
    FOR 66 DAYS...

   XXXX
   HOPE-TRY AGAIN
   XXXX
   THE CORRECT RESPONSE IS $117.00
   AND WAS ARRIVED AT THIS WAY...
   $8200 x 0.103 x 66 / 360 = $117.00
   (PRINCIPAL) x (RATE) x (TIME-RATIO) = (INTEREST)

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 2 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: )OFF... IF YOU ARE FINISHED
DISTRIBUTION OF EXPENSE

WHEN DETERMINING THE COST OF MANUFACTURED ITEMS, GENERAL OR OVERHEAD EXPENSE MUST BE CONSIDERED. USUALLY THERE IS NO DIRECT METHOD OF APPORTIONMENT, AND YOU ARE FORCED TO ESTIMATE WHAT EACH DEPARTMENT'S SHARE SHOULD BE.

IN THE FOLLOWING PROBLEM, THE BASIS OF DISTRIBUTION IS SQUARE FEET OF SPACE THAT EACH DEPARTMENT OCCUPIES.

<table>
<thead>
<tr>
<th>SQUARE FEET</th>
<th>DISTRIBUTION OF EXPENSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFFICE</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td></td>
</tr>
<tr>
<td>MANUFACTURING</td>
<td></td>
</tr>
<tr>
<td>1,500</td>
<td></td>
</tr>
<tr>
<td>SHIPPING</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td></td>
</tr>
<tr>
<td>2,500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$1,500 TOTAL OVERHEAD EXPENSE</td>
</tr>
</tbody>
</table>

STEP 1--TO DETERMINE EACH DEPARTMENT'S SHARE OF THE $1,500 OVERHEAD EXPENSE FIND THE PERCENT FOR EACH DEPARTMENT BY DIVIDING THE DEPARTMENT AREA BY THE TOTAL AREA.

OFFICE = 500 SQ/FT ÷ 2,500 SQ/FT = 20 PERCENT
MANUFACTURING = 1,500 SQ/FT ÷ 2,500 SQ/FT = 60 PERCENT
SHIPPING = 500 SQ/FT ÷ 2,500 SQ/FT = 20 PERCENT

STEP 2--MULTIPLY THE TOTAL OVERHEAD EXPENSE BY THE DEPARTMENTAL PERCENTAGE. (REMEMBER TO CONVERT PERCENTAGE TO A DECIMAL BY DROPPING THE PERCENT SIGN AND MOVING THE DECIMAL TWO PLACES TO THE LEFT.)

OFFICE = $1,500 ÷ .20 = $300
MANUFACTURING = $1,500 ÷ .60 = $500
SHIPPING = $1,500 ÷ .20 = $300

NOTE: ONCE DEPARTMENTAL PERCENTAGES ARE DETERMINED, THEY MAY BE USED AGAIN AS LONG AS SPACE ALLOCATION REMAINS THE SAME.

TRY THE FOLLOWING PROBLEMS TO INSURE THIS CONCEPT. GOOD LUCK!!
1) THE TOTAL OVERHEAD EXPENSE IS $3000. THE DRUG DEPT.'S PERCENTAGE IS 5 PERCENT. WHAT IS THE DRUG DEPT.'S DOLLAR SHARE OF THE EXPENSE...?

2) THE TOTAL OVERHEAD EXPENSE IS $3000. THE SHIRT DEPT.'S PERCENTAGE IS 37.5 PERCENT. WHAT IS THE SHIRT DEPT.'S DOLLAR SHARE OF THE EXPENSE...?

3) THE TOTAL OVERHEAD EXPENSE IS $8000. DEPARTMENT A'S PERCENTAGE IS 4 PERCENT. WHAT IS DEPARTMENT A'S DOLLAR SHARE OF THE EXPENSE...?

4) THE TOTAL OVERHEAD EXPENSE IS $8000. THE HAT DEPT.'S PERCENTAGE IS 25 PERCENT. WHAT IS THE HAT DEPT.'S DOLLAR SHARE OF THE EXPENSE...?

5) THE TOTAL OVERHEAD EXPENSE IS $2000. DEPARTMENT B'S PERCENTAGE IS 40 PERCENT. WHAT IS DEPARTMENT B'S DOLLAR SHARE OF THE EXPENSE...?
6) The total overhead expense is $7500. Total area is 4000 sq/ft. The plant dept occupies 1000 sq/ft. What is their dollar share of overhead expense...?

Precisely

7) The total overhead expense is $6000. Total area is 1000 sq/ft. Department B occupies 400 sq/ft. What is their dollar share of overhead expense...?

Cool Man

8) The total overhead expense is $3200. Total area is 2000 sq/ft. The electrical dept occupies 500 sq/ft. What is their dollar share of overhead expense...?

Excellent

9) The total overhead expense is $7700. Total area is 1000 sq/ft. The hat dept occupies 300 sq/ft. What is their dollar share of overhead expense...?
HELP
THE CORRECT RESPONSE IS 52310.00
AND WAS ARRIVED AT IN THIS MANNER...
(A) 300 ÷ 1000 = 0.3000
(DEPT. AREA ÷ TOTAL AREA)
(B) $7700.00 × 0.3000 = $2310
(TOTAL EXPENSE × DEPT. PERCENTAGE)

10) THE TOTAL OVERHEAD EXPENSE
IS $7600. TOTAL AREA IS 2500 SQ/FT.
THE ELECTRICAL DEPT OCCUPIES 700 SQ/FT.
WHAT IS THEIR DOLLAR SHARE OF
OVERHEAD EXPENSE...

PLEASE RECHECK AND TRY AGAIN

THE CORRECT RESPONSE IS 52128.00
AND WAS ARRIVED AT IN THIS MANNER...
(A) 700 ÷ 2500 = 0.2800
(DEPT. AREA ÷ TOTAL AREA)
(B) $7600.00 × 0.2800 = $2128
(TOTAL EXPENSE × DEPT. PERCENTAGE)

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 2 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: )OFF... IF YOU ARE FINISHED
A PRORATION PROBLEM IS USUALLY CONCERNED WITH THE DISTRIBUTION OF OVERHEAD EXPENSES TO DIFFERENT DEPARTMENTS. THINK OF IT THIS WAY-- YOU'RE TRYING TO DETERMINE A SPECIFIC DEPARTMENT'S FAIR SHARE OF OVERALL EXPENSES. LOOK AT THE FOLLOWING PROBLEM

<table>
<thead>
<tr>
<th>Sales</th>
<th>Prorated Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoe Dept.</td>
<td>$6,000</td>
</tr>
<tr>
<td>Dress Dept.</td>
<td>$10,000</td>
</tr>
<tr>
<td>Total Sales</td>
<td>$16,000</td>
</tr>
</tbody>
</table>

$4,000 TOTAL OVERHEAD EXPENSE

In this problem, there is $4,000 of overhead expense. The only way to distribute a fair amount to each department is by using an expense factor. To work the problem two steps are involved.

First Step - Divide Total Expense by Total Sales

$4,000 / $16,000 = .25 (Expense Factor)

Second Step - Multiply Each Department's Sales by the Expense Factor (25%). (Round Off All Expense Factors to Two Places)

Shoe Dept. $6,000 x .25 = $1,500 prorated expense

For the Dress Dept., Repeat Step Two...

$10,000 x .25 = $2,500 prorated expense

Ready for Some Problems-- Good Luck !!!
1) TOTAL OVERHEAD EXPENSE IS $12096.
   THE TOTAL SALES ARE $80400.
   WHAT IS THE EXPENSE FACTOR...?

   RIGHT!!

2) TOTAL OVERHEAD EXPENSE IS $3333.
   THE TOTAL SALES ARE $10160.
   WHAT IS THE EXPENSE FACTOR...?

   RIGHT ON

3) TOTAL OVERHEAD EXPENSE IS $15768.
   THE TOTAL SALES ARE $56400.
   WHAT IS THE EXPENSE FACTOR...?

   A-OK!

4) TOTAL OVERHEAD EXPENSE IS $4750.
   THE TOTAL SALES ARE $19600.
   WHAT IS THE EXPENSE FACTOR...?

   FULLY GOOD

5) TOTAL OVERHEAD EXPENSE IS $3282.
   THE TOTAL SALES ARE $14700.
   WHAT IS THE EXPENSE FACTOR...?

   OK...

6) TOTAL OVERHEAD EXPENSE IS $7980.
   THE TOTAL SALES ARE $38000.
   IF DEPARTMENT C'S SALES ARE $13000, WHAT WOULD BE THEIR
   PORTION OF OVERHEAD EXPENSE...?

   2730
   ALRIGHT!!

7) TOTAL OVERHEAD EXPENSE IS $4760.
   THE TOTAL SALES ARE $14000.
   IF DEPARTMENT A'S SALES ARE $12000, WHAT WOULD BE THEIR
   PORTION OF OVERHEAD EXPENSE...?
That's Right

8) Total Overhead Expense is $7600.
The Total Sales are $52000.
If the Jewelry Dept's Sales are
$25000, what would be their
portion of overhead expense...

9) Total Overhead Expense is $6800.
The Total Sales are $28000.
If the Men's Dept's Sales are
$14000, what would be their
portion of overhead expense...

Help
The correct response is $4340.00
and was arrived at in this manner...
(A) $6800.00 + $28000.00 = 0.31
(Total Expense + Total Sales)
(B) $14000.00 x 0.31 = $4340.00
(Dept Sales x Expense Factor)

10) Total Overhead Expense is $2900.
The Total Sales are $65000.
If the Men's Dept's Sales are
$15000, what would be their
portion of overhead expense...

Sorry-Here's Another Chance

The correct response is $1140.00
and was arrived at in this manner...
(A) $3900.00 + $65000.00 = 0.06
(Total Expense + Total Sales)
(B) $15000.00 x 0.06 = $1140.00
(Dept Sales x Expense Factor)

Of the 10 attempted, you got 8 right on the
first try, and 0 on the other.
This package is now completed...
Type: Go... to do something else, or
Type: Off... if you are finished.
SERIES DISCOUNT

Many manufacturers and wholesalers advertise their merchandise through catalogues. The price quoted in the catalogue is the retail or catalog price. The retailer is given the suggested retail price plus one or more discounts in order to arrive at a wholesale price or invoice price. This method has at least two advantages.

1. By inserting a new discount sheet in the catalog, prices can be changed without printing new catalogs thus reducing printing costs.

2. Trade discounts are also used to encourage larger purchases. This is accomplished by increasing the discount when larger quantities are purchased.

In the following problem, the catalog price for a dining room suit is $500. The retailer is given discounts of 20 percent, 15 percent, and 10 percent.

In finding the invoice price, the first discount is based on the list price, while the second discount is based on the remainder after deducting the first discount. The third discount is calculated on the remainder after the second discount.

<table>
<thead>
<tr>
<th>Step</th>
<th>Price</th>
<th>Discount</th>
<th>New Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>$500</td>
<td>-20%</td>
<td>$400</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-10%</td>
<td>$340</td>
</tr>
<tr>
<td>Second</td>
<td>$400</td>
<td>-15%</td>
<td>$340</td>
</tr>
<tr>
<td>Third</td>
<td>$340</td>
<td>-10%</td>
<td>$306</td>
</tr>
</tbody>
</table>

Would you like to see an alternate method...? Yes
A second method uses the complement of the discount. In the above example: $500 less 20 percent, 15 percent, and 10 percent.

**First step**

\[
\begin{array}{l}
$500 \\
\times 0.80 \quad \text{COMPLEMENT OF 20 PERCENT} \\
\times 0.85 \quad \text{COMPLEMENT OF 15 PERCENT} \\
\times 0.90 \quad \text{COMPLEMENT OF 10 PERCENT} \\
\end{array}
\]

\[
\begin{array}{l}
$400 \\
$340 \quad \text{\$340} \\
$306 \quad \text{\$306}
\end{array}
\]

I'll give you the catalog price and discounts, you determine the wholesale price using the method that is easiest for you.

Do you prefer the discount or complement method...?

*Type: discount or complement*... complement

1) The list price is $2000
   Discounts are 25, and 15 percent.
   What is the cash or wholesale price...?

1275

Far out

2) The list price is $1600
   Discounts are 15, and 10 percent.
   What is the cash or wholesale price...?

1224
3) THE LIST PRICE IS $600
   DISCOUNTS ARE 15, AND 10 PERCENT.
   WHAT IS THE CASH OR WHOLESALE
   PRICE...?
382.50

STUPENDOUS

4) THE LIST PRICE IS $1200
   DISCOUNTS ARE 20, AND 5 PERCENT.
   WHAT IS THE CASH OR WHOLESALE
   PRICE...?
1292

ALRIGHT!!

5) THE LIST PRICE IS $1200
   DISCOUNTS ARE 25, AND 5 PERCENT.
   WHAT IS THE CASH OR WHOLESALE
   PRICE...?
855

FAR OUT

6) THE LIST PRICE IS $1900
   DISCOUNTS ARE 25, AND 15 PERCENT.
   WHAT IS THE CASH OR WHOLESALE
   PRICE...?
1147.50

RIGHT ON

7) THE LIST PRICE IS $750
   DISCOUNTS ARE 16, 15, AND 10 PERCENT.
   WHAT IS THE CASH OR WHOLESALE
   PRICE...?
$81.95
6) THE LIST PRICE IS $1050
DISCOUNTS ARE 30, AND 20 PERCENT.
WHAT IS THE CASH OR WHOLESALE
PRICE...?

HELP
THE CORRECT RESPONSE IS $661.50
AND WAS ARRIVED AT IN THIS MANNER...
(A) $1050.00 x 0.70 = $735.00
(B) $735.00 x 0.90 = $661.50

10) THE LIST PRICE IS $2000
DISCOUNTS ARE 14, 16, AND 5 PERCENT.
WHAT IS THE CASH OR WHOLESALE
PRICE...?

THE CORRECT RESPONSE IS $1470.60
AND WAS ARRIVED AT IN THIS MANNER...
(A) $2000.00 x 0.86 = $1720.00
(B) $1720.00 x 0.90 = $1548.00
(C) $1548.00 x 0.95 = $1470.60

OF THE 10 ATTEMPTS, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 2 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: QUIT... IF YOU ARE FINISHED.
DISCOUNT METHOD

1) The list price is $400
   Discounts are 15, and 10 percent.
   What is the cash or wholesale
   price...?

   306.
   Very good

2) The list price is $100
   Discounts are 20, and 5 percent.
   What is the cash or wholesale
   price...?

   76.
   Stupendous

3) The list price is $300
   Discounts are 25, and 15 percent.
   What is the cash or wholesale
   price...?

   191.25
   First rate

4) The list price is $1800
   Discounts are 18, and 10 percent.
   What is the cash or wholesale
   price...?

   1377
   A-ok!

5) The list price is $300
   Discounts are 20, and 5 percent.
   What is the cash or wholesale
   price...?
6) THE LIST PRICE IS $19.50
   DISCOUNTS ARE 30, 20, AND 14 PERCENT.
   WHAT IS THE CASH OR WHOLESALE
   PRICE...?
399.12
STUPENDOUS

7) THE LIST PRICE IS $45.00
   DISCOUNTS ARE 15, AND 10 PERCENT.
   WHAT IS THE CASH OR WHOLESALE
   PRICE...?
348.25
PRECISELY

8) THE LIST PRICE IS $150
   DISCOUNTS ARE 15, AND 10 PERCENT.
   WHAT IS THE CASH OR WHOLESALE
   PRICE...?
114.75
COOL MAN

9) THE LIST PRICE IS $400
   DISCOUNTS ARE 15, AND 10 PERCENT.
   WHAT IS THE CASH OR WHOLESALE
   PRICE...?
HELP
THE CORRECT RESPONSE IS $306.00
AND WAS ARRIVED AT IN THIS MANNER...
(A) \$60.00 \times 0.15 = \$9.00
\$60.00 - \$9.00 = \$51.00
(B) \$340.00 \times 0.10 = \$34.00
\$340.00 - \$34.00 = \$306.00

19) THE LIST PRICE IS \$350
DISCOUNTS ARE 25, 15, AND 15 PERCENT.
WHAT IS THE CASH OR WHOLESALE
PRICE...?

XXXX
HERE'S ANOTHER CHANCE
XXXX

THE CORRECT RESPONSE IS \$189.06
AND WAS ARRIVED AT IN THIS MANNER...
(A) \$350.00 \times 0.25 = \$87.50
\$350.00 - \$87.50 = \$262.50
(B) \$262.50 \times 0.15 = \$39.37
\$262.50 - \$39.37 = \$223.13
(C) \$223.13 \times 0.15 = \$33.47
\$223.13 - \$33.47 = \$189.66

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 2 ON THE OTHER.

THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: OFF... IF YOU ARE FINISHED
PERCENTAGE OF INCREASE OR DECREASE

A BUSINESSMAN FREQUENTLY COMPARES HIS CURRENT SALES, EXPENSES, AND PROFITS WITH AMOUNTS FOR THE SAME ITEMS FROM PREVIOUS PERIODS OF TIME. BY STUDYING THE RESULTS HE CAN DETERMINE TRENDS AND MAKE MORE INTELLIGENT DECISIONS.

IN ADDITION, IT IS ALSO HELPFUL TO CONVERT THIS INFORMATION INTO A PERCENTAGE OF INCREASE OR DECREASE. BOTH THE AMOUNT OF INCREASE OR DECREASE AND PERCENTAGE OF INCREASE OR DECREASE CAN BE DETERMINED BY FOLLOWING THESE STEPS:

1. FIND THE AMOUNT OF CHANGE BY SUBTRACTING THE SMALLER AMOUNT FROM THE LARGER AMOUNT. (IF THE PREVIOUS PERIOD AMOUNT IS SMALLER THAN THE CURRENT AMOUNT, THERE WILL BE AN INCREASE. IF THE PREVIOUS PERIOD IS LARGER THAN THE AMOUNT OF THE CURRENT PERIOD THERE WILL BE A DECREASE.)

2. DIVIDE THE AMOUNT OF CHANGE BY THE PREVIOUS OR EARLIER AMOUNT TO OBTAIN THE PERCENTAGE OF INCREASE OR DECREASE.

3. CONVERT YOUR ANSWER TO A PERCENT BY MOVING THE DECIMAL IN YOUR ANSWER TWO PLACES TO THE RIGHT.

WOULD YOU LIKE AN EXAMPLE...? YES
FIRST STEP--DETERMINE THE AMOUNT OF CHANGE

$3,800 AUGUST SALES

-$7,500 JULY SALES

$1,300 AMOUNT OF INCREASE

SECOND STEP--DIVIDE THE AMOUNT OF CHANGE BY THE PREVIOUS PERIOD AMOUNT.

PREVIOUS SALES $7,500

$1,300 $1,300.0000 AMOUNT OF CHANGE

1.733 PERCENT OF INCREASE

THIRD STEP--CONVERT YOUR ANSWER TO A PERCENTAGE BY MOVING DECIMAL TWO PLACES TO THE RIGHT.

.1733 BECOMES 17.33 PERCENT

IN THIS EXAMPLE, THE SHOE DEPARTMENT EXPERIENCED A $1,300 INCREASE IN SALES. IN ADDITION, THIS AMOUNTED TO A 17.33 PERCENT INCREASE IN SALES WHEN COMPARED TO THE PREVIOUS MONTH'S OR JULY'S SALES.

NOW TRY SOME PROBLEMS TO SEE IF YOU CAN FIND A PERCENT OF INCREASE OR PERCENT OF DECREASE.

(NOTE: WHENEVER YOU USE A DECIMAL NUMBER BE SURE THAT YOU ROUND IT OFF TO THREE PLACES...)

GOOD LUCK...

ARE YOU READY TO TRY SOME PROBLEMS...? YES

1) JANUARY, 1973 SALES WERE $1000. FEBRUARY, 1973 SALES WERE $3500. WHAT IS THE AMOUNT OF INCREASE...?
2) JANUARY, 1973 SALES WERE
   $1000. FEBRUARY, 1973 SALES WERE
   $4500. WHAT IS THE AMOUNT
   OF INCREASE...?

3) JULY, 1970 SALES WERE
   $6000. AUGUST, 1970 SALES WERE
   $3000. WHAT IS THE AMOUNT
   OF DECREASE...?

4) 1971 SALES WERE
   $5000. 1972 SALES WERE
   $10000. WHAT IS THE AMOUNT
   OF INCREASE...?

5) MAY, 1974 SALES WERE
   $11000. JUNE, 1974 SALES WERE
   $15500. WHAT IS THE AMOUNT
   OF INCREASE...?

6) 1974 SALES WERE
   $5000. 1975 SALES WERE
   $4500. WHAT IS THE PERCENTAGE
   OF INCREASE...?

7) SEPTEMBER, 1974 SALES WERE
   $13000. OCTOBER, 1974 SALES WERE
   $13500. WHAT IS THE PERCENTAGE
   OF INCREASE...?
8) MAY, 1972 SALES WERE
$2000. JUNE, 1972 SALES WERE
$1500. WHAT IS THE PERCENTAGE
OF INCREASE...?

NICE JOB

9) 1972 SALES WERE
$14000. 1973 SALES WERE
$11500. WHAT IS THE PERCENTAGE
OF DECREASE...?

HELP
THE CORRECT RESPONSE IS 17.9 PERCENT
AND WAS ARRIVED AT IN THIS MANNER...
$14000 - $11500 = $2500
$2500 / $14000 = -0.179
-0.179 = 17.9 PERCENT

10) MAY, 1972 SALES WERE
$18500. JUNE, 1972 SALES WERE
$12500. WHAT IS THE PERCENTAGE
OF INCREASE...?

XXXX
HERE'S ANOTHER CHANCE
XXXX
THE CORRECT RESPONSE IS 10.0 PERCENT
AND WAS ARRIVED AT IN THIS MANNER...
$12500 - $10500 = $2000
$2000 / $10500 = 0.180
0.180 = 18 PERCENT

OF THE 10 ATTEMPTED, YOU GOT 8 RIGHT ON THE
FIRST TRY, AND 0 ON THE OTHER.
THIS PACKAGE IS NOW COMPLETED...
TYPE: GO ... TO DO SOMETHING ELSE, OR
TYPE: )OFF... IF YOU ARE FINISHED
APPENDIX B

The student handout containing instructions for operation of the APL computer terminal is included in Appendix B.
INSTRUCTIONS FOR OPERATION OF
APL COMPUTER TERMINALS

I. Location of APL Terminals: Room B-125 (Business Math/Office Machines Room) or Room R-154 (behind the reference desk in the library)

II. Operating Instructions:

A. Turn on the APL terminal, type your account number, and press the carriage return. (Always press the carriage return after typing an entry.) Example:

)`81359  BOB

B. After the computer has responded to your entry, type the following:

)`LOAD 516 BUS\(\text{ALT}\)MATH (\(\text{ALT}\) is the shift of the H key)

C. The computer will respond with:

BUSINESS MATH EXERCISES

WOULD YOU LIKE INSTRUCTIONS...?

1. You type either yes or no. If you type yes, the computer will type out general instructions. If you type no, the computer will ask--WOULD YOU LIKE A LIST OF AVAILABLE PROGRAMS...?

2. When the computer types the question--WOULD YOU LIKE A LIST OF AVAILABLE PROGRAMS...? answer with either yes or no. If you type yes, the computer will print out a list of available programs. If you type no, the computer will respond--TYPE THE NAME OF THE PROGRAM YOU WISH TO USE.

3. To the above question--you type the name of the program you want. For Example:

PERCENTS TO A DECIMAL
D. After the program begins, just follow the instructions until you have finished the program.

E. After you have finished, type the following to sign off.

)OFF

III. Special Notes to Using the Terminals:

A. The terminal types in all capital letters. The shift key is for the special symbols.

B. To correct a typing mistake, backspace to the error and hit the ATTN key. If for instance, you type:

1234

and the 3 was supposed to be a 2, you would backspace to the 3 and hit the ATTN key. The paper would then look like this after you enter the correct number.

1234 v 24

C. Programs may be done over and over as many times as desired. Programs that are not assigned may be done if desired.

IV. List of Programs:

1. PERCENTS TO A DECIMAL
2. DECIMALS TO A PERCENT
3. COMPLEMENT
4. ROUND OFF
5. FRACTIONS TO A DECIMAL
6. CASH DISCOUNT
7. MARKDOWN
8. COMMISSION
9. COST MARKUP
10. RETAIL MARKUP
11. SIMPLE INTEREST
12. DISTRIBUTION OF EXPENSE
13. PRORATION
14. SERIES DISCOUNT
15. PERCENTAGE OF INCREASE OR DECREASE
APPENDIX C

A brief summary of the instructional material used in the lecture-demonstration classes is presented in Appendix C.
PERCENTS TO A DECIMAL

Often it is easier to work with the decimal equivalent of a percent than the percentage itself. For example, all calculators can multiply a number by the decimal equivalent of a percent, but only the newer, more expensive machines have a percent key for multiplication purposes.

There are two methods of changing a percent to a decimal. One method is more theoretical while the other is a more practical approach. Either method is pretty easy - so it is your choice.

METHOD ONE - To Change a Percent to a Decimal

A. Drop the percent sign
B. Divide the number by 100
C. EXAMPLE: 43% = 43 ÷ 100 = .43

METHOD TWO - To Change a Percent to a Decimal

A. Move the decimal point two places to the left and drop the percent sign.
B. EXAMPLE: 75% = .75
DECIMALS TO A PERCENT

A lot of times the decimal answer that we end up with would be more meaningful if we converted the decimal answer to a percentage.

There are two methods of changing a decimal to a percent. Either method is OK, so pick the one that is easiest for you.

METHOD ONE - To Convert a Decimal to a Percent:

A. Multiply the decimal answer by 100

B. Add a percent sign

C. EXAMPLE: \(0.56 = 0.56 \times 100 = 56\%\)

METHOD TWO - To Convert a Decimal to a Percent:

A. Move the decimal point two places to the right

B. Add a percent sign

C. EXAMPLE: \(0.83 = 83\%\)
COMPLEMENT

Often, it is easier to work with the complement instead of the discount when you are trying to determine the selling price of an article.

For example: A dress that originally cost $100 is marked down 10%. What is the sales price of the dress?

**LONG METHOD**—

A. 10% = .10
B. $100 × .10 = $10 Discount
C. $100 - $10 = $90 Sale Price

**SHORT METHOD—** A. MENTALLY subtract the discount from 100%.

100% - 10% = 90% Complement

B. Multiply the original cost by the complement. (90%)

$100 × .90 = $90 Sale Price

When trying to determine the complement, the basic rule is:

100% (Original Cost) - Discount = Complement

**EXAMPLE 1—20% Discount**

100% - 20% = 80% (Complement)

**EXAMPLE 2—27% Discount**

100% - 27% = 73% (Complement)
ROUND OFF

When rounding off numbers, the FIRST STEP is to determine the number of decimals you desire in your final answer.

Decimals may be rounded to one, two, three, four, or more places—the decision is yours. Probably two places or hundredths is the most popular application because that is needed when working with money.

When rounding off decimals by hand, consider the number to the right of the last digit to be retained. If this digit is 5 or more, add 1 to the previous digit; if it is 4 or less, drop it.

EXAMPLES—.457 rounded to two places becomes .46
.453 rounded to two places becomes .45
.455 rounded to two places becomes .46
Today, the most important reason for changing a fraction to a decimal is that electronic calculators cannot work with numbers in fractional form.

When faced with this problem, you can do one of two things. First, there are Fraction--Decimal Equivalent Tables. The problem with most tables is that they don't contain all fractions that you might need; plus you must memorize the table.

Second, any fraction can be changed to a decimal by dividing the Numerator (top number) by the Denominator (bottom number). For example:

\[ \frac{1}{2} = 1 \div 2 = .50 \]
\[ \frac{2}{5} = 2 \div 5 = .40 \]

Some fractions don't work out exactly. In this case, round your answers to four places, unless otherwise specified. For example:

\[ \frac{2}{3} = 2 \div 3 = .6667 \]
CASH DISCOUNT

To encourage prompt payment of an invoice, many businesses often grant what is known as a cash discount. Cash discounts look like this

2/10, N/30

The cash discount can be explained as follows: 2/10 means 2% discount if the invoice amount is paid within 10 days of the invoice date; N/30 means net or no discount after the first 10 days. The entire amount of the invoice is due within 30 days of the invoice date.

In the following problem, the invoice price is $1,600. Terms are 2/10, N/30. We decide to pay the invoice amount within 10 days and take advantage of the discount.

FIRST STEP

\[ \text{Original Amount} \times \frac{0.02}{1} = \text{Amount of Discount} \]

$1,600 \times 0.02 = $32.00 \text{ Amount of Discount}

SECOND STEP

\[ \text{Original Amount} - \text{Amount of Discount} = \text{Amount to be Paid} \]

$1,600 - 32 = $1,568 \text{ Amount to be Paid}
MARKDOWN

Sometimes it is necessary for retailers to lower the price on certain merchandise in order to dispose of it.

This is easily accomplished by using a markdown percentage such as 10% or 20%. Often, the retailer will advertise the sale as 10% or 20% off the normal price.

To find the sale price when the original amount and markdown percentage are known, follow these steps:

1. Change the markdown percentage to a decimal. (Remember - Move the decimal two places to the left.) For example: 20% = .20

2. Multiply the decimal equivalent by the original price.

3. Subtract the amount of markdown from the original amount. This results in the sale price.

EXAMPLE—A power saw was originally priced at $35. In order to increase sales, the merchant reduces the price by 10%. What is the sale price of the saw?

First Step—10% = .10

Second Step—$35 x .10 = $3.50 Markdown

Third Step—$35 - 3.50 = $31.50 Sale Price
Commission is a form of compensation for performing a business service, such as buying or selling merchandise. The type of commission that most people are familiar with is that paid to the salesman.

A salesman's commission is usually in the form of a given percent of the value of goods or services sold. Naturally, commission is paid on actual sales only. Returned goods or freight charges are not included for commission purposes.

Commission is determined by multiplying the dollar amount of sales by the commission percentage. For example:

Joe Barnharg sells $20,000 worth of merchandise during the month of October. Joe receives a 3% commission on all sales. How much did he receive in commission?

$20,000 \times .03 = $600.00
COST MARKUP

One method of determining the selling price of an article is based on the original cost of the article. Most small stores use the cost method.

The difference between the businessman's cost of an article and the price at which he sells the article is called the markup amount. The markup amount is necessary to recover the operating expenses of the business, the cost of the goods sold, and a profit for the owners.

When using the cost method, the selling price is determined by multiplying the cost of the article by the desired markup percentage. The markup percentage is determined by either past experience or industry averages. This idea is more easily understood if the following formula is used.

\[
\text{Original Cost} \times \text{Markup Percentage} = \text{Markup Amount}
\]

A second step is necessary to determine the selling price.

\[
\text{Original Cost} + \text{Markup Amount} = \text{Selling Price}
\]

In the following example, a retailer buys a radio for $22.00. The retailer knows that his markup percentage must
be 40% (based on cost) to cover the original cost of the article, expenses, and provide a reasonable profit. At what price must he sell the radio? Two steps are needed to solve this problem.

FIRST STEP ORIGINAL COST X MARKUP PERCENTAGE = MARKUP AMOUNT

$22.00 \times 40\% = \text{MARKUP AMOUNT}

$22.00 \times .40 = \$8.80

SECOND STEP ORIGINAL COST + MARKUP AMOUNT = SELLING PRICE

$22.00 + \$8.80 = \$30.80
RETAIL MARKUP

A businessman may wish to base his markup on the selling price of an article. Most large department and chain stores use this method. The markup amount is necessary to recover the operating expenses of the business, the costs of the goods sold, and a profit for the owners.

When using the retail method, the selling price is determined by dividing the original cost of the article by the complement of the desired markup percentage.

An example is necessary to understand the retail method: Tom Reech, a clothing merchant, buys a shipment of sport coats. Each coat cost Reech $60.00. From past experience, Tom knows he must obtain a 40% markup based on the selling price method. To determine the sales price when the original cost and markup percentage are known:

1. Determine the complement of the markup percentage.
   
   \[ 100\% - 40\% = 60\% \text{ (Original Cost or Complement)} \]

2. Divide the original cost by the complement.
   
   \[ \$60.00 \div .60 = \$100.00 \text{ (Selling Price)} \]
SIMPLE INTEREST

Interest is the charge which is paid for the use of borrowed money. Banks, savings and loan associations, finance companies, and credit unions are in business primarily to lend money.

The amount borrowed is the PRINCIPAL. The RATE is the percent of the principal that is charged as interest. The TIME is the period of borrowing and may be expressed in days, months, years, or a combination of these forms beginning on the date the note is signed.

The amount of interest is found by multiplying the principal by the rate by the time. This can be expressed in a formula

\[ I = P \times R \times T \]

If the time is given as a certain number of days, the number of days must be placed over the number of days in one year. For time purposes, 360 days is considered a banker's year.

EXAMPLE---FIND THE INTEREST ON A LOAN OF $525.57 AT 9% FOR 75 DAYS.

\[
\text{INTEREST} = \text{PRINCIPAL} \times \text{RATE} \times \text{TIME} \\
\text{INTEREST} = \$525.57 \times 0.09 \times \frac{75}{360} \\
\text{INTEREST} = \$525.57 \times 0.09 \times 75 \div 360 \\
\text{INTEREST} = \$9.85* \\
\]

*Note that rounding is not done until the last step.
DISTRIBUTION OF EXPENSE

When determining the cost of manufactured items, general or overhead expenses must be considered. Usually there is no direct method of apportionment, and you are forced to estimate what each department's share of the expense should be.

In the following problem, the basis of distribution is square feet of space that each department occupies.

<table>
<thead>
<tr>
<th>SQUARE FEET</th>
<th>DISTRIBUTION OF EXPENSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>500</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1,500</td>
</tr>
<tr>
<td>Shipping</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>2,500</td>
</tr>
</tbody>
</table>

$1,500 Total Overhead Expense

Step 1--To determine each department's share of the $1,500 overhead expense, find the Percent for each department by dividing the Department Area by the Total Area.

Office = 500 sq/ft ÷ 2,500 sq/ft = 20%
Manufacturing = 1,500 sq/ft ÷ 2,500 sq/ft = 60%
Shipping = 500 sq/ft ÷ 2,500 sq/ft = 20%

Step 2--Multiply the Total Overhead Expense by the Departmental Percentage. (Remember to convert percentage to a decimal by dropping the percent sign and moving the decimal two place to the left.)
Office = $1,500 \times .20 = $300.00 \\
Manufacturing = $1,500 \times .60 = $900.00 \\
Shipping = $1,500 \times .20 = $300.00 \\

\text{NOTE: Once departmental percentages are determined, they may be used again as long as space allocation remains the same.}
PRORATION

A proration problem is usually concerned with the distribution of overhead expenses to different departments. Think of it this way—you're trying to determine a specific department's fair share of overall expenses. Look at the following problem:

<table>
<thead>
<tr>
<th>Sales</th>
<th>Prorated Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoe Dept.</td>
<td>$6,000</td>
</tr>
<tr>
<td>Dress Dept.</td>
<td>$10,000</td>
</tr>
<tr>
<td>Total Sales</td>
<td>$16,000</td>
</tr>
<tr>
<td>Total Overhead</td>
<td>$4,000</td>
</tr>
</tbody>
</table>

In this problem, there is $4,000 of overhead expense. The only way to distribute a fair amount to each department is by using an expense factor. To work the problem, two steps are involved.

FIRST STEP--Divide Total Expense by Total Sales.

\[
\frac{4,000}{16,000} = 0.25 \text{ (Expense Factor)}
\]

SECOND STEP--Multiply each department's sales by the expense factor (0.25). (Round off all expense factors to two places.)

Shoe Dept. $6,000 \times 0.25 = $1,500 Prorated Expense

For the dress department, repeat step two...

$10,000 \times 0.25 = $2,500 Prorated Expense
SERIES DISCOUNT

Many manufacturers and wholesalers advertise their merchandise through catalogs. The price quoted in the catalog is the retail or catalog price. The retailer is given the suggested retail price plus one or more discounts in order to arrive at a wholesale price or invoice price. This method has at least two advantages.

1. By inserting a new discount sheet in the catalog, merchants can change prices without printing new catalogs, thus reducing the printing costs.

2. Trade discounts are also used to encourage larger purchases. This is accomplished by increasing the discount when larger quantities are purchased.

In the following problem, the catalog price for a dining room suite is $500. The retailer is given discounts of 20%, 15%, and 10%.

To find the invoice price, the first discount is based on the list price, while the second discount is based on the remainder after deducting the first discount. The third discount is calculated on the remainder after the second discount is deducted.
An alternate method uses the complement of the discounts.

In the above example: $500 less 20%, 15%, and 10%

**FIRST STEP**

$500

\[ \times 0.80 \text{ Complement of 20%} \]

$400

**SECOND STEP**

$400

\[ \times 0.85 \text{ Complement of 15%} \]

$340

**THIRD STEP**

$340

\[ \times 0.90 \text{ Complement of 10%} \]

$306
PERCENTAGE OF INCREASE OR DECREASE

A businessman frequently compares his current sales, expenses, and profits with amounts for the same items from previous periods of time. By studying the results, he can determine trends and make more intelligent decisions.

In addition, it is also helpful to convert this information into a percentage of increase or decrease. Both the amount of increase or decrease and percentage of increase or decrease can be determined by following these steps:

1. Find the amount of change by subtracting the smaller amount from the larger amount. (If the previous period amount is smaller than the current amount, there will be an increase. If the previous period is larger than the amount of the current period, there will be a decrease.)

2. Divide the amount of change by the previous or earlier amount to obtain the percentage of increase or decrease.

3. Convert your answer to a percent by moving the decimal in your answer two places to the right.

EXAMPLE

FIRST STEP--Determine the Amount of Change

$8,500 August Sales

-7,500 July Sales

$1,300 Amount of Increase
SECOND STEP—Divide the amount of change by the previous period amount.

\[
\frac{1,300}{7,500} = 0.1733 \text{ Percent of Increase}
\]

Previous Sales  7,500 /\underline{1,300.0000} Amount of Change

THIRD STEP—Convert your answer to a percentage by moving the decimal two places to the right.

\[
0.1733 = 17.33\%
\]

In this example, the shoe department experienced a $1,300 increase in sales. In addition, this amounted to a 17.33% increase in sales when compared to the previous month's or July's sales.
APPENDIX D

The assignment sheets used by students in the lecture-demonstration group are presented in Appendix D.
PERCENTS TO A DECIMAL

DIRECTIONS: Convert the following percentages to decimal equivalents.

1. 54% converted to a decimal is
2. 73% converted to a decimal is
3. 34% converted to a decimal is
4. 85% converted to a decimal is
5. 23% converted to a decimal is
6. 3% converted to a decimal is
7. 4.5% converted to a decimal is
8. 5% converted to a decimal is
9. 19.7% converted to a decimal is
10. 74.1% converted to a decimal is

No. Right

No. Wrong
### DECIMALS TO A PERCENT

DIRECTIONS: Convert the following decimals to percentages.

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. .24</td>
<td></td>
</tr>
<tr>
<td>2. .76</td>
<td></td>
</tr>
<tr>
<td>3. .18</td>
<td></td>
</tr>
<tr>
<td>4. .62</td>
<td></td>
</tr>
<tr>
<td>5. .39</td>
<td></td>
</tr>
<tr>
<td>6. .07</td>
<td></td>
</tr>
<tr>
<td>7. .133</td>
<td></td>
</tr>
<tr>
<td>8. .264</td>
<td></td>
</tr>
<tr>
<td>9. .063</td>
<td></td>
</tr>
<tr>
<td>10. .08</td>
<td></td>
</tr>
</tbody>
</table>

No. Right ______

No. Wrong ______
COMPLEMENT

DIRECTIONS: Determine the complement for the following percentages.

1. The complement of 15% is __________
2. The complement of 25% is __________
3. The complement of 34% is __________
4. The complement of 12% is __________
5. The complement of 42% is __________
6. The complement of 32.8% is __________
7. The complement of 6.5% is __________
8. The complement of 10.7% is __________
9. The complement of 8.3% is __________
10. The complement of 35.9% is __________

No. Right __________

No. Wrong __________
ROUND OFF

DIRECTIONS: Using the standard 5/4 procedure, round off the following numbers to the indicated values

1. .563 rounded off to 2 places is

2. .594 rounded off to 2 places is

3. .686 rounded off to 2 places is

4. .269 rounded off to 2 places is

5. .875 rounded off to 2 places is

6. .2374 rounded off to 3 places is

7. .899 rounded off to 2 places is

8. .73985 rounded off to 4 places is

9. .892 rounded off to 1 place is

10. .999 rounded off to 2 places is

No. Right

No. Wrong
FRACTIONS TO A DECIMAL

DIRECTIONS: Determine the decimal equivalents for the following fractions. Please use 4 places in your answer.

1. \(1/4\) converted to a decimal is 

2. \(1/2\) converted to a decimal is 

3. \(1/9\) converted to a decimal is 

4. \(1/3\) converted to a decimal is 

5. \(3/8\) converted to a decimal is 

6. \(23/36\) converted to a decimal is 

7. \(4/7\) converted to a decimal is 

8. \(9/25\) converted to a decimal is 

9. \(7/18\) converted to a decimal is 

10. \(5/6\) converted to a decimal is 

No. Right 

No. Wrong
CASH DISCOUNT

DIRECTIONS: Determine the amount of discount for the following invoice amounts. (Terms are included in the problem.) Take advantage of all discounts.

<table>
<thead>
<tr>
<th>Invoice Amount</th>
<th>Terms</th>
<th>Discount Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $2,000</td>
<td>2/10, N/30</td>
<td></td>
</tr>
<tr>
<td>2. $3,000</td>
<td>3/10, N/30</td>
<td></td>
</tr>
<tr>
<td>3. $5,000</td>
<td>1/10, N/30</td>
<td></td>
</tr>
<tr>
<td>4. $2,500</td>
<td>2/20, N/30</td>
<td></td>
</tr>
<tr>
<td>5. $100</td>
<td>3/15, N/30</td>
<td></td>
</tr>
</tbody>
</table>

DIRECTIONS: Determine the Net Amount (amount that is paid) if the cash discount is taken for the following problems.

<table>
<thead>
<tr>
<th>Invoice Amount</th>
<th>Terms</th>
<th>Net Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. $2,000</td>
<td>2/10, N/60</td>
<td></td>
</tr>
<tr>
<td>7. $8,000</td>
<td>1/10, N/30</td>
<td></td>
</tr>
<tr>
<td>8. $6,600</td>
<td>2/20, N/45</td>
<td></td>
</tr>
<tr>
<td>9. $9,544</td>
<td>3/10, N/30</td>
<td></td>
</tr>
<tr>
<td>10. $3,450</td>
<td>1/10, N/60</td>
<td></td>
</tr>
</tbody>
</table>

No. Right_____
No. Wrong_____
MARKDOWN

DIRECTIONS: Determine the amount of discount (savings) for the following problems.

1. A living room suit originally priced at $220.00 is marked down 10%. What is the discount amount? (discount amount = amount of savings) $__________

2. A basketball originally priced at $25.00 is marked down 20%. What is the discount amount? $__________

3. A radio originally priced at $40.00 is marked down 40%. What is the discount amount? $__________

4. A coat originally priced at $80.00 is marked down 25%. What is the discount amount? $__________

5. A volleyball originally priced at $20.00 is marked down 50%. What is the discount amount? $__________

DIRECTIONS: Determine the sale price for the articles in the following problems. (Original minus Discount equals Sale Price.)

6. A television originally priced at $425.00 is marked down 30%. What is the sale price? $__________

7. A blouse originally priced at $15.50 is marked down 40%. What is the sale price? $__________
8. A typewriter originally priced at $229.00 is marked down 20%. What is the sale price?

$___________

9. An end table originally priced at $79.95 is marked down 28%. What is the sale price?

$___________

10. A chair originally priced at $149.00 is marked down 15%. What is the sale price?

$___________

No. Right_______
No. Wrong_______
DIRECTIONS: Determine the commission in the following problems.

1. 20% commission on $4,000 sales . . . ___________

2. 10% commission on $225 sales . . . ___________

3. 15% commission on $100 sales . . . ___________

4. 25% commission on $400 sales . . . ___________

5. 40% commission on $10 sales . . . ___________

6. 2.5% commission on $32 sales . . . ___________

7. 8% commission on $1,525 sales . . . ___________

8. 4 1/4% commission on $20 sales . . ___________

9. 12.3% commission on $150 sales . . ___________

10. 2 1/2% commission on $12 sales . . ___________

No. Right__________

No. Wrong__________
**COST MARKUP**

**DIRECTIONS:** Determine the amount of markup (based on cost) for the following problems.

<table>
<thead>
<tr>
<th>Original Cost</th>
<th>Markup Percentage (%)</th>
<th>Amount of Markup</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $100</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>2. $250</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>3. $18</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>4. $10</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>5. $2</td>
<td>75%</td>
<td></td>
</tr>
</tbody>
</table>

**DIRECTIONS:** Determine the selling price for the following problems. The original cost and the markup percentage are given. Be sure to use the cost method of markup.

<table>
<thead>
<tr>
<th>Original Cost</th>
<th>Markup Percentage (%)</th>
<th>Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. $4</td>
<td>24%</td>
<td></td>
</tr>
<tr>
<td>7. $223</td>
<td>20.3%</td>
<td></td>
</tr>
<tr>
<td>8. $72</td>
<td>48%</td>
<td></td>
</tr>
<tr>
<td>9. $650</td>
<td>39.5%</td>
<td></td>
</tr>
<tr>
<td>10. $12.75</td>
<td>8.2%</td>
<td></td>
</tr>
</tbody>
</table>

No. Right______
No. Wrong______
RETAIL MARKUP

DIRECTIONS: Determine the Retail Price for the following problems. The original cost and the markup percentage are given. Be sure to use the retail method of markup.

<table>
<thead>
<tr>
<th>Original Cost</th>
<th>Markup Percentage (%)</th>
<th>Retail Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>$166</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>$64</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>$890</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>$13</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>$300</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>$450</td>
<td>18%</td>
<td></td>
</tr>
<tr>
<td>$9</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>$15</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>$3</td>
<td>62.3%</td>
<td></td>
</tr>
</tbody>
</table>

No. Right ____

No. Wrong ____
SIMPLE INTEREST

DIRECTIONS: Determine the amount of interest for the following loan amounts.

1. The amount borrowed is $400 at 11% for one year. What is the amount of interest?
   
   $__________________

2. The amount borrowed is $200 at 15% for one year. What is the amount of interest?
   
   $__________________

3. The amount borrowed is $1,000 at 9% for one year. What is the amount of interest?
   
   $__________________

4. The amount borrowed is $2,500 at 12% for one year. What is the amount of interest?
   
   $__________________

5. The amount borrowed is $800 at 18% for one year. What is the amount of interest?
   
   $__________________

6. The amount borrowed is $13,000 at 8 1/2% for 180 days. What is the amount of interest?
   
   $__________________

7. The amount borrowed is $25,000 at 9.3% for 90 days. What is the amount of interest?
   
   $__________________

8. The amount borrowed is $4,300 at 10.4% for 15 days. What is the amount of interest?
   
   $__________________
9. The amount borrowed is $200 at 17% for 49 days. What is the amount of interest?

$__________

10. The amount borrowed is $35,400 at 8.75% for 135 days. What is the amount of interest?

$__________

No. Right_______

No. Wrong_______
DISTRIBUTION OF EXPENSE

DIRECTIONS: Determine each department's share of overhead expense in the following problems.

1. Total overhead expense is $4,500. The dress department's share is 25%. What is the dress department's dollar share of the expense?

$_________ 

2. Total overhead expense is $2,000. The plant department's share is 40%. What is the plant department's dollar share of the expense?

$_________ 

3. Total overhead expense is $6,000. The jewelry department's share is 12%. What is the jewelry department's dollar share of the expense?

$_________ 

4. Total overhead expense is $1,000. The luggage department's share is 19%. What is the luggage department's dollar share of the expense?

$_________ 

5. Total overhead expense is $1,500. The film department's share is 43%. What is the film department's dollar share of the expense?

$_________ 

DIRECTIONS: Determine each department's share of overhead expense in the following problems. You will be given total overhead expense, total area, and each department's area.

6. Total overhead expense is $14,000. Total area is 1,000 sq. ft. The finance department occupies 700 sq. ft. What is their dollar share of overhead expense?

$_________
7. Total overhead expense is $18,950. Total area is 2,000 sq. ft. The shoe department occupies 1,000 sq. ft. What is their dollar share of overhead expense?

$____________________________

8. Total overhead expense is $1,200. Total area is 400 sq. ft. The supply department area is 100 sq. ft. What is their dollar share of overhead expense?

$____________________________

9. Total overhead expense is $10,000. Total area is 3,000 sq. ft. The filing department occupies 1,500 sq. ft. What is their dollar share of overhead expense?

$____________________________

10. Total overhead expense is $22,000. Total area is 5,000 sq. ft. The drug department occupies 800 sq. ft. What is their dollar share of overhead expense?

$____________________________

No. Right_______

No. Wrong_______
PRORATION

DIRECTIONS: Determine the expense factor for each of the following problems. (Expense factor = Total Expense divided by Total Sales)

<table>
<thead>
<tr>
<th>Total Sales</th>
<th>Total Overhead Expense</th>
<th>Expense Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5,000.00</td>
<td>$1,000.00</td>
<td></td>
</tr>
<tr>
<td>$10,000.00</td>
<td>$2,500.00</td>
<td></td>
</tr>
<tr>
<td>$23,000.00</td>
<td>$3,970.00</td>
<td></td>
</tr>
<tr>
<td>$20,000.00</td>
<td>$4,000.00</td>
<td></td>
</tr>
<tr>
<td>$16,000.00</td>
<td>$2,300.00</td>
<td></td>
</tr>
</tbody>
</table>

DIRECTIONS: Determine each department's share of overhead expense for the information below. (Don't forget—you still need the expense factor)

6. Total overhead expense is $4,000. The total sales are $8,000. If department D's sales are $2,000, what will be their portion of overhead expense?

$______________

7. Total overhead expense is $6,000. The total sales are $8,000. If the shoe department's sales are $10,000, what will be their portion of overhead expense?

$______________

8. Total overhead expense is $10,000. The total sales are $20,000. If the dress department's sales are $6,000, what will be their portion of overhead expense?

$______________

9. Total overhead expense is $12,500. The total sales are $125,000. If the men's department sales are $30,000, what will be their portion of overhead expense?

$______________
10. Total overhead expense is $4,000. The total sales are $20,000. If the sports department's sales are $8,000, what will be their portion of overhead expense?

$ __________________

No. Right_______

No. Wrong_______
### Series Discount

**DIRECTIONS:** Determine the wholesale price for the following problems.

<table>
<thead>
<tr>
<th>List Price</th>
<th>Terms or Discounts</th>
<th>Wholesale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$525.00</td>
<td>10% and 15%</td>
<td></td>
</tr>
<tr>
<td>$125.00</td>
<td>15% and 20%</td>
<td></td>
</tr>
<tr>
<td>$400.00</td>
<td>20% and 10%</td>
<td></td>
</tr>
<tr>
<td>$1,000.00</td>
<td>25% and 14%</td>
<td></td>
</tr>
<tr>
<td>$800.00</td>
<td>10% and 20%</td>
<td></td>
</tr>
<tr>
<td>$2,400.00</td>
<td>10%, 15% and 2%</td>
<td></td>
</tr>
<tr>
<td>$750.00</td>
<td>20%, 5%, and 10%</td>
<td></td>
</tr>
<tr>
<td>$3,400.00</td>
<td>10%, 10%, and 10%</td>
<td></td>
</tr>
<tr>
<td>$1,000.00</td>
<td>8%, 5%, and 3%</td>
<td></td>
</tr>
<tr>
<td>$6,700.00</td>
<td>12%, 18%, and 2%</td>
<td></td>
</tr>
</tbody>
</table>

No. Right______

No. Wrong_____
PERCENTAGE OF INCREASE OR DECREASE

DIRECTIONS: Determine the amount of increase or decrease in each of the following problems.

1. 1972 sales were $4,000. 1973 sales were $9,000. What is the amount of increase?

   Dollar
   Amount of
   $_________ Increase

2. 1973 sales were $7,500. 1974 sales were $1,200. What is the amount of decrease?

   $_________

3. January sales were $14,500. February sales were $17,000. What is the amount of increase?

   $_________

4. 1974 sales were $8,999. 1975 sales were $9,550. What is the amount of increase?

   $_________

5. March sales were $20,000. April sales were $18,500. What is the amount of decrease?

   $_________

DIRECTIONS: Determine the percentage of increase or decrease in each of the following problems.

6. 1971 sales were $2,000. 1972 sales were $3,900. What is the percentage of increase?

   __________ %

7. November sales were $4,800. December sales were $6,700. What is the percentage of increase?

   __________ %
8. 1974 sales were $35,000. 1975 sales were $30,000. What is the percentage of decrease?


9. August sales were $7,200. September sales were $4,500. What is the percentage of decrease?


10. 1975 sales were $89,000. 1976 sales were $98,000. What is the percentage of increase?


No. Right____
No. Wrong____
APPENDIX E

The mathematical pretest and posttest are included in Appendix E. The pretest was administered to all students during the first week of the semester. The posttest was administered after students completed all course assignments.
BUSINESS MATHEMATICS PRETEST

1. Convert the following percentages to the decimal equivalent.
   a. 86% is _______
   b. 44.5% is _______
   c. 13.7% is _______

2. Convert the following decimals to a percentage.
   a. .25 is _______
   b. .336 is _______
   c. .754 is _______

3. Determine the complement when given the following percentages.
   a. The complement of .25 is _______.
   b. The complement of .37 is _______.
   c. The complement of .334 is _______.

4. Round off the following numbers to two places.
   a. .344 becomes _______
   b. .3684 becomes _______
   c. .5449 becomes _______

5. Convert the following fractions to the decimal equivalent.
   a. 1/2 becomes _______
   b. 1/5 becomes _______
   c. 5/9 becomes _______
6. Determine the net amount for the following invoice amounts.

<table>
<thead>
<tr>
<th>Invoice Amount</th>
<th>Terms</th>
<th>Net Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $3,000</td>
<td>2/10, N/30</td>
<td></td>
</tr>
<tr>
<td>b. $1,653</td>
<td>1/10, N/30</td>
<td></td>
</tr>
<tr>
<td>c. $3,362</td>
<td>3/10, N/30</td>
<td></td>
</tr>
</tbody>
</table>

7. Find the sale price when the original price and the discount are given.

<table>
<thead>
<tr>
<th>Original Amount</th>
<th>Discount</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $80</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>b. $35</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>c. $47</td>
<td>18%</td>
<td></td>
</tr>
</tbody>
</table>

8. How much did the following salesmen receive in commission?

<table>
<thead>
<tr>
<th>Sales Rate</th>
<th>Commission</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Joe Barnes $25,000 5%</td>
<td></td>
</tr>
<tr>
<td>b. Bill Bates $37,000 3.5%</td>
<td></td>
</tr>
<tr>
<td>c. Jolly Green $13,500 2.5%</td>
<td></td>
</tr>
</tbody>
</table>

9. Using the Cost method of markup determine the selling price for the following:

<table>
<thead>
<tr>
<th>Cost</th>
<th>Rate of Markup</th>
<th>Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $12.00</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>b. $20.00</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>c. $37.00</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>d. $43.00</td>
<td>15%</td>
<td></td>
</tr>
</tbody>
</table>
10. Using the Retail of markup determine the selling price for the following:

<table>
<thead>
<tr>
<th>Cost</th>
<th>Rate of Markup</th>
<th>Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8.00</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>$3.00</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>$34.00</td>
<td>30%</td>
<td></td>
</tr>
</tbody>
</table>

11. Determine the amount of interest for the following loan amounts.

a. A $1,000 loan at 8% for 1 year

b. A $1,350 loan at 9 1/4% for 175 days

c. A $4,040 loan at 12% for 195 days

12. Determine each department's dollar share of overhead expense.

a. Total overhead expense is $11,000. The shoe department's percentage of overhead expense is 25%. What is the shoe department's dollar share of overhead expense?

b. Total overhead expense is $11,000. The handbag department's percentage of overhead expense is 30%. What is the handbag department's dollar share of overhead expense?

c. Total overhead expense is $11,000. The dress department's percentage of overhead expense is 45%. What is the dress department's dollar share of overhead expense?
13A. Total sales for the XYZ company are $300,000. Total overhead expense is $30,000. What is the amount of the expense factor?

Answer

13B. Total sales for 1975 for Bill's Clothing Store are $120,000. Overhead expense is $20,000. If the shoe department's sales are $35,000, what is their share of overhead expense?

Answer

13C. Total sales for 1975 for Millie's Dress Shop are $40,000. Overhead expense is $5,000. If the shoe department's sales are $15,000, what is their share of overhead expense?

Answer

14. Determine the net or wholesale price when given the following information.

<table>
<thead>
<tr>
<th>Original Price</th>
<th>Discounts</th>
<th>Net or Wholesale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $3,000</td>
<td>5 - 5 - 2</td>
<td></td>
</tr>
<tr>
<td>b. $2,350</td>
<td>10 - 10</td>
<td></td>
</tr>
<tr>
<td>c. $1,730</td>
<td>15 - 10 - 3</td>
<td></td>
</tr>
</tbody>
</table>

15. Determine the difference and the percentage of increase or decrease when given the following information.

<table>
<thead>
<tr>
<th>1975</th>
<th>1974</th>
<th>Amounts of Difference</th>
<th>Percentage of Increase or Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $12,000</td>
<td>$9,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. $13,000</td>
<td>$16,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. $75,000</td>
<td>$60,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
BUSINESS MATHEMATICS POSTTEST

1. Convert the following percentages to the decimal equivalent.
   a. 83% is ____________.
   b. 45.5% is ____________.
   c. 12.5% is ____________.

2. Convert the following decimals to a percentage.
   a. .35 is ____________.
   b. .332 is ____________.
   c. .478 is ____________.

3. Determine the complement when given the following percentages.
   a. The complement of .15 is ____________.
   b. The complement of .27 is ____________.
   c. The complement of .335 is ____________.

4. Round off the following numbers to two places.
   a. .345 becomes ____________.
   b. .3789 becomes ____________.
   c. .4513 becomes ____________.

5. Convert the following fractions to the decimal equivalent.
   a. 1/4 becomes ____________.
   b. 1/8 becomes ____________.
   c. 3/7 becomes ____________.
6. Determine the net amount for the following invoice amounts.

<table>
<thead>
<tr>
<th>Invoice Amount</th>
<th>Terms</th>
<th>Net Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $2,000</td>
<td>2/10, N/30</td>
<td></td>
</tr>
<tr>
<td>b. $1,554</td>
<td>1/10, N/30</td>
<td></td>
</tr>
<tr>
<td>c. $2,342</td>
<td>3/10, N/30</td>
<td></td>
</tr>
</tbody>
</table>

7. Find the sale price when the original price and the discounts are given.

<table>
<thead>
<tr>
<th>Original Amount</th>
<th>Discount</th>
<th>Sale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $90</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>b. $45</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>c. $28</td>
<td>18%</td>
<td></td>
</tr>
</tbody>
</table>

8. How much did the following salesmen receive in commission?

<table>
<thead>
<tr>
<th>Sales</th>
<th>Rate</th>
<th>Commission</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Joe Barnes $20,000</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>b. Bill Bates $36,000</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>c. Jolly Green $12,500</td>
<td>2.5%</td>
<td></td>
</tr>
</tbody>
</table>

9. Using the Cost method of markup determine the selling price for the following:

<table>
<thead>
<tr>
<th>Cost</th>
<th>Rate of Markup</th>
<th>Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $15.00</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>b. $10.00</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>c. $22.00</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>d. $42.00</td>
<td>15%</td>
<td></td>
</tr>
</tbody>
</table>
10. Using the Retail method of markup determine the selling price for the following:

<table>
<thead>
<tr>
<th>Cost</th>
<th>Rate of Markup</th>
<th>Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$7.00</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>$4.00</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>$28.00</td>
<td>40%</td>
<td></td>
</tr>
</tbody>
</table>

11. Determine the amount of interest for the following loan amounts.

<table>
<thead>
<tr>
<th>Loan Amount</th>
<th>Interest Rate</th>
<th>Interest Duration</th>
<th>Interest Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000</td>
<td>8%</td>
<td>1 year</td>
<td></td>
</tr>
<tr>
<td>$1,350</td>
<td>9 1/2%</td>
<td>165 days</td>
<td></td>
</tr>
<tr>
<td>$3,020</td>
<td>11%</td>
<td>195 days</td>
<td></td>
</tr>
</tbody>
</table>

12. Determine each department's dollar share of overhead expense.

a. Total overhead expense is $12,000. The shoe department's percentage of overhead expense is 20%. What is the shoe department's dollar share of overhead expense?

Answer

b. Total overhead expense is $12,000. The handbag department's percentage of overhead expense is 25%. What is the handbag department's dollar share of overhead expense?

Answer

c. Total overhead expense is $12,000. The dress department's percentage of overhead expense is 55%. What is the dress department's dollar share of overhead expense?

Answer
13A. Total sales for the XYZ company are $200,000. Total overhead expense is $30,000. What is the amount of the expense factor?

**Answer**

13B. Total sales for 1975 for Bill's Clothing Store are $130,000. Overhead expense is $30,000. If the shoe department's sales are $45,000, what is their share of overhead expense?

**Answer**

13C. Total sales for 1975 for Millie's Dress Shop are $80,000. Overhead expense is $10,000. If the shoe department's sales are $25,000, what is their share of overhead expense?

**Answer**

14. Determine the net or wholesale price when given the following information.

<table>
<thead>
<tr>
<th>Original Price</th>
<th>Discounts</th>
<th>Net or Wholesale Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $2,000</td>
<td>10 - 10</td>
<td></td>
</tr>
<tr>
<td>b. $1,850</td>
<td>5 - 5 - 2</td>
<td></td>
</tr>
<tr>
<td>c. $2,350</td>
<td>15 - 10 - 3</td>
<td></td>
</tr>
</tbody>
</table>

15. Determine the difference and the percentage of increase or decrease, when given the following information.

<table>
<thead>
<tr>
<th>1975</th>
<th>1974</th>
<th>Amount of Difference</th>
<th>Percentage of Increase or Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $10,000</td>
<td>$8,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. $12,000</td>
<td>$19,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. $85,000</td>
<td>$70,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX F

Scores for all students are included in Appendix F. Numbers from one to forty-six are used to identify students in the lecture-demonstration group. Numbers forty-seven to ninety-one are used to identify students in the computer-assisted group.
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The explanatory letter, response form, and summary of computer programs sent to the seven panel members who were asked to establish validity for the mathematical pretest and posttest are included in Appendix G.
Dear

During the Spring semester, 1976, I will be conducting research with computer-assisted instruction in practical mathematics for office machines students.

In order to conduct my study, I have found it necessary to validate the enclosed achievement pretest and posttest. Seven people will be asked to serve as panel members to evaluate the instruments. Would you serve as a member of this panel?

If so, please examine each test and indicate whether you think the test will adequately determine whether a student can work problems in the mathematical areas involved in this study. I have enclosed a summary of program content for the fifteen topics under examination to help you evaluate the pretest and posttest. It is important that you indicate yes or no for each test.

In order to maintain anonymity for each panel member, please do not sign the evaluation sheets. A prompt return on your evaluation will certainly be appreciated. If you prefer not to serve as a panel member, please indicate below and return the material to me promptly so that I might choose another judge.

Sincerely,

Robert Hughes

jw

Enclosures

I prefer not to serve as a panel member.
PRETEST

Will this test adequately determine whether a student can correctly work problems in the mathematical areas under evaluation in this experimental study?

Yes  No

POSTTEST

Will this test adequately determine whether a student can correctly work problems in the mathematical areas under evaluation in this experimental study?

Yes  No
COMPUTER-ASSISTED INSTRUCTION IN APPLIED MATHEMATICS
FOR OFFICE MACHINES STUDENTS

INTRODUCTION--Fifteen computer programs or packages have been developed to aid instruction in office machines. The explanations contained in the programs are designed to help the student understand the concept involved. An example stressing the business application involved is available to further illustrate the mathematical idea. Problems are selected on a random basis which provides the student with a different set of problems each time he works through the computer package.

Students are given two chances to work each problem. If they obtain a correct answer the first time, the computer responds with positive reinforcement. If the student arrives at an incorrect response, he is given a second chance. If after two attempts, the student cannot obtain a correct answer, the computer responds with the correct response and an explanation of how to work the problem. At the conclusion of the program, the computer informs the student of the number of problems he attempted and the number that he answered correctly. Average time per computer program is approximately eight minutes.

PERCENTS TO A DECIMAL--Two methods are presented to the student in this program. One method involved dropping the percent sign and dividing the number by 100. A second method, which consists of moving the decimal two places to the left and dropping the percent sign, is also presented.

DECIMALS TO A PERCENT--Two methods are presented to the student. The first method involves taking the decimal, multiplying by 100, and adding a percent sign. The second method consists of moving the decimal two places to the right and adding a percent sign.

COMPLEMENT--The material for complement explains the rationale of why a complement is sometimes easier to use than a discount. One basic rule (100 PERCENT - DISCOUNT = COMPLEMENT) is included in the explanation. A detailed example is included to illustrate the concept.

ROUND OFF--The S/4 round off is illustrated in this package. In addition to the rationale for rounding off numbers, the following rule needed for rounding off numbers is included in this package. The basic rule included is:

When rounding off decimals, consider the number to the right of the last digit to be retained. If this digit is 5 or more, add 1 to the previous digit, if the number is 4 or less, drop it.
FRACTIONS TO A DECIMAL--Students are shown how to convert a common fraction to a decimal by dividing the NUMERATOR (top number) by the DENOMINATOR (bottom number).

CASH DISCOUNTS--The most common cash discounts are examined. Each term in the cash discount is defined. In addition, the rationale of why a firm grants a cash discount receives major emphasis in this program.

MARKDOWN--A three step procedure is given students in this program. The steps involved in markdown are: (1) Change the markdown percentage to a decimal; (2) Multiply the decimal equivalent by the original price; (3) Subtract the amount of markdown from the original amount.

COMMISSION--This package explains the type of workers who receive compensation on a commission basis. Commission is determined by multiplying the dollar amount of sales by the commission percentage.

COST MARKUP--In addition to background information, two steps are used to explain cost markup. The first step is: Original Cost X Markup Percentage = Markup Amount. The second step is: Original Cost + Markup Amount = Sales Price.

RETAIL MARKUP--A two step procedure is used to explain retail markup. The first step is to determine the complement of the markup percentage. The second step is to divide the original cost by the complement.

SIMPLE INTEREST--The basic formula, Interest = Principal X Rate X Time, is used to explain simple interest. Special emphasis is given to the factor of time (i.e. days, months, and years).

DISTRIBUTION OF EXPENSE--The problem of determining each department's share of indirect expense is explained by allocating the expense on the basis of each department's square footage.

PRORATION--The problem of determining each department's share of indirect expense is explained by obtaining an expense factor (Total Expense divided by Total Sales). The expense factor is multiplied by departmental sales to arrive at each department's share of expense.

SERIES DISCOUNT--Both the discount method and the complement method of working with series or trade discounts are explained in this package. Students are given the catalog or retail sales price and the discounts. They must determine the net price or wholesale price.

PERCENTAGE OF INCREASE OR DECREASE--A three step procedure is used to determine the percentage of increase or decrease. The steps are: (1) Determine the amount of change; (2) Divide the amount of change by the previous period amount; (3) Convert the decimal answer to a percentage.
BIBLIOGRAPHY

Books


Articles


Unpublished Material


