R E P O R T R E S U M E S

ED 010 504 05

SELF-INSTRUCTIONAL MATERIAL IN BASIC MUSIC THEORY FOR ELEMENTARY TEACHERS.

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REPORT NUMBER CRP-2529 PUB DATE JAN 67
REPORT NUMBER BR-5-0210
CONTRACT OEC-5-10-007
EDRS PRICE MF-$0.09 HC-$1.80 45P.

DESCRIPTORS- *PROGRAMED TEXTS, PROGRAMED INSTRUCTION, MUSIC EDUCATION, *CURRICULUM ENRICHMENT, STUDENT TEACHERS, COMPARATIVE ANALYSIS, CONVENTIONAL INSTRUCTION, ELEMENTARY EDUCATION, COURSE ORGANIZATION, *MUSIC THEORY, *AUTOINSTRUCTIONAL AIDS, *TEACHER EDUCATION, LAWRENCE, KANSAS

A PROGRAMED TEXTBOOK IN MUSIC THEORY WAS DEVELOPED FOR A MUSIC COURSE REQUIRED OF STUDENTS PREPARING TO BE ELEMENTARY TEACHERS. FIVE DIFFERENT GROUPS OF STUDENTS, OVER A PERIOD OF FIVE SEMESTERS, WERE GIVEN VARYING KINDS OF INSTRUCTION TO EVALUATE MATERIALS FOR THE TEXTBOOKS. GROUP 1 RECEIVED FACE-TO-FACE INSTRUCTION IN MUSIC THEORY BUT NO PROGRAMED INSTRUCTION. GROUP 2 USED A TENTATIVE PROGRAM AND PARTICIPATED IN REVISING AND REARRANGING IT. GROUP 3 USED THE PROGRAM AND RECEIVED NO FACE-TO-FACE INSTRUCTION. GROUP 4 PARTICIPATED IN FURTHER REVISION OF THE MATERIAL. GROUP 5 USED THE FINAL VERSION OF THE PROGRAM AND RECEIVED NO FACE-TO-FACE INSTRUCTION. ANALYSIS INDICATED THAT GROUP 2 ACHIEVED MORE THAN ANY OF THE OTHER GROUPS. CONTINUAL OBSERVING, REVISING, AND TESTING APPEARED TO RESULT IN EFFICIENCY AND ENJOYMENT FOR THE TEACHER TRAINEES. GROUP 5 LEARNED AS MUCH MUSIC THEORY AS GROUP 1 AND ACCOMPLISHED THEIR LEARNING IN LESS TIME. (GD)

(5-0210)

FINAL REPORT

Project No. 2529

Contract No. OE-5-10-007

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January 1967

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

SELF-INSTRUCTIONAL MATERIAL IN BASIC MUSIC THEORY FOR ELEMENTARY TEACHERS.

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Genevieve Hargiss

January 1967

The research reported herein was performed pursuant to a contract with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

The University of Kansas

Lawrence, Kansas

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ACKNOWLEDGEMENTS

The writer wishes to express appreciation to Dr. Kenneth E. Anderson, Dean of the School of Education of the University of Kansas, for administrative approval and encouragement without which this project would not have been undertaken; to Dr. Marcus E. Hahn, Chairman of the Department of Music Education, and Dr. E. Thayer Gaston, Professor of Music Education, for counsel regarding the many problems which inevitably arose; and to Mrs. Mildred Zimmerman who was an extraordinary teaching and research assistant.

The product of the research is a programed textbook entitled Music Theory for Elementary Teachers. We are indebted to Dr. Otis Simmons and Miss Penny Emery for the hand-drawn notation in the manuscript, to Mrs. Betty Hagerman who supervised the typing and duplicating of the manuscript during a two-year period of continual revision, and to the five different groups of students, about 400 in all, who showed us how to make a book that will teach music theory to people like themselves.

G. H.

SELF-INSTRUCTIONAL MATERIAL IN BASIC MUSIC THEORY FOR ELEMENTARY TEACHERS

Introduction

Music can help to fulfill the needs of children, but unless music is included as part of the learning experiences in elementary classrooms, its contribution will not be fully realized. If elementary schools are to have adequate programs of music education for all children, the classroom teachers must actively participate in music teaching. Many of them lack competency in this area.

Teacher-training institutions have recognized the problem and have provided courses in music for students preparing to be elementary teachers. Traditionally, these courses have been fundamentals of music followed by methods of teaching music. Instruction has usually been given in class meetings devoted to lectures, demonstrations, and discussion.

At the University of Kansas in 1958, a study was undertaken to determine (a) what specific learning experiences contribute most to elementary music-teaching competency; (b) how the particular learning processes of acquiring music skills and knowledge of basic music theory (sometimes called "fundamentals") can best be stimulated, guided, and accelerated; (c) how skills and theory can be kept musically meaningful, perceived by the students as integral aspects of their total competency; and (d) how the learning experiences can best be organized in a one-semester course. The parts of the study which had to do with the acquisition of music skills and learning basic music theory were carried out under controlled conditions, and the resulting sets of objective data were tested for significance by analysis of variance and covariance (10).

The study confirmed that music-teaching competency depends to a great extent upon possession of simple music skills and knowledge of basic music theory. It also confirmed that the ability to perceive tonal relationships, essential to musical insight, is most easily and rapidly developed when hearing, sight, and touch are employed together, the senses reinforcing one another. The piano keyboard, because it provides a space frame for tonal relationships, makes possible this multisensory perception with the result that music theory, which is not in itself music, has musical meaning. This is consistent with the conclusion of Hebb (11) that conceptual learning has an understructure of sensorimotor learning.

In the musical training of elementary teachers at the University of Kansas, music skills, basic music theory, and methods of teaching elementary classroom music are not separated. A single course, carrying

three semester-units of credit, is organized in the following manner. All students enrolled in the course, usually numbering from 80 to 90, meet in one large class for lectures and demonstrations of elementary music-teaching methods; they are divided into groups of not more than 20 for discussion and for practice in adapting methods to their own individual personalities and abilities; they also meet in laboratory groups of not more than 10, each student at a piano, for instruction in playing and singing skills, and in basic music theory with reference to the space frame provided by the keyboard; and each student is scheduled for individual practice and study at a piano.

A survey was made, by means of a questionnaire, to determine the students' attitudes and opinions about the course. The students considered the laboratory sessions to be the most useful part. They recommended that the laboratory time be increased and that the teaching methods be related to the skills the students are able to develop. It was proposed that basic music theory be programed for self-instruction, thus making more time available in the laboratories for teaching music skills. The problem of the present study, then, was to develop a self-instructional program and to test its efficiency.

Related Literature and Research

The Socratic dialogues have been cited as examples of programed instruction, but the modern self-instructional form is attributed to Pressey (16) in the 1930's. It was used successfully in military training programs during World War II, and subsequently for specialized training in industry, before it received much attention from educators generally.

At present, programing is part of an all-out attack on the application of learning theory to educational practice. Skinner (19), basing programed learning upon the principles of immediate and continuous reinforcement, has been perhaps its leading exponent. Piaget (15), while not concerned with programed learning as such, used the method of a logician in developing a theory of intellectual growth. His "stages" of concept formation are directly applicable to step-by-step arrangement of information for programed presentation to learners of various ages. Ausubel's (1) defense of verbal learning is especially pertinent to programing at the college level. He distinguishes between discovery learning and reception learning; both can be meaningful. Meaningfulness depends upon the learner having a set to relate what is learned to an existing cognitive structure. Discovery learning can be too time-consuming for mature learners.

The significance of programed learning is well expressed by Rothwell who says, "The theoretician and the practitioner seem to be in different camps in their approach to learning. Programed learning has possibilities of bringing the two together; it is possible that such joint endeavor will lead to significant improvements in learning situations and increments in the effects of learning." (18)

Music theory is a body of organized, factual knowledge which can be programed; i.e., it can be imparted step by step in logical units. Leonhard warns, however, that "we should be extremely careful about attempts to transfer the results of applied research to musical learning except as a lead to our own experimentation." (14)

Crowder (5) estimates that it usually takes from 100 to 150 hours to program adequately the material to be covered in a one-hour lecture. In his opinion the necessary skills can be learned, but the practical expedients of time and cost usually prevent local school systems and individual teachers from producing programs. However, statements by other authorities imply that teachers, given help and support, are in a uniquely suitable position to develop good programs. Klaw (13) insists that the collaboration between a programer and his test subjects is one of the most significant aspects of programed instruction. He cites Lomoski, president of the Center for Programed Instruction in New York City, as saying that the programer has the privilege of deciding what is to be taught, but the students show him how to teach it. Robinson adds, "Programed instruction must be judged not as it operates alone, but how effective it is when used in conjunction with all of the other appropriate tools." (17)

Many self-instructional programs have now been written for school use. Reviewing the research studies which have compared the efficiency of programed instruction with that of classroom teaching, Klaw (13) reports that in almost every instance students getting programed instruction learned as much as those getting the conventional kind; very often they appeared to learn more, and in less time. There seems to be no question that programed instruction can be effective, but comparisons with conventional methods cannot be generalized because they must reflect the quality of the program which is used and the competence of the particular teacher.

The relative merits of teaching machines versus programed textbooks were investigated by Eigen and Komoski (7). They did not find statistically significant differences. Goldstein and Gotkin (9) reviewed eight other studies of this kind, none of which showed differences in learning. In several, however, there was a significant saving of time in favor of the programed textbooks. Machines may have interest value because they are

a novelty to the students, but this effect soon wears off. Another advantage that has been claimed for the machines is their cheat-proof quality, but cheating is rather pointless when a student is testing himself. Moreover, the research suggests that students who look ahead to some answers may learn as much as those who do not. A programed book is more bulky than the same material prepared for use in a machine but, on the other hand, it is usable in more situations.

Recent and on-going research is concerned with comparing one version of a program with another, and it is attempting to determine just what qualities in a program produce efficient learning. At Temple University, Hough and Revsin (12) tried to identify the factors which influence achievement resulting from programed instruction at the college level. They found that high and low achievers did not differ significantly in regard to verbal ability, attitude toward programed instruction, attitude toward content, nor in personality traits. There were no significant differences in the effects of reinforcement versus no reinforcement. They concluded that motivation as a function of long range goal achievement is the explanation of differences in achievement, and that the quality of a program depends on logical organization of small steps instead of error rate or frequency of reinforcement.

Wendt and Rust (21) carried out a major experiment in transfer of programed learning to performance in a real life situation. In teaching freshmen at Southern Illinois University how to use the library, they combined verbal, pictorial, and performance frames in a program of self-instruction. The pictorial frames were expensive, and the performance frames required the program to be used near appropriate materials to carry out the performance tasks. Nevertheless, this research showed that these two types of frames are very effective in transferring learning to performance in a life situation.

Several research studies dealing with programed instruction in music have been done at Ohio State University. Barnes (2) programed the first five weeks of a course in music fundamentals for elementary teachers. Two classes were taught in the same way, but the students in one class were given the program, in book form, to use outside of class. They achieved significantly more than the students who did not have the book. Other research at the same institution has been directed by Spohn (20). His projects were carried out in music theory classes for music majors and made use of 48 listening booths where successful instruction in the development of aural skills was presented by means of tape recordings.

At the University of Connecticut, Carlsen (3) developed self-instructional programs in melodic dictation consisting of recorded tapes to be used with programed books. He concluded that melodic dictation can be taught better by programed instruction than by the traditional teacher-classroom approach. However, he found no significant difference in the effectiveness of the linear and branching methods of programing.

A comprehensive survey to determine the extent of programed music instruction and to locate centers of activity was made recently by Dallin. He sent a questionnaire to 752 college music departments inquiring about their use of and interest in programed, automated, and self-instructional materials. Replies were received from 444 institutions. Of these, 107 indicated that they were currently using these methods of instruction, and 163 indicated that they planned to do so. He reports further:

> At present programed music instruction is used primarily in conjunction with conventional texts and classroom procedures, not to replace them. The function of programed music texts and tapes is usually supplementary or remedial, though often required. Earlier misapprehensions and overly optimistic expectations about the outcomes of programed instruction have now been replaced by more realistic attitudes. Music teachers generally recognize that the principles of programed learning have many applications and welcome programed texts and recordings as valuable, new resources in teaching music. The development of music programs is still in the pioneering stage, but it is not too early to predict programed instruction will contribute significantly to efficient and effective music teaching in the future. (6)

The Present Study

The underlying purpose of the present study was to increase the music-teaching competency of students preparing to be elementary teachers. Specifically, the project itself had the following objectives:

1. To develop a self-instructional program that would teach functional music theory, thus making more time available for teaching music skills. That the program should take the form of a book to be used at a piano was an assumption based on previous research and on the teaching experience of the initiator of the project.

2. To test the hypothesis that students using the self-instructional program would learn as much music theory as students who received instruction in the conventional way.

3. To revise the program after observing the reactions of students as they progressed through it, trying alternative frames in places where difficulties were apparent.

4. To test the hypothesis that students using the revised self-instructional program would learn more music theory than students who used the first program.

Method

The project was carried out at the University of Kansas in the required one-semester music course for students preparing to be elementary teachers, over a period of five successive semesters. From one semester to another the groups of students were very nearly homogeneous as to age, sex, intelligence, interests, and socio-economic level. Previous knowledge of music theory and degree of musicality were believed to be the important variables.

Before the study was begun, a syllabus of the theory content was prepared. An objective paper-and-pencil test was constructed to cover this content; it consisted of multiple-choice items presented verbally and graphically in print. After administering the test as a try-out, an item analysis was made and only items of positive discrimination value were retained. When the revised test was administered later to another group, it was found to have a reliability of .79 as determined by a product moment correlation of the scores on odd-numbered items with the scores on even-numbered items. Because the test was carefully based on the theory-content syllabus, it could be assumed to have curricular validity. A copy is included as Appendix A to this report.

The Gaston Test of Musicality (8) is also a paper-and-pencil test, but the items are chords and melodies presented by a disc recording. Musicality, as measured by this test, includes ability to differentiate aural musical stimuli and also the ability to relate what is heard to notation on the musical staff. The Gaston test is standardized, with well-established reliability and validity.

The musicality test was given at the beginning of each of the five semesters of the study. The theory test was given as a pretest at the beginning of each semester and again as a posttest at the end of each semester.

Throughout cycles of programing, observing, testing, and revising, attention was given to the following:

1. What size of step is best for presenting various parts of the material?

2. What sequence of presentation is most efficient?

3. Is any of the content ambiguous (or redundant)?

4. In what places should be content be expanded (or reduced)?

5. Which parts of the content are more effectively presented by the linear method of programing, and which by the intrinsic or branching method?

6. Which parts are more effectively presented in verbal frames, which in pictorial frames, and which in performance frames?

7. How often, and where, should self-testing occur?

8. How can the pacing be suited to individual differences at various levels of competency?

9. What should be the extent of each branching route?

Semester-by-Semester Procedure

Fall Semester, 1964, Group I. The project director and her assistant began to program the music theory instruction. The students, however, received only face-to-face instruction in the conventional way. Nothing was said to them, nor to later groups of students, about the fact that they were serving as subjects for an experimental study.

Spring Semester, 1965, Group II. These students were given the tentative self-instructional material. Their reactions were noted and their participation sought in rewording, making additions and deletions, rearranging, and deciding where branching routes were needed. Verbal, pictorial, and performance frames were tried out. By the end of the semester, the first version of the self-instructional program was completed. Copies were duplicated during the summer.

Fall Semester, 1965, Group III. These students used the self-instructional program during their individual study and practice periods.

They received no face-to-face instruction in music theory. The instructional time that previously had been devoted to music theory was used for more teaching of music skills and more relating them to elementary classroom procedures.

Spring Semester, 1966, Group IV. The students used the self-instructional program, but they were asked to participate in revising it. As they progressed through it, they were encouraged to ask questions and to suggest changes, additions, and deletions. They were observed and consulted during their individual study and practice periods, as well as in the laboratories, and their reactions were noted. Copies of the revised self-instructional program were duplicated during the summer.

Fall Semester, 1966, Group V. This was the final semester of the study. The students used the revised self-instructional program and received no music theory instruction from the teacher.

Scores of the groups on the music theory posttest were subjected to analysis of variance and covariance, holding theory pretest scores and musicality scores constant. Significance of the differences between the adjusted mean scores was determined by t tests.

Results

(The raw data and the basic computation tables may be seen in Appendix B to this report.)

The mean scores on the posttest, adjusted statistically to eliminate differences between the groups in musicality and previous knowledge of music theory, are as follows:

Group I	40.8841
Group II	42.4641
Group III	39.3596
Group IV	40.1860
Group V	40.6941

Analysis of variance indicates that there are significant differences between the adjusted means:

Source	df	SS	MS	F	$F_{.01}$
Between	4	413.4120	103.3530	4.90	3.36
Within	397	8,365.7653	21.0725		
Total	401	8,779.1773			Reject H_O

Comparison of the adjusted mean of each group with that of every other group, by t tests, shows just where the significant differences are:

Groups	Difference	t*	df	Probability
I - II	-1.5800	-2.307	156	$<$ .05 (sig.)
I - III	1.5245	2.033	161	$<$ .05 (sig.)
I - IV	.6981	.954	145	$>$ .05 (not sig.)
I - V	.1900	.272	177	$>$ .05 (not sig.)
II - III	3.1045	4.285	157	$<$ .01 (sig.)
II - IV	2.2781	3.283	141	$<$ .01 (sig.)
II - V	1.7700	2.610	173	$<$ .01 (sig.)
III - IV	- .8264	-1.065	146	$>$ .05 (not sig.)
III - V	-1.3345	-1.828	178	$>$ .05 (not sig.)
IV - V	- .5081	- .700	162	$>$ .05 (not sig.)

* In obtaining the t values, the error term is computed separately for each pair of groups.

Discussion

Of particular interest is the achievement of Group II, the first students to participate in revising and rearranging the material. This amounted to having both face-to-face instruction and programed instruction, and these students did better than those in any of the other groups.

Group III was comprised of the students who used the first version of the self-instructional program, and they did not do as well as those in Group I who received face-to-face instruction. The program was predom-

inantly linear, and the students complained that it was time-consuming and uninteresting.

Group IV, the second group of students to participate, did as well as Group I but not as well as Group II. There was not as much for them to do. Their suggestions concerned presenting larger concepts in fewer frames and dispensing with the linear type of programing in some sections of the material. This had to be done, for the most part, by the staff.

Group V used the final version of the program. These students did as well as those in Group I who received face-to-face instruction. More importantly, they spent less time on the study of music theory than did any of the other groups. They also seemed to enjoy their study; there were few complaints, and there was very little confusion.

Conclusions, Implications, and Recommendations

It may be concluded that students at the University of Kansas who are preparing to be elementary teachers can learn as much music theory from the final version of the self-instructional material which has been developed during this project as from face-to-face instruction, and that they can do it in less time. Furthermore, class time can be devoted to other aspects of their music training. However, the results imply that students learn more when they receive both face-to-face instruction and programed instruction than when they receive either alone. It is recommended, therefore, that the two kinds of instruction be given together.

Another conclusion is that linear programing is not always best for intelligent, adult learners. The material developed during this project was first arranged in a linear program with small bits of information in successive frames, each frame calling for an overt response. In parts of the material this was considered by the students to be uninteresting and time-consuming. That it is unnecessary is implied in the results of the present study and confirmed by Colman and Smallwood who, in the preface to their autoinstructional textbook on computer language, make the following statement:

> Traditional applications . . . require students to respond overtly to every new unit of information . . . which is immediately verified in the text. Experiments, particularly by Arnold Roe at UCLA, indicate, however, that under some circumstances, if the overt response and verification are omitted, the result is a program of instruction that is equally effective and significantly more efficient. (4)

There is also consistency here with the findings of Hough and Revsin (12), at Temple University, who found no significant differences in the effects of reinforcement versus no reinforcement and concluded that the quality of a program depends upon the organization of its steps instead of error rate or frequency of reinforcement.

The present study was concerned with music theory as it functions in the acquisition of music skills. The learners were adults with above-average intelligence who, studying music theory at pianos, produced their own feedback stimulated by visual, aural, and kinesthetic perception, and conceptual thinking. Each revision of the material resulted in larger concepts in fewer frames. The students who used the final version made higher scores on the posttest than did the students who used the first version. The better students saved considerable time, and all of them seemed to find their study more interesting. The implication is that these results are due to the following characteristics of the final version. Written responses are still requested in some sections, particularly in the drill sections for students with little or no previous musical experience. Sometimes the response consists of playing and listening. In many places throughout the program, however, intellectual response is assumed; the students are left free to make associations and relate new concepts to old in their own ways. The section on the notation of rhythm is placed late in the program, not because it is considered to be less important, but to allow time and attention to be concentrated first on the more complex concepts of tonal structure. Rhythm, to a greater extent than the other elements of music, is physical stimulation to which the entire body responds. In other words, learning rhythm is not an intellectual exercise, nor can it be programed in a book. The notation of rhythm involves concepts, but they are arithmetical and comparatively simple.

It was found that the students had to be urged to omit parts of the program that they did not need. Implied in this is that making branching directions clear is one of the most difficult aspects of programing.

Finally, but not least, the experience of carrying out this project has given support to the basic premise that the study of music theory is meaningful, musically, only to the extent that it is applied to practice, all along the way. This is just as true when the student has programed instruction as when he receives any other kind. A supplement to the theory material was prepared, which included songs for practice in improvising chorded accompaniments. Although care was taken to use only songs that were believed to be in the public domain, determining this beyond question proved to be very difficult and seemed, finally, to involve more responsibility than an unincorporated individual should assume. Rather than risk inadvertant copyright infringements, the practice supplement was deleted,

and the students were referred for practice to collections of children's songs and folk songs, many of which are published in inexpensive paperback form.

Summary

The problem of this research was to develop a program of self-instruction in music theory for students who are preparing to be elementary teachers. The project was carried out at the University of Kansas, in the music course which is required of these students, over a period of five semesters with five different groups of students designated as Group I, Group II, Group III, Group IV, and Group V, respectively. Group I received face-to-face instruction in music theory but no programed instruction; Group II used a tentative program and participated in revising and rearranging it; Group III used the program and received no face-to-face instruction; Group IV participated in further revision of the material; Group V used the final version of the program and received no face-to-face instruction. Scores of the groups on a music theory posttest were subjected to analysis of variance and covariance, holding theory pretest scores and musicality scores constant. Significance of the differences between the adjusted mean scores was determined by t tests.

Group II, the first students to participate in revising and rearranging the programed material, achieved more than any of the other groups. They received what amounted to both face-to-face instruction and programed instruction.

Group III was comprised of students who had only programed instruction, and they did not do as well as those in Group I who received face-to-face instruction. The early version of the program, which they used, was predominantly the linear type, and they complained that it was time-consuming and uninteresting.

Group IV, the second participation group, did as well as Group I but not as well as Group II. There was not as much for them to do. Their suggestions concerned presenting larger concepts in fewer frames and dispensing with the linear type of programing in some sections of the material. This had to be done, for the most part, by the staff.

Group V used the final version of the program. These students did as well as those in Group I who received face-to-face instruction. More importantly, they spent less time on the study of music theory than did any of the other groups. They also seemed to enjoy their study; there were few complaints, and there was very little confusion.

The continual observing, revising, and testing resulted in an end-product that is efficient and enjoyable for intelligent, adult learners. It is a branching program, some sections of which retain a modified linear form, and it accommodates students with widely varied musical backgrounds. It is to be used at a keyboard in order to realize the contribution of visual, kinesthetic, and aural perception to conceptual thinking. It contains basic rudiments for those students who need them, but the concern is with music theory as it functions in the acquisition of music skills. Theory is applied to practice, all along the way.

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APPENDIX A

MUSIC THEORY PRETEST AND POSTTEST

Directions: This test is composed of 50 items which are to be answered on a separate answer sheet. DO NOT MARK ON THE TEST ITSELF. You are to choose the best answer for each item and blacken the space on the answer sheet which corresponds with your selection. Do not blacken more than one space per item, or you will not receive credit for either one. Use a pencil rather than a pen, as erasures are permitted only if they are complete erasures.

Your score on the test will be the number of items answered correctly. All items count the same, so do not linger too long on the difficult ones. You will have 50 minutes to take the test. If you finish before the time is up, you may leave quietly. Place your answer sheet and your copy of the test on the instructor's table at the front of the room.

1. Which of the following is the best statement about sound?

    1. Sound is vibration.
    2. Sound is perceived by the brain.
    3. Sound is a molecular disturbance called a sound wave.
    4. Sound is a psychological phenomenon.

2. A musical sound (a tone) has four characteristics. Three of these characteristics are duration, loudness, and quality; the other is

    1. Timbre.
    2. Wave form.
    3. Pitch.
    4. Amplitude.

3. On the piano keyboard, an octave is divided into

    1. 8 small intervals .
    2. 10 small intervals.
    3. 12 small intervals.
    4. 16 small intervals.
    5. None of these is correct.

4. The smallest interval in the diatonic tonal system is

    1. An octave.
    2. A whole tone.
    3. A semitone.
    4. A sixteenth.
    5. None of these is correct.

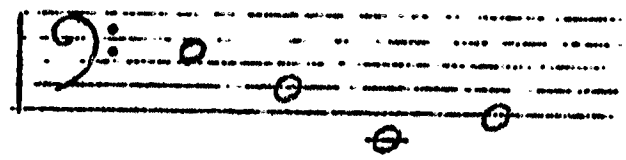
5. How many letters are used in assigning pitch labels to the tones of the diatonic system?

    1. 6
    2. 7
    3. 8
    4. 10
    5. 12

6. Tones are symbolized graphically by notes placed on the lines, and in the spaces between the lines, of the musical staff. The lines and spaces are lettered to correspond with the letter names of tones. The symbol which assigns the letters, and also the pitch register, to the lines and spaces of a staff is called a

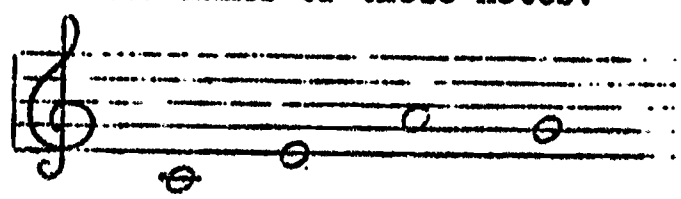
    1. Clef.
    2. Signature.
    3. Score.
    5. Brace.
    6. None of the above is correct.

7. What are the letter names of these notes?



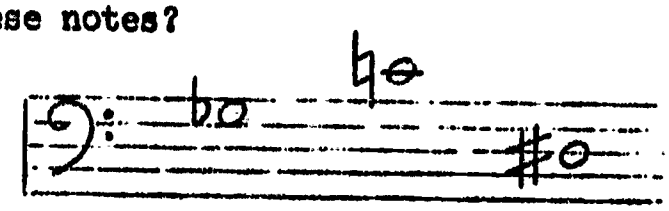
1. C G C E
2. E G E B
3. C B C E
4. E B E G
5. None of these is correct.

8. What are the letter names of these notes?



1. A E A G
2. E G C B
3. C E C B
4. C G A B
5. None of these is correct.

9. What are these notes?

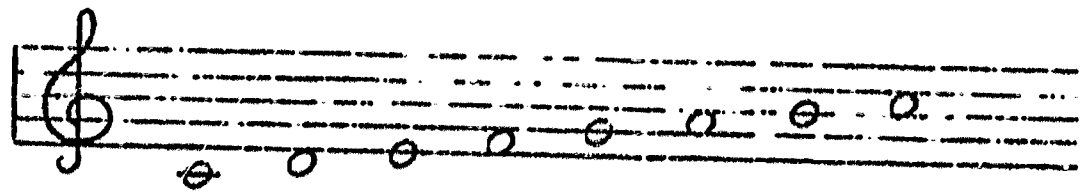


1. G natural, C sharp, D flat
2. E flat, A natural, B sharp
3. E flat, C natural, B sharp
4. G flat, C natural, D sharp
5. G flat, A sharp, D natural

10. A <u>series</u> of tones arranged in pitch order from lowest to highest, or from highest to lowest, is a

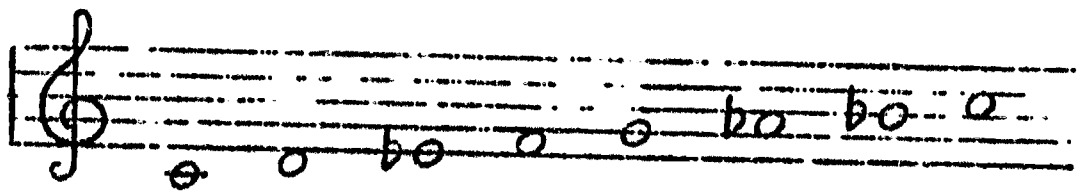
1. Scale.
2. Minor scale.
3. Major scale.
4. Diatonic scale.
5. None of these is correct.

11. What is this?



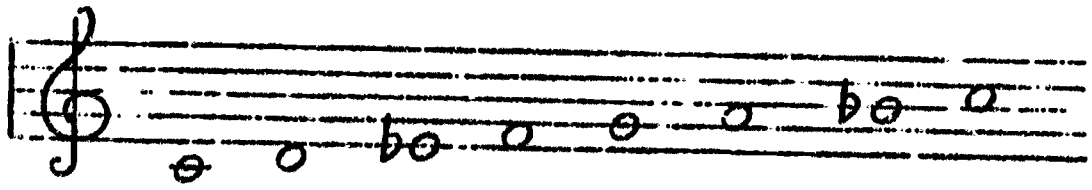
1. Major scale
2. Minor scale
3. Whole-tone scale
4. Chromatic scale
5. None of these is correct.

12. What is this?



1. Major scale
2. Minor scale
3. Whole-tone scale
4. Chromatic scale
5. None of these is correct.

13. What is this?



1. Major scale
2. Minor scale
3. Whole-tone scale
4. Diatonic scale
5. None of these is correct.

14. The intervals between the tones of a diatonic scale are all

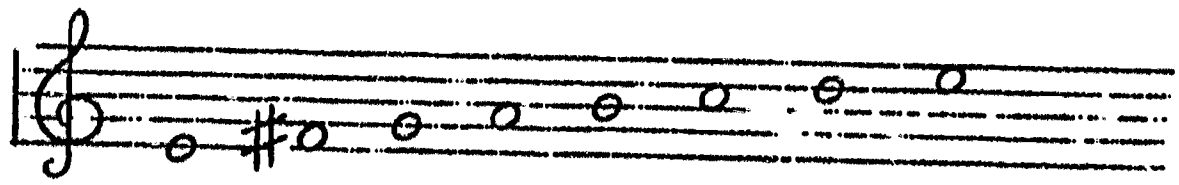
1. Seconds.
2. Thirds.
3. Fifths.
4. Octaves.
5. None of these is correct.

15. The interval between D and the F# above it, is a

1. Second.
2. Third.
3. Fourth.
4. Fifth.
5. None of these is correct.

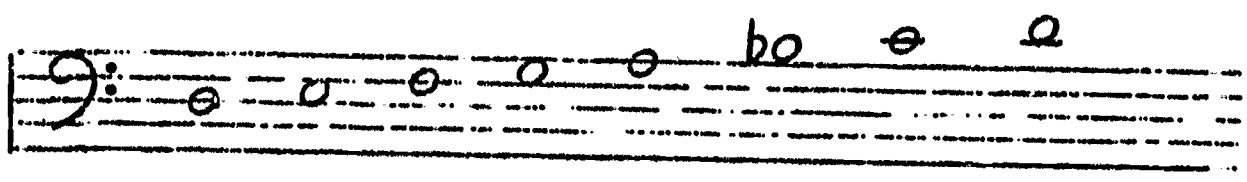
The next four items (16 through 19) are diatonic scales, major or minor. Choose the specific name of each.

16.



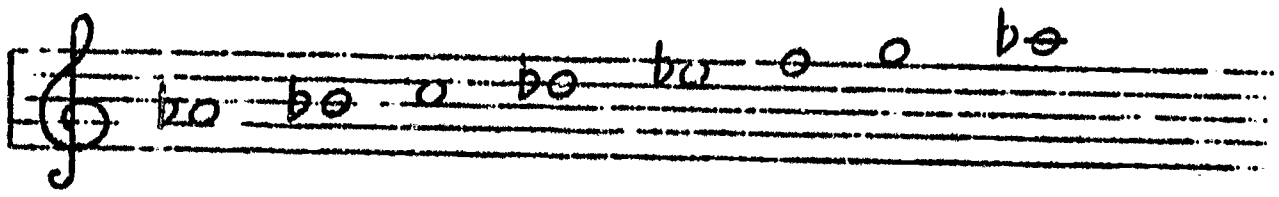
1. G major
2. E major
3. g minor
4. e minor
5. None of these is correct.

17.



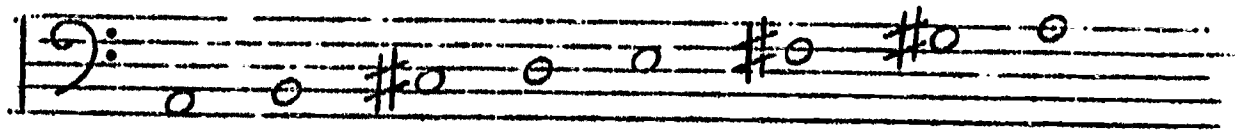
1. d minor
2. B flat major
3. b minor
4. D major
5. None of these is correct.

18.



1. a flat minor
2. B flat major
3. E flat major
4. c minor
5. None of these is correct.

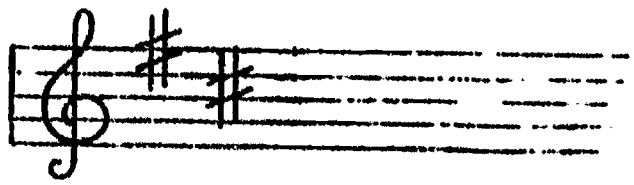
19.



1. A major
2. F major
3. a minor
4. f sharp minor
5. None of these is correct.

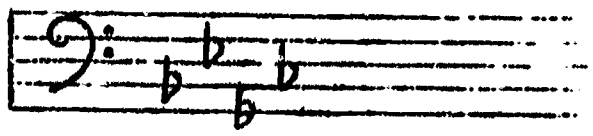
In each of the next five items (20 through 24), the key signature may or may not be correct. It must be placed on the staff correctly and also consist of the right number of sharps or flats. If it is correct, you are to select the pair of keys, major and relative minor, for which it is the signature.

20.



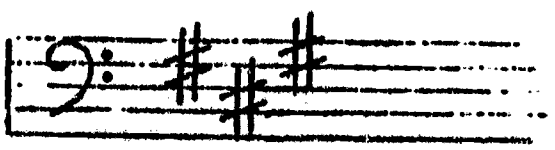
1. D major and f sharp minor
2. G major and b minor
3. B major and d minor
4. D major and b minor
5. None of these is correct.

21.

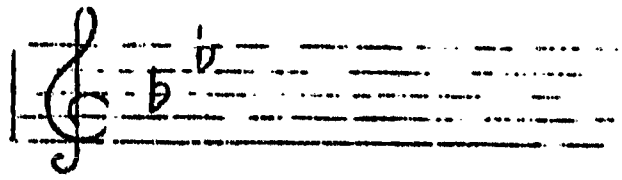


1. B flat major and f minor
2. E flat major and c minor
3. A flat major and f minor
4. A flat major and b flat minor
5. None of these is correct.

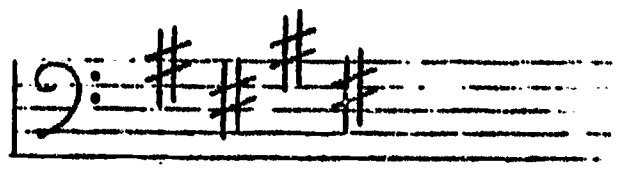
22.



1. F sharp major and a minor
2. E major and f sharp minor
3. A major and e minor
4. A major and f sharp minor
5. None of these is correct.

23. 

1. B flat major and g minor
2. D major and f minor
3. F major and b flat minor
4. E flat major and c minor
5. None of these is correct.

24. 

1. A major and f sharp minor
2. C sharp major and e minor
3. E major and g minor
4. E major and c sharp minor
5. None of these is correct.

25. The altered tone most often used in minor keys (in traditional music of Western Europe and the United States) is

1. Raised four.
2. Lowered four.
3. Raised seven.
4. Lowered seven.
5. None of these is correct.

26. Here are the first measures of The Star-Spangled Banner. What is the altered tone?

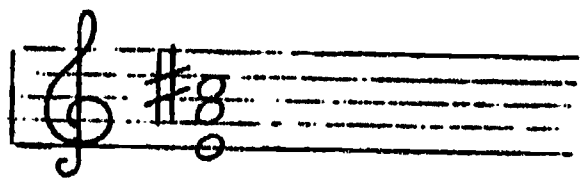
1. Raised four
2. Lowered four
3. Raised seven
4. Lowered seven
5. None of these is correct.

27. The intervals between the tones of chords (before they are inverted) are

1. Seconds.
2. Thirds.
3. Fifths.
4. Octaves.
5. None of these is correct.

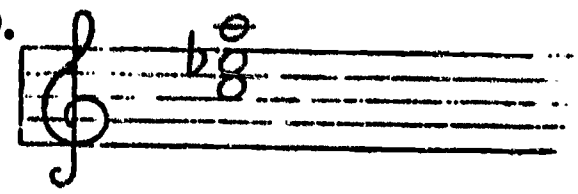
The following ten items (28 through 37) are chords. Choose the specific name of each. Notice the numbering of the items across the page.

28.



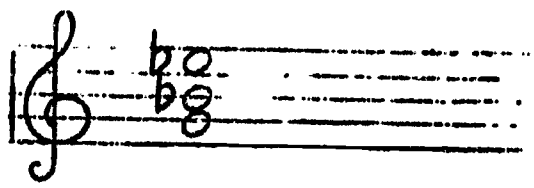
1. E
2. c♯m
3. A
4. E7
5. None of these is correct.

29.



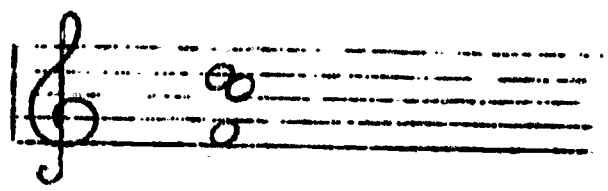
1. A
2. A7
3. e♭m
4. am
5. None of these is correct.

30.



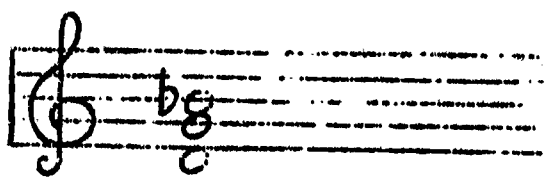
1. B♭
2. g dim.
3. G7
4. E♭
5. None of these is correct.

31.



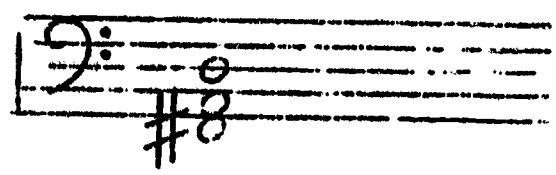
1. D
2. D7
3. F7
4. dm7
5. None of these is correct.

32.



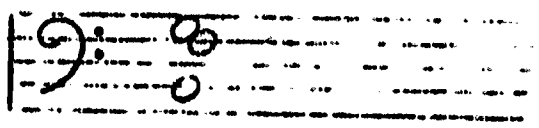
1. gm
2. B♭
3. D7
4. gm dim.
5. None of these is correct.

33.



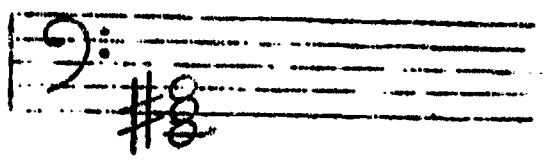
1. bm
2. D7
3. f♯m
4. D aug.
5. None of these is correct.

34.



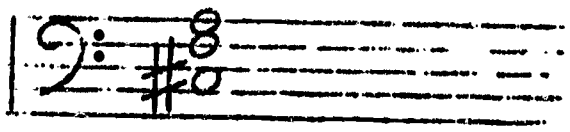
1. G
2. bm$_7$
3. G$_7$
4. gm$_7$
5. None of these is correct.

35.



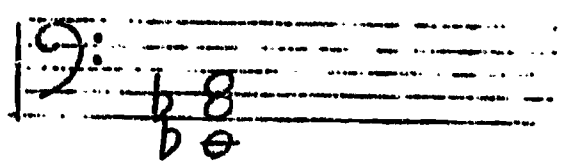
1. g#m
2. E$_7$
3. C aug.
4. E
5. None of these is correct.

36.



1. F
2. F aug.
3. c#m
4. D
5. None of these is correct.

37.



1. a♭m
2. E♭$_7$
3. e♭ dim.
4. A♭
5. None of these is correct.

38. A three-tone chord built on the first tone of a key is called a

1. Tonic triad.
2. Dominant triad.
3. Tonic seventh.
4. Dominant seventh.
5. None of these is correct.

39. A three-tone chord built on the fourth tone of a key is called a

1. Tonic triad.
2. Dominant triad.
3. Tonic seventh.
4. Dominant seventh.
5. None of these is correct.

40. A four-tone chord built on the fifth tone of a key is called a

1. Tonic triad.
2. Dominant triad.
3. Tonic seventh.
4. Dominant seventh.
5. None of these is correct.

41. A part of a melody which stresses the first, fourth, and sixth tones of the key is traditionally accompanied by the

1. Tonic chord.
2. Subdominant chord.
3. Dominant seventh chord.

42. If the time signature is six over four, a half note will have a duration of

1. One-eighth of the measure.
2. One-fourth of the measure.
3. One-third of the measure.
4. One-half of the measure.

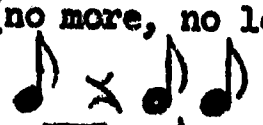
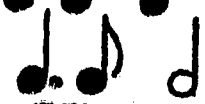
43. If the time signature is four over two, a quarter note will have a duration of

1. One-eighth of the measure.
2. One-fourth of the measure.
3. One-third of the measure.
4. One-half of the measure.

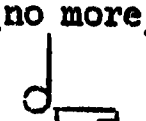
44. If the time signature is six over eight, a dotted quarter note will have a duration of

1. One-eighth of the measure.
2. One-fourth of the measure.
3. One-third of the measure.
4. One-half of the measure.

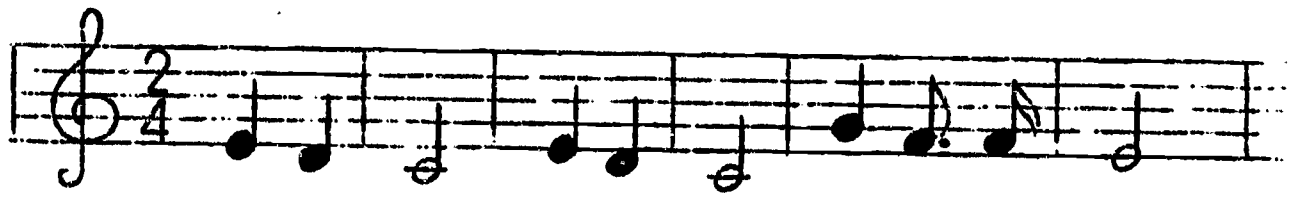
45. If the time signature is two over four, which of the following is one complete measure (no more, no less)?

1. 
2. 
3. 
4. 
5. None of these is correct.

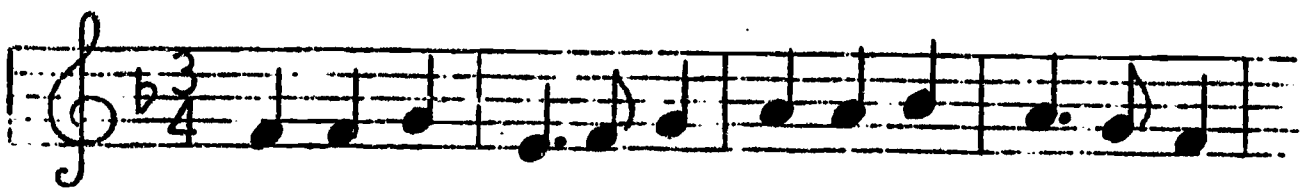
46. If the time signature is four over eight, which of the following is one complete measure (no more, no less)?

1. 
2. 
3. 
4. 
5. None of these is correct.

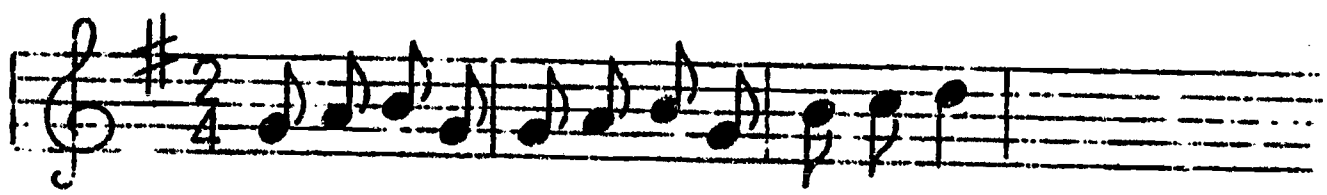
The remaining four items (57 through 60) are notation of the beginning measures of familiar melodies. Select the correct title in each case.

47. 

1. Old Folks at Home
2. Three Blind Mice
3. London Bridge
4. O Susanna
5. Are You Sleeping?

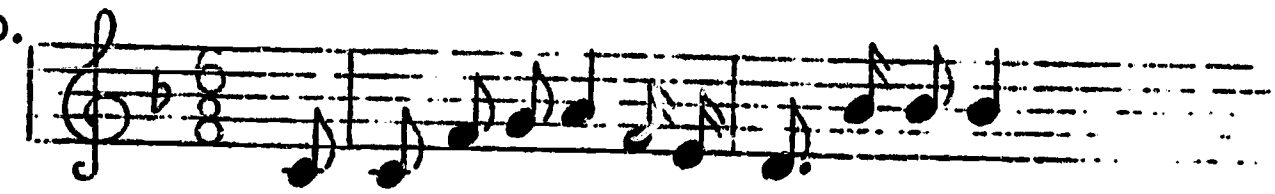
48. 

1. My Country 'Tis of Thee
2. America the Beautiful
3. Dixie
4. Jingle Bells
5. Yankee Doodle

49. 

1. My Country 'Tis of Thee
2. Billy Boy
3. Are You Sleeping?
4. Silent Night
5. Yankee Doodle

50.



1. Are You Sleeping?
2. Home On the Range
3. Clementine
4. Billy Boy
5. Old Folks at Home

APPENDIX B

RAW DATA AND COMPUTATION TABLES FOR ANALYSIS OF VARIANCE AND COVARIANCE

Independent Variables: X = Gaston Test of Musicality
Y = Music Theory Pretest

Dependent Variable: Z = Music Theory Posttest

RAW DATA FOR GROUP I

X	Y	Z	X	Y	Z
47	8	47	37	10	36
35	6	42	46	13	40
53	14	39	52	17	42
35	7	34	52	35	45
51	20	46	38	16	43
44	20	45	52	15	44
50	17	47	39	22	42
46	19	46	49	27	44
33	16	30	31	11	44
38	10	29	42	10	35
44	26	45	54	24	46
43	17	35	42	15	29
38	12	41	51	19	43
48	18	42	47	17	44
47	16	43	47	15	44
48	24	45	41	25	41
48	23	45	47	28	39
45	30	43	49	15	45
23	20	44	32	14	34
41	18	45	44	36	48
39	23	44	34	10	29
34	15	41	50	14	42
42	9	43	41	14	41
37	18	44	42	11	43
46	24	41	41	15	32
46	15	39	39	12	34
48	40	46	36	17	37
56	24	42	31	13	38
45	15	47	56	20	48
45	17	32	50	20	42
39	15	35	51	15	43
45	14	38	40	18	39
43	13	40	45	15	31
52	19	38	53	24	39
47	20	43	55	20	34
38	16	44	38	11	43
41	25	42	48	23	47
55	48	47	46	15	43
40	10	37	48	26	39
42	8	26	46	28	42
37	12	44			

RAW DATA FOR GROUP II

X	Y	Z	X	Y	Z
48	14	43	43	12	45
58	20	47	54	21	46
48	14	44	48	18	37
50	29	41	51	25	45
50	26	48	46	17	44
52	15	43	53	27	47
58	21	47	54	22	48
34	17	46	35	14	43
55	25	41	47	19	45
49	26	46	44	18	38
45	18	42	46	41	47
35	24	45	44	17	44
49	23	46	42	13	47
41	22	43	45	14	48
37	8	30	54	18	45
52	14	42	46	13	44
38	32	42	48	21	48
53	19	33	41	19	44
43	16	34	56	29	50
49	15	48	38	13	34
53	22	46	48	18	42
52	15	45	41	18	40
52	16	47	41	11	42
50	19	44	51	20	44
52	23	44	48	14	45
45	8	41	44	16	42
47	18	36	46	14	42
48	15	42	47	11	42
51	11	33	43	14	43
45	22	44	34	16	33
46	15	42	42	15	47
44	18	46	53	22	46
49	14	45	47	16	29
50	19	37	40	24	43
49	12	45	42	13	40
46	16	46	42	16	44
50	21	48	41	16	38
53	22	45	49	20	41
47	17	44			

RAW DATA FOR GROUP III

X	Y	Z	X	Y	Z
47	21	43	50	27	41
44	18	41	38	9	39
56	19	44	53	22	37
30	14	37	43	16	39
38	8	36	44	20	45
49	19	28	50	11	31
41	25	34	38	17	36
42	27	48	44	18	40
52	41	46	58	12	41
49	14	39	45	26	44
30	13	46	49	23	44
45	13	40	46	19	33
51	26	47	47	19	42
50	29	44	54	19	42
44	17	41	39	21	23
38	10	44	55	41	45
39	7	41	46	14	29
31	14	26	55	23	40
53	25	45	38	18	41
45	19	41	35	17	38
41	20	45	42	33	42
47	18	41	52	22	44
40	14	39	37	26	45
41	14	31	51	15	38
51	20	43	40	17	33
48	21	43	27	17	42
49	14	40	52	48	47
45	17	41	44	20	41
36	15	39	44	17	27
46	16	36	33	14	38
48	18	33	40	20	35
46	20	40	52	19	42
52	17	44	31	18	43
47	21	41	39	17	34
46	17	46	43	17	36
50	23	46	54	38	45
42	19	35	43	15	45
33	20	28	54	25	44
47	17	39	53	35	46
36	8	42	43	17	30
47	14	37	39	23	47

RAW DATA FOR GROUP IV

X	Y	Z	X	Y	Z
48	18	39	59	42	47
47	22	45	41	17	43
46	26	45	52	15	45
43	26	48	35	14	41
29	12	38	40	13	34
40	12	34	42	16	35
48	22	37	58	17	40
39	15	34	43	13	39
48	15	36	42	23	44
31	19	28	41	15	30
46	13	38	51	14	43
34	16	38	37	14	44
36	8	30	30	15	40
54	37	47	48	22	44
45	14	42	43	22	41
48	22	48	33	11	26
52	28	46	48	11	43
37	19	37	46	16	43
46	9	40	46	16	35
45	25	41	40	12	23
49	17	42	52	16	44
50	20	43	45	19	39
37	15	39	51	23	45
46	23	45	56	16	42
40	15	30	49	27	42
45	30	46	43	25	45
49	23	44	44	16	31
36	29	43	46	12	41
50	17	38	46	10	41
23	13	39	32	18	41
37	23	41	47	19	45
47	13	37	52	14	43
43	18	42	43	14	40

RAW DATA FOR GROUP V

X	Y	Z	X	Y	Z
43	12	37	54	22	42
33	11	42	54	21	42
52	18	35	43	11	43
35	3	44	41	20	30
47	16	36	35	11	40
37	29	47	35	17	33
46	14	43	43	26	46
37	15	43	47	18	33
46	17	40	47	15	42
46	26	43	51	11	25
47	35	43	50	25	44
41	4	45	40	14	39
43	16	38	48	17	44
43	17	30	37	3	41
48	15	45	46	26	45
54	17	44	39	14	41
31	17	31	38	8	39
42	17	39	40	15	35
43	15	46	51	24	46
52	14	41	48	17	44
42	13	32	53	22	44
39	13	32	41	22	43
39	10	41	45	33	44
46	15	42	49	13	38
48	16	43	47	17	33
49	16	43	56	16	42
42	7	37	44	29	46
47	17	40	54	33	45
32	11	39	39	22	48
37	7	33	55	31	44
42	18	36	31	18	32
39	11	27	47	19	41
35	12	41	52	21	43
48	20	40	38	25	40
50	21	41	46	17	40
50	35	43	30	17	28
39	4	24	39	5	39
48	11	44	33	11	46
36	20	41	33	20	40
52	17	48	53	23	47
46	28	48	45	15	43
41	18	45	56	23	42
34	15	38	45	19	44
40	7	42	42	20	39
53	27	47	45	19	44
50	18	42	26	13	30
38	17	46	54	36	47
47	30	46	51	16	40
39	12	41	49	19	39

SUMMARY OF BASIC COMPUTATIONS

Group	N	ΣX	ΣX^2	$\bar{X}$	ΣY	ΣY^2	$\bar{Y}$	ΣZ	ΣZ^2	$\bar{Z}$	ΣXY	ΣYZ	ΣXZ
I	81	3,555	159,555	43.89	1,466	30,888	18.10	3,300	136,522	40.74	66,030	60,994	145,744
II	77	3,607	171,251	46.84	1,406	27,966	18.26	3,303	143,161	42.90	66,454	60,922	155,305
III	82	3,652	166,460	44.54	1,607	35,775	19.60	3,254	131,588	39.68	73,300	65,047	145,786
IV	66	2,895	130,231	43.86	1,201	24,477	18.20	2,639	107,395	39.98	53,713	49,227	116,877
V	98	4,299	193,025	43.87	1,723	35,167	17.58	3,959	162,687	40.40	77,633	71,074	174,943
Total	404	18,008	820,522	44.57	7,403	154,273	18.32	16,455	681,353	40.73	337,130	307,264	738,655

BASIC DATA TABLE

Group	N	Σx^2	Σxy	Σy^2	Σyz	Σz^2	Σxz
I	81	3,530.0000	1,688.8888	4,355.2098	1,268.0740	2,077.5555	910.6666
II	77	2,284.1298	591.1168	2,292.8051	610.0779	1,475.1688	578.7532
III	82	3,812.3902	1,729.7073	4,281.7195	1,276.5365	2,459.7560	863.9512
IV	66	3,245.7727	1,032.7727	2,622.4393	1,205.1969	1,874.9848	1,120.8636
V	98	4,439.2755	2,049.5612	4,873.8469	1,468.3163	2,751.4795	1,272.1734
Within		17,311.5682	7,092.0468	18,426.0206	5,828.2016	10,638.9446	4,746.4080
Total	404	17,828.7722	7,146.7722	18,618.5222	5,738.3440	11,137.5915	5,185.5940

ADJUSTED SUMS OF SQUARES

Group	b_1	b_2	$b_1\Sigma xz$	$b_2\Sigma yz$	Σz^2_s
I	.145710	.204727	132.6932	297.5637	1,647.2986
II	.197711	.215111	114.4259	131.2345	1,229.5084
III	.111851	.252951	96.6338	322.9012	2,040.2210
IV	.227623	.369928	255.1343	445.8361	1,174.0144
V	.183014	.224303	232.8255	329.3478	2,189.3062
					(8,280.3486)
Σ within	.171663	.250231	814.7826	1,458.3967	8,365.7653
Total	.197734	.232305	1,025.3682	1,333.0460	8,779.1773

Between = 413.4120

Test for Homogeneity of Variance

The variances of the five groups on the dependent variable are as follows: Group I, 25.6488; Group II, 19.1580; Group III, 29.9970; Group IV, 28.4088; Group V, 28.0763. The resultant standard deviations are: Group I, 5.06; Group II, 4.38; Group III, 5.48; Group IV, 5.33; Group V, 5.30.

A ratio of 1.25 is obtained when the ratio of the largest standard deviation, 5.48, to the smallest standard deviation, 4.38, is computed. According to Lindquist, the ratio of the largest standard deviation to the smallest must exceed 3.00 before there is a noticeable effect on analysis of variance. Therefore, it may be assumed that the variances of the groups are homogeneous.

Test for Homogeneity of Multiple Regression

SUMMARY TABLE

Group	n	n-1	Σz^2_a	S^2	log S^2	(n-1)(log S^2)
I	81	80	1,647.2986	20.60	1.3139	105.1120
II	77	76	1,229.5084	16.18	1.2089	91.8764
III	82	81	2,040.2210	25.19	1.4012	113.4972
IV	66	65	1,174.0144	18.06	1.2567	81.6855
V	98	97	2,189.3062	22.57	1.3536	131.2992
Total	404	399	8,280.3486			523.4703

1. $MS_w = \frac{8,280.3486}{399} = 20.75$

2. log MS_w = 1.3171

3. (399)(1.3171) = 525.5229

4. 525.5229 - 523.4703 = 2.0526

5. χ^2 = (2.3026)(2.0526) = 4.7263

6. χ^2 with α = .05 and df = k-1 = 4 is 9.488

7. Thus, accept H_0.

Test for Significance of Multiple Regression

SUMMARY TABLE

Source	SS	df	MS	F	$F_{.01}$
Regression	2,358.4142	2	1,179.2071	53.86	4.66
Residual	8,779.1773	401	21.8932		
Total	11,137.5915	403			

Reject H_0. There is a significant relationship among the three variables.