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SKILL AND KNOWLEDGE PROFICIENCIES FOR SELECTED ACTIVITIES IN THE REQUIRED PROGRAM AT MEMPHIS STATE UNIVERSITY

by

Andrea Cross Farrow

A Dissertation Submitted to
the Faculty of the Graduate School at
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Approved by

Dissertation Adviser

APPROVAL SHEET

This dissertation has been approved by the following committee of the Faculty of the Graduate School at the University of North Carolina at Greensboro.

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FARROW, ANDREA CROSS. Skill and Knowledge Proficiencies for Selected Activities in the Required Program at Memphis State University. (1970) Directed by: Dr. Rosemary McGee.

The purpose of this study was to construct objective measures suitable for use as proficiency tests in the following courses of the required activity program in Physical Education at Memphis State University: Archery and Bowling, Badminton, Bowling, Golf, and Tennis. Men and women students enrolled in the classes of the respective activities at Memphis State University in the 1969-70 school year were the subjects in this study. The number of subjects for each activity ranged from 144 to 404. Three areas were reviewed in the literature: proficiency testing programs in Physical Education and knowledge and performance tests in the selected activities.

Objective knowledge tests, using a multiple-choice format, were developed for each activity and/or course. Test items from many knowledge tests were used, and some items were constructed for this study. Statistical validity was calculated for each question on the original tests by the Flanagan method. Test questions for the final forms of the examinations had indices of discrimination of .20 or above and difficulty ratings between 10 per cent and 90 per cent. The content and emphasis of each test were based on content balance inventories completed by the instructors teaching each activity. There were forty-five to fifty questions on the final forms of the tests. The reliability coefficients of the final examination, calculated by the Kuder-Richardson formula, ranged from .85 to .91.

Objective skill measures were made in each activity. Direct measures for assessing skill in bowling, archery and golf were used. Objective skill test batteries were constructed for badminton and tennis. The measure used for archery was adapted from the AAHPER skill test manual. Each student shot four ends from ten yards and four ends from twenty yards. The tests given in badminton were the French-Stalter Clear and Short Serve Tests, and the Bounce and Footwork tests; the latter two were constructed for this study. The students bowled six games for the bowling measure. The students in the golf classes all played the same eighteen hole par-three golf course. Measures used in tennis included the Broer-Miller Test, an adaptation of the Timmer Test, the Hewitt Serve Test and the Wisconsin Serve Test. Reliability coefficients were calculated for each measure by the Split-Halves method utilizing the Spearman-Brown Prophecy formula. A reliability coefficient of .80 or above was considered acceptable. Face validity was assumed for the archery, bowling and golf measures. Validity for the badminton and tennis tests were based on a criterion of tournament rankings. A coefficient of .70 or above was considered acceptable. Multiple R's were calculated for the badminton and tennis tests by the Doolittle method. The following were found to be reliable and valid measures for their respective activities: the archery skill measure, badminton batteries consisting of the Clear Test and either the bounce or footwork test, the Tennis batteries consisting of the Wisconsin Serve Test and either the Broer-Miller or Timmer test. The data from the bowling measure indicated that six games were not sufficient to yield a reliable score but that nine games would probably give a reliable score. A cursory examination of the golf data indicated that the scores

were not reliable so the skill measure for golf was dropped from further consideration.

T-scales were developed for each knowledge test and for each reliable and valid skill measure. These scales were designed for use by the Physical Education Department at Memphis State University for deciding the cut-off point (1) for passing or failing in the Credit by Examination Program and (2) for allowing students to enroll in advanced activity courses.

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CHAPTER I

INTRODUCTION

The practice of proficiency testing has become prevalent in college entrance requirements and curricula. Many colleges and universities require students to reach a specific achievement level on national entrance examinations, such as the Scholastic Aptitude Test, the American College Testing Programs and the Preliminary Scholastic Test, before they will consider them for admission. Almost every college and university greets incoming freshmen with batteries of placement tests in English, mathematics, science and languages. Some of these give the student either course credit or ability placement; others find deficiencies which must be made up in remedial course work.

Elements of proficiency testing have been evident in institutions of higher learning in this country since the Pre-Revolutionary Period. The need for and consequent uses of various types of proficiency tests in colleges and universities have expanded as the number of colleges and universities has grown, as the college population has increased, as knowledge in every field has advanced, as the number of fields of learning has multiplied, and as the philosophy of individualized instruction has attained prominence. Proficiency testing has been used most extensively in two areas: admissions and placement.

Admissions

The Hamiltonian philosophy prevailed in higher education in the colonial era. It was thought that only "a relatively small proportion of the population [was] qualified to assume positions of leadership and high service and that, therefore, only [those] should be entitled to collegiate education." (3:60)

Few people availed themselves of a secondary or college education. Most college students came from the New England Latin Grammar Schools which placed great emphasis on religious training. The colleges were founded for religious purposes and were concerned primarily with training students for the ministry. Within the limited scope of their operations, however, the colleges found it necessary to give entrance examinations to ascertain if a student had the acceptable competencies for college admission. All of the examinations were oral, and, because of the nature of the colleges, included only Latin and Greek. They demanded, however, extremely advanced proficiency in these subjects. The requirements for entering Harvard in 1650, typical of the colleges of that time, were stated in the original college laws:

> When any schollar is able to read Tully or such like classical Latine Author ex temporare, and make and speake true Latine prose Suo (ut aiant) Morte, and decline perfectly the paradigmes of nounes and verbes in the Greek tounge, then may hee bee admitted into the Colledge, nor shall any claim admission before such qualifications. . . . (16:251)

College entrance requirements were, for the most part, a reflection of the curricula of the secondary schools from which the colleges drew their students. Consequently, college entrance requirements remained almost the same as they were in 1650, until the academy movement

began in secondary education in about 1810. The academies, influenced by the rising secular forces in society after the Revolution, tried to balance their curricula between the classics and the new fields of science, geography, mathematics, history and English. Many of the colleges were requiring some of these subjects for admission by 1850; however, the classics remained the core requirement until after the Civil War. (16)

Higher education in the post-Civil War period became more diversified. The state universities were founded and grew rapidly. They had greater freedom in developing their curricula because they did not have religious ties. The move toward diversification of the curricula in higher education was greatly implemented by the formation of the land-grant colleges as a result of the Morrill Act of 1862. Entrance requirements became more varied and flexible in this period. Some students who did not meet the entrance requirements were even admitted provisionally. (16)

The Kalamazoo Case of 1874 established the "legality of publicly supported high schools." (16:251) Public secondary education grew rapidly, and the public schools became the primary preparatory institutions for students entering college. This had a momentous effect on college admissions requirements and curricula. This, and the growing social pressures for democracy in education, caused the classics to decline in importance as admission requirements. They were replaced by "English composition, United States history, modern languages, physics, chemistry and mathematics." (16:251)

Increasing numbers of secondary schools began to send students into the colleges and universities. Institutions of higher education found it necessary to evaluate qualitatively the secondary schools from which they drew students. Colleges, universities and state governments began to investigate the secondary schools to ascertain if indeed they were satisfactory college preparatory training institutions. The regional accreditation associations grew from these investigations. The colleges and universities found that it was essential for them, not only to be able to evaluate the secondary schools, but also to be able to evaluate each student's preparation for college work.

The first large scale attempt to evaluate the qualifications of each student for college admission came in New York state in 1878 with the establishment of the "Regents" examination. It was an achievement examination given on a state-wide basis, and its intent was to find out what the student had learned in secondary school and to what degree he was prepared to go on to college. (16)

The Committee on College Entrance Requirements studied the problem of entrance requirements in 1899. From it and the New England Association of Colleges and Preparatory Schools grew the College Entrance Examinations Board in 1902. The CEEB examinations offered students and institutions several advantages over previous testing systems:

1. There was some "uniformity and comparability" of entrance exams for the first time.

2. Exams were offered at several locations; students did not have to travel to the institution of their choice to take entrance exams.

3. They saved the colleges money and time since they did not have to prepare their own examinations. (16)

The CEEB grew in importance in the first quarter of the century, but did not have real control of entrance examinations until about 1925.

In the meantime, the success that the armed forces had with objective testing methods during World War I opened the way for the objectifying of college entrance examinations in the 1920's. Entrance examinations until that time had been completely essay; now objective type questions were added as supplements. The first objective examinations used to any extent were the Thorndike Intelligence Tests and the Cooperative Achievement Tests. Both were introduced in the twenties. (16)

The position of objective and standardized entrance examinations was greatly enhanced when Yale, Harvard and Princeton jointly agreed, in 1941, to use scores from the objective tests of the CEEB and the Scholastic Aptitude Test for admission. They had been using a particular number and pattern of high school courses as the requirement for admission. (16)

College and university enrollments increased tremendously during and after World War II. More people trained in scientific and technical work were needed during World War II for the war industries. College curricula were expanded to take care of this need, and entrance requirements were lowered so more people could be trained. An unprecedented number of applicants requested college admission after World War II as a result of the GI Bill, further increasing enrollments and broadening entrance requirements.

The Jacksonian philosophy of higher education became more dominant in the post-war period. President Truman's Commission on Higher Education expressed this philosophy stating that, "colleges should offer many kinds of courses other than those needed for a few of the higher professions" and suggested that at least one-half of the population could benefit from a college education. (3:62) The Educational Policies Commission, in a 1964 Report, went further:

> Unless opportunity for education beyond the high school can be made available to all, then the American promise of individual dignity and freedom cannot be extended to all. Increasingly those persons who establish for themselves a life of independent dignity are those whose minds have been developed by such education. In the future, the important question needs to be not 'Who deserves to be admitted?' but 'Whom can the society, in conscience and self-interest, exclude?' (3:62-63)

More and more colleges and universities, as the number of applicants has increased, have turned to standardized admissions tests as one basis for their entrance requirements. Three tests of the CEEB are now given widely as qualifiers for college admission: the Scholastic Aptitude Test, the American College Testing Programs and the Preliminary Scholastic Aptitude Test. The SAT is a series of achievement tests in each of the major school subjects, including a writing sample. ACT consists of a battery of tests to measure the student's general educational development in English, mathematics, social studies, and science. PSAT is a test of verbal and mathematical ability; it is often taken by high school juniors preliminary to the SAT. (35)

The number of college age young people is increasing rapidly. Since 1900 the population has increased two and one-half times. The number of students attending high schools has increased thirteen times,

and the percentage of the college age group attending college has increased from four to forty percent. There were over five million college students in 1969, and it is predicted that there will be over ten million in 1975. (45) More young people now have the increased need, desire and financial ability to obtain a greater amount of education beyond high school. (71) Better means of evaluating each student's potential for achievement will be needed as more and more flock to the doors of institutions of higher education and bring wider and wider ranges of abilities.

Placement

Brown and Mayhew have raised the question, "How can colleges and universities be organized to cope with the demands for excellence and the democratic ideal that all should experience college?" (3:108) There was little need to vary the pace of instruction for students of different capacities when comparatively few young people went to college. Today, however, approximately forty percent of the college age group attend college, and it is predicted that eventually seventy percent of Americans will go to college. If this prediction is accurate, the general range of I.Q.'s for college students will be from 89-142. (41) As the American dream of education for all becomes a reality, appropriate provision for those of highest and lowest abilities will be an increasingly persistent and complex problem.

Many colleges and universities for the past forty years have turned to honors programs to help meet the needs of the students in the highest ability group. The first honors program in this country was

started at Swarthmore College in 1921. This program was strongly committed to the upper division students only. The concepts of the Swarthmore program were never popular with the state colleges and universities, but did spread to a number of small private colleges. (4)

The University of Colorado began developing an honors program in the 1930's. This program included both lower and upper division students and stressed an interdisciplinary approach. The establishment of the Inter-University Committee on the Superior Student (ICSS) in 1957, was an outgrowth of the Colorado program. The ICSS's mission was to establish honors programs in colleges and universities all across the country. It emphasized a complete honors program approach: a four year program, general and departmental honors, and different curricula, teaching methods and materials for the honors program. (4) A major problem in this type of honors program is early identification of the superior student. Types of proficiency or competency tests have been used widely to place students in honors programs. The concepts of the ICSS honors program have been accepted widely by both public and private institutions of higher education.

One of the long time major problems of education has been "avoiding duplication in high school and college curricula and providing a continuous sequence between the two institutions." (30:349) The smooth transition from high school to college concerned such groups as the Committee of Ten in 1893, and the 1934 Eight Year Study. Three extensive studies have concluded that the answer is in advanced placement:

(1) The University of Buffalo Study, (2) The Andover Study, and (3) The Kenyon Plan.

The University of Buffalo pioneered in the area of advanced placement in the 1930's. It worked closely with a number of high schools and agreed to give college credit for high school work done past the regular requirements. Examinations for the program were constructed and administered by the University. These examinations were to test whether or not the high school student was actually meeting college standards of achievement. Between 1932 and 1946, 1,496 students took 2,730 of the University advanced placement examinations, and 81 percent received college credit. (30)

From their inception, the advanced placement programs worked to close the gap between secondary schools and colleges by increasing the articulation between the two groups. The School and College Study of General Education, known as the Andover Study, began in the early 1950's. It was a joint effort by three preparatory schools and three universities: Phillips, Exeter and Lawrenceville Academies, and Harvard, Yale and Princeton Universities. The School and College Study of Admission with Advanced Standings, known as the Kenyon Plan, also originated in the early 1950's. Twelve colleges and universities joined in this study. The Andover and Kenyon studies formed a combined Studies Committee in 1954. The Advanced Placement Program now in operation came out of the suggestions from this Committee. It is a program

> in which able students take college-level work while they are in high school. . . . These courses are not what is generally labeled "honors courses". . . . Advanced Placement courses (throughout the country) follow a course outline, select from a bibliography, and have an examination written by a subject matter committee of

> three college and two high school teachers. . . . Most students prepare for the exams by taking an Advanced Placement course in high school. (30:350)

Students do not have to take an Advanced Placement course, however, to be eligible to take the examinations. The Advanced Placement Program is not concerned with college admissions; it is designed for advanced placement and credit in college courses. (30)

The CEEB agreed to administer the Advanced Placement Program in 1955. Examinations are now given in eleven areas: American History, Biology, Chemistry, English, European History, French, German, Latin IV, Latin V, Mathematics, Physics and Spanish. The program has grown rapidly. Participation in the program in its first decade increased from eighteen to 1,681 high schools, from 94 to 765 colleges, from 532 to 21,769 students taking the examinations, and from 959 to 28,762 examinations taken annually. (30)

This program has been praised highly by numerous educators from all disciplines. Lohnes, a German teacher, describes the attributes of Advanced Placement:

> For the first time, a national program has established national standards for college level work done in the secondary schools, thus providing the colleges with a nationally accepted instrument upon which to base their decisions in awarding both placement and credit, and at the same time setting a high standard of achievement for the secondary schools which may well have a far reaching effect upon their entire curriculum. (48:416)

Most educators mention seven different points in their praise of Advanced Placement:

1. It provides for individual differences by allowing "bright students to take courses which challenge their intellectual abilities." (39:22)

2. It prevents bright students from repeating material they had in high school. (63)

3. It has helped to bridge the gap between secondary schools and colleges, two groups "whose ideas and attitudes have at times been diametrically opposed." (48:416)

4. It gives the student "more time for Honors Programs, more opportunity for independent study and more breadth and insight in his total academic complex" and an earlier opportunity to establish lines of communication between his undergraduate and graduate programs. (75:211)

5. It upgrades and enriches the high school program as a whole as the quality in the Advanced Placement courses sifts down through the preliminary courses. (62)

6. It is changing the college curricula in that fewer basic courses are being offered and more advanced and diversified courses are being offered. (18)

7. It is changing the programs for the preparation of teachers. (61)

Our sensitivity to the need for more planning for these superior young people has increased in recent years because of international tensions and scientific advances. We now recognize, more than ever, the urgency to educate a greater number of our very able young people for responsible positions in research and leadership. (33: 215)

A society in which knowledge is doubling every decade cannot afford the luxury, in student or instructional time and effort, of rehashing material with which the student is already familiar. A recent survey of a large number of colleges and universities indicated that fifty-six per cent of the institutions surveyed allowed students to "Exempt-out" of a required course by examination and that thirty per cent of this same group award course credit. (66)

Gerich adequately summarized the Advanced Placement program when he stated, "Through this plan, we have given our more able students

opportunities on the same terms as we have sought to give these to the mentally and physically handicapped and all other minorities in public education." (33:215)

Proficiency Testing in Physical Education

Many college and university Physical Education departments are now moving toward proficiency testing programs because of their desire to individualize programs, and their need to handle increasing enrollments.

Individualizing Programs

Physical educators are indicating increased interest in individualizing programs to meet the needs of the general college student. It has been the general practice in colleges and universities to put students in beginning classes in Physical Education activities. The practice rests on the assumption that a great majority of students entering college have no background or experience in any activity. Physical Education programs are improving in the public schools. Some high schools, especially in major cities, are employing facilities, equipment, programs and methodology far beyond the capabilities of many colleges and universities. Opportunities for and participation in recreational activities outside the schools have increased tremendously in the past few years. The American public spent over eighty-three billion dollars on recreation in 1969. (27) With pre-college Physical Education programs improving and recreational opportunities expanding, the assumption that students have no background or experience in physical activities is no longer tenable. More highly skilled students are emerging

as school programs continue to improve and all types of recreational activities attain increasing popularity.

The skilled student in the required program is not interested in or motivated by participation in a beginning level course. He should have the same opportunity for advanced placement in Physical Education as he has in other fields. The student with a special interest in a physical activity should have the opportunity to pursue that activity past the beginning level the same as he would if his special interest were in some aspect of physics, mathematics, art, music, etc.

Physical Educators have become concerned also about the student who enters college without the basic skills in movement considered necessary before he can be expected to conquer the more complicated movement patterns involved in sports activities. Some colleges and universities are now developing programs of what might be called "deficiency" testing. These programs require all incoming students either to pass a test of basic or fundamental skills or to take a course in this area before they are eligible to take other course work in the department. These programs are similar to the remedial programs offered in many other fields.

The development of proficiency and deficiency testing programs at the college level will greatly enhance the ability of Physical Education departments to meet the needs and interests of students of varying skill levels and abilities.

Increasing Enrollments

A second reason proficiency testing programs are being initiated in many colleges and universities is a practical one; many colleges and

universities do not have the facilities, equipment, and staff available to handle the increasing enrollments. Some institutions are giving proficiency tests in order to exempt the highly skilled from one or more activities rather than to give up entirely their required Physical Education program for the general college student. Some institutions give credit for the course if the student passes the proficiency examination; some exempt the student from the requirement, but give no credit. Some type of proficiency examination is required in either case.

Over fifty Women's Physical Education departments indicated, in a recent survey, that they have some kind of proficiency testing programs; many others indicated that they are in the process of developing proficiency testing programs or are interested in developing them. (101) Wilson, in a survey of the institutions in Washington, Oregon and California, reported an additional eleven colleges and universities with programs. (140) Most of these sixty programs seem to be in the trial and error stages. Few have been reported in the literature and even fewer have been reported in such a way that they would be helpful to someone trying to develop a program. It would seem that some definite information on procedures and evaluation tools would be helpful to many departments trying to develop programs at this time.

Wilson summarized the value of well developed proficiency testing programs in Physical Education:

> Well-designed competency tests can contribute to the development of programs which will provide for each student maximum opportunities for the pursuit of excellence, quality, creativity, critical thinking, enrichment, with increased superior achievement. (76:34)

Proficiency Testing at Memphis State University

The Physical Education Department at Memphis State University is interested in offering the students on its campus the opportunity to "Exempt-out" of courses for which they possess sufficient skills and to advance place students who wish to take intermediate and advanced level courses. The development of a proficiency testing program in the required activities program will greatly enhance the Department's ability to meet the needs and interests of students varying in skill levels and abilities. This program in Physical Education would be a part of the general University program of awarding course credit by examination.

The Memphis State University Bulletin, Catalog Issue 1969-70 states:

> Examinations for credit in courses offered by the University may, under special circumstances, be offered to students who believe they have already mastered the material of the course through private study, technical employment, or the like. (12:110)

The following regulations govern these examinations:

1. Permission to take an examination for credit will be given only in instances where the student has already gained fundamental knowledge of the subject.

2. Permission to take a credit examination must be secured from the instructor of the course, the department chairman, and the dean of the college in which the student is registered.

3. Credit examinations normally will be given in conjunction with the final examination in the course for which credit is sought. The faculty and administrative personnel involved may choose to require a standardized examination instead of the final examination, or in addition to it.

4. Credit for course work earned on an examination basis will not be recorded until the student has successfully completed a more advanced course in the subject with at least a C grade.

5. Credit examinations are indicated on the student's record as P. To pass a credit examination the student must make a grade equivalent of at least a C in the course. Grades on credit examinations will not be used in computing the quality point average.

6. The maximum credit which may be established through credit examination is 15 semester hours with not more than 8 semester hours in one area.

7. Permission to take a credit examination will be granted only to students who are registered for no less than 12 semester hours in residence and who are in good academic standing. (12:110-11)

Regulations 6 and 7 were broadened by the Administrative Council during the Fall of 1969:

> Thirty semester hours may be earned by examination, but no more than 12 semester hours in one area.
>
> All students in good standing, full-time, part-time, or extension may take an examination for credit in any course in the undergraduate curricula. (111)

This appears to indicate an increased interest on the part of the Administrative Council to expand the Examination by Credit program.

The Physical Education Department had indicated that the logical place to begin conducting these examinations is in the required activity program. The most popular courses with the students were recommended for the initiation of the program: Archery and Bowling combination; Badminton, Bowling, Golf, and Tennis. Three of the courses selected were also those in which the Department offered advanced level activity courses. There have been problems concerning eligibility to enroll in these courses and standard placement exams will aid in the solution of these problems. The Physical Education Department at Memphis State University plans to use the proficiency tests developed in

this study both for the Credit-by-Examination Program and for placement in advanced level activity courses.

CHAPTER II

STATEMENT OF THE PROBLEM

The purpose of this study was to construct test batteries suitable for use as proficiency tests in selected courses of the required activity program in Physical Education at Memphis State University.

Limitations of the Study

The scope of this study was limited in the following ways:

Selection of Activities.--The activities selected for study were the five sports most popular with students enrolled in the required activity program at Memphis State University: archery, badminton, bowling, golf and tennis.

Badminton, bowling, golf and tennis were full semester courses at Memphis State University. Bowling was also combined with archery for an additional course in which each was taught for one-half the semester. All activity courses met three hours a week and counted one semester hour of credit.

Selection of Subjects.--Men and women students enrolled in the respective activities at Memphis State University during the Fall of 1969 and the Spring of 1970 were the subjects in this study.

Selection of Performance Measures.--Objective skill measurements were made in each activity. Direct measures for assessing skill

in bowling, archery and golf were chosen instead of objective skill tests. Objective skill tests were used to assess skill in badminton and tennis. The selection of performance tests was limited by a criterion of administrative efficiency in terms of time, equipment, facilities and personnel.

Selection of Knowledge Tests.--Knowledge tests were used to assess knowledge and understanding in the activities. Test items were selected from many knowledge tests, both published and unpublished; some items were also constructed by the writer.

Development of Norms.--Norms were developed for each population in each activity. Both performance and knowledge norms were included for each activity.

The norms will be used for two purposes by the Physical Education Department at Memphis State University:

(1) to decide the cut-off point for passing or failing in the Credit-by-Examination Program, and

(2) to decide the cut-off point for allowing students to enroll in advanced activity courses.

The cut-off points in each activity will be established by the Department of Physical Education at Memphis State University in accordance with University policy.

Definition of Terminology

The following definitions were accepted and employed for the purpose of consistency and understanding;

Proficiency--a pre-determined standard of achievement in skill and/or knowledge which is indicative of the individual's ability to perform adequately.

Proficiency Tests--measures to determine if a student is proficient in an activity. These are generally batteries of skill and knowledge tests.

Proficiency Testing Program--the administration of proficiency tests in one or more activities either to exempt students from a particular activity or to place students in an appropriate skill level group.

Competency--a term synonymous with proficiency.

Advanced Placement--placement of students in courses according to their ability even though they have not had beginning level courses.

Exemption--meeting the requirements for courses without actually taking them by passing a set standard of achievement. Credits and grades may or may not be given for the courses.

Major Student--an undergraduate student majoring in Physical Education. Sometimes referred to as a professional student.

Required Activity Program--a program of one or more physical activity courses required to receive a degree.

Service Program--physical activity courses for students other than Physical Education majors. Sometimes referred to as the general college program.

Skill or Physical Performance Tests--objective tests used to measure skill achievement.

Written or Knowledge Tests--paper and pencil tests which measure knowledge and understanding in an activity.

CHAPTER III

REVIEW OF LITERATURE

Literature in three areas was reviewed for this study: (1) proficiency testing programs, (2) knowledge tests in the selected activities, and (3) performance tests in the selected activities. The proficiency testing program section is divided into (1) surveys of proficiency testing programs, (2) programs for major or professional students, and (3) programs for required activity students. The knowledge tests and performance tests sections are each divided into the criteria for evaluating each test type and the tests found in the literature.

The first sources surveyed were of all the currently published measurement and evaluation books in Physical Education. Only one, Barrow and McGee, mentions proficiency testing. They describe proficiency tests and suggest that the development of proficiency testing programs is a trend in Physical Education.

The reason, perhaps, that the other books do not include anything on proficiency testing is that it is a recent development in Physical Education. This probability was substantiated by the information available in the Physical Education periodicals. All of the reports found on proficiency testing were published in the past eight years. This is not to say that proficiency testing in Physical Education did not exist before that time; some large universities have been

utilizing such programs since the early 1950's. Ewers reported that twenty of the thirty colleges and universities he contacted reported using proficiency testing as a part of their men's Physical Education activity program. (80:6) This survey was made in the early 1960's. It has been only in the past decade, however, that any reports have been made in the literature on the programs that have been developed.

Proficiency Testing Programs

Nelson (55) contributed a basic study to the literature in this area. He sent questionnaires to a number of prominent Physical Educators to determine what proficiencies or competencies Physical Education major students should have. He asked each subject four questions:

1. To what extent should skill testing be required?
2. What skills should be required and at what degree of proficiency should they be tested?
3. Should physical fitness be a part of the testing program?
4. What part should participation in varsity sports, intramurals, clubs, etc., play in the requirement? (55:65)

He reported some specific answers made by various subjects; however, all of these answers appear to be reflected in the six conclusions that he drew:

1. Require performance ability and good teaching methods in the areas of aquatics, dance, game and relays, individual and dual sports, team sports, combatives, gymnastics and adapted activities. The specific activities will be determined by the program in his or her school or geographic area. The performance level should be above average for that of junior and senior high school students in beginning classes, after students have learned that activity.
2. Each student should be a masterful performer, the equivalent of a collegiate team member, in at least one, and preferably more specific sports or activities.

3. Flexibility in meeting minimum standards of performance ability should be allowed, since people have strengths and weaknesses which can be balanced against one another when all of the qualities of good teaching are considered. However, this does not rule out reasonable and versatile physical proficiency in place of good intelligence or a so-called "good personality."

4. Physical fitness should be emphasized and adequately tested.

5. Participation in varsity sports and/or intramural sports should be strongly encouraged and made a part of the requirement.

6. Most of the physical proficiency testing should come within the first two years prior to entering the methods program and student teaching. Testing should occur early enough to plan the student's program of activity, but not be so strict as to prevent a student from getting the required skills and development before graduation. (55:66-67)

Nelson's report suggested some basic philosophy on what a proficiency program should include, what the standards for proficiency should be, how proficiency should be obtained, and how strict the rules should be.

Wilson surveyed eleven colleges and universities on the west coast to investigate the current concepts and practices in proficiency testing for college women majoring in Physical Education. (140) The purposes of the survey were "to ascertain the purposes of the proficiency program . . . to determine for whom it is designed, the devices used for evaluation, the means of administering the program and the use made of the results." (140:1) Wilson found that proficiency tests were being used (1) to screen students for the methods courses and student teaching, (2) to diagnose student's deficiencies and weaknesses, and (3) to exempt students who have had advanced experiences in activities. In some institutions students had to pass proficiency tests as part of particular courses. In others, students were responsible for preparing themselves to pass proficiency tests.

Wilson found that

> The actual types of testing programs in use vary greatly among the institutions and, in some cases, within departments. Both performance and knowledge examinations are used but not all institutions require knowledge tests. In some institutions examinations have been developed for this purpose or existing validated tests are used. In other colleges and universities the personnel who teach the particular sport or dance activity concerned are responsible for administering tests acceptable to themselves. In such institutions and/or activities the tests may vary from one testing period to another depending upon personnel. (140:2)

Wilson found the following:

> Some type of aquatic test is a universal requirement in the eleven institutions. Beyond this it seems that most of the activities common to the junior and senior high school program are tested by at least one-third of the institutions. Fewer schools, less than 37 per cent, involve themselves in a testing program in the more specialized activities. Such results are to be expected since a limited number of students have had opportunities for extensive instruction in activities such as: archery, basic skills, body mechanics, bowling, golf, gymnastics and apparatus, modern dance, recreational games, social dance, track and field and tumbling. These are students who have been enrolled in junior and/or senior high schools which offer a diversified and complete physical education instructional program. Some students will have had extensive participation opportunities through agencies such as camps, playgrounds and private clubs and/or modern dance, recreational games, social dance, softball and track and field. In all probability the institutions reporting testing in these activities are influenced by their availability in the areas from which students come. (140:4)

Wilson found that there was no general order in administering skill and knowledge tests. She suggests that administering knowledge tests prior to skill tests will "simplify the skill testing procedure and decrease both staff and student time." (140:2)

Wilson found four ways in which students were being evaluated on skill: (1) subjective judgments by instructors, (2) objective tests, (3) ratings or certifications and (4) determinations by individuals administering the tests. Approximately twenty-two per cent of the tests were done by the subjective judgments of instructors. One to three

judges were used. Judges had prepared lists of specific elements on which judgments were to be made in most cases. Most subjective ratings were recorded only as pass or fail. Approximately fifteen per cent of the tests were objective. Some standardized tests and some departmentally constructed objective tests were used. Tests from the literature included the Miller badminton test, the Humiston Motor Ability Test, the Scott Motor Ability Test, the Dyer tennis test, the Modified Dyer tennis test, and the Miller-Broer tennis test. Ten per cent of the testing involved ratings or certificates. Two tests of this type were the American Red Cross Certificates in aquatics and the D.G.W.S. official's ratings. About twenty-two per cent of the tests were determined by individual instructors. The type of test or tests given in these situations could vary so from one testing period to another as to make the setting of any kind of standards very difficult. The number of institutions administering skill tests in each activity is listed in Table 1. Tennis and badminton were the activities most frequently included in the programs. Knowledge tests were not used as frequently as skill tests in assessing achievement. The per cent of schools giving knowledge tests in each activity along with skill tests varied from 25 to 100 per cent. The per cent of schools administering knowledge tests along with skill is given in Table 1.

Wilson found that testing sessions were scheduled in a variety of ways. Some institutions gave tests during freshmen orientation periods, some by appointments with individual instructors, some at stated periods during the year and some during specific courses. Wilson found little similarity among practices for administering the tests.

TABLE 1

INSTITUTIONS TESTING SKILL AND KNOWLEDGE
WILSON SURVEY

Activity	Number of Institutions Testing Skill	Knowledge Test Per Cent of Those Testing Skill
Bowling	2	100.0
Tap Dance	1	100.0
Social Dance	3	66.6
Volleyball	5	60.0
Badminton	7	55.5
Golf	4	50.0
Softball	4	50.0
Tennis	7	42.8
Field Hockey	5	40.0
Archery	3	33.3
Basketball	6	33.3
Body Mechanics	3	33.3
Folk and Square Dance	6	33.3
Gymnastics and Apparatus	3	33.3
Soccer--Speedball	6	33.3
Tumbling	3	33.3
Aquatics	3	27.2
Modern Dance	4	25.0

The majority of schools used only faculty, but others paid student help or used students from the tests and measurements courses as test administrators.

Wilson concluded that the colleges and universities investigated generally agreed on the following points:

(1) A proficiency examination program is considered desirable.

(2) the curricular pattern should be designed to provide opportunities for students to improve areas of deficiency as well as to continue study on advanced levels in those situations where a broad program of superior quality permits. For some activities institutions waive requirements when the minimum standard is met.

(3) as enrollments increase, more students will enroll for their first two years in junior colleges. This means that background instruction will be secured there and some accurate means of assessing level of competence will become increasingly necessary to the four year institution. Adequate measuring devices must be developed now. Future students, their high school and junior college faculty need to know what the standards are to be.

(4) the development of adequate measures of proficiency can be a great asset in the education of each student. Time and energy can then be directed to the pursuit of excellence at the level suited to the ability of the individual. Opportunities for taking full advantage of the curricular and noncurricular offerings of the institution will be increased. Each student's educational experience will be one of enrichment, both in breadth and depth, in general education as well as in the area of major concern. (140:12)

The purpose of the Farrow survey (101) was to gain information about proficiency testing programs in Physical Education from selected institutions in the United States. One hundred and six institutions were selected that were thought most likely to have proficiency testing programs. The selections did not include institutions in Washington, Oregon, and California because Wilson had recently surveyed these states. Twenty-three colleges and universities reported proficiency testing programs in their required activity programs; eighteen reported

programs for their professional students, and seven reported programs for both their required and majors' programs. A total of forty-eight colleges and universities reported some type of proficiency testing program. These institutions were asked to fill out a questionnaire on the activities and procedures in their proficiency programs. Nineteen colleges and universities completed questionnaires pertaining to their required activities programs, and eleven colleges and universities completed questionnaires on their majors' programs.

All programs, except one, required the students to take some kind of skill test; most programs also included some kind of knowledge testing. However, more majors' programs than required programs included knowledge tests as a part of the evaluation. There was no pattern to the order in which the types of tests were administered, but more programs required the knowledge tests to be taken first. Most schools having this requirement also required the student to pass the knowledge test before being eligible to take the skill tests.

Institutions giving both skill and knowledge tests indicated several methods of combining these scores to decide if a student passed or failed. Most required the students to make a specific score on each type of test, but some required the students to make a specific score on the two types or tests combined.

Almost all institutions gave proficiency tests on a pass-fail basis. However, several also assigned intermediate or advanced achievement levels as the result of proficiency tests.

Very few specific cut-off points for passing or failing were given, and there was variety in those listed: top thirty to thirty-five

per cent, eighty points or over, eightieth percentile, fifty-fifth percentile, sixtieth T-score, B, B-, and C. Local norms were used exclusively in setting up these scales, except for the A.A.H.P.E.R. Fitness norms and the American Red Cross swimming levels.

The institutions indicated the activities in which they gave proficiency tests. The activities included in two or more programs are listed in Table 2. The listing is divided into the required programs and the professional programs.

Swimming was by far the activity listed most frequently for the required activities programs. It is interesting that the seven activities most frequently listed for the required program were all individual sports. The activities most frequently listed for the majors' programs were badminton, basketball, swimming, volleyball, tennis and softball; these programs showed a greater balance between team and individual activities.

Few institutions indicated that they used any standardized knowledge or skill tests in their testing programs. All knowledge tests were constructed by individuals or departments. Departmental or individual instructor's tests and subjective ratings were used almost exclusively in skill assessment. However, a number of specific published skill tests were listed by a few institutions. Only one university indicated that they used any published skill tests in their required activity program. Most institutions indicated they used subjective ratings along with skill tests for skill assessment. The same skill test was used rarely by more than one institution. The published skill tests listed for each activity are as follows:

TABLE 2

ACTIVITIES INCLUDED IN REQUIRED AND MAJORS PROGRAMS
FARROW SURVEY

The Required Program		The Professional Program	
Activity	Frequency	Activity	Frequency
Swimming	15	Badminton	10
Tennis	9	Basketball	10
Archery	7	Swimming	10
Badminton	7	Volleyball	10
Bowling	7	Tennis	9
Golf	7	Softball	8
Gymnastics	6	Field Hockey	7
Modern Dance	6	Golf	7
Volleyball	6	Gymnastics	7
Basketball	5	Modern Dance	7
Field Hockey	4	Soccer	6
Softball	3	Archery	5
Fitness	3	Folk Dance	5
Fencing	2	Track & Field	5
Folk Dance	2	Square Dance	4
Soccer	2	Bowling	2
Square Dance	2		
N = 19 college & universities		N = 11 colleges & universities	

Archery	Jr. Columbia Round
Badminton	French, Miller
Basketball	Leilich, Edgren, Modified Edgren, Johnson 30 sec. shoot, Hampsten's ball handling test
Field Hockey	Schmithals & French, Stewart's wall volley test
Fitness	AAHPER
Golf	Vanderhoof, West
Soccer	Warner
Swimming	American Red Cross, Linthen's Test
Tennis	Miller-Broer, Mans-Jones, Modified Dyer, University of Wisconsin serve, modified Hewitt serve test
Softball	AAHPER Throw, University of Wisconsin throw, CAPECW test
Volleyball	Liba-Stauff Pass, French-Cooper, University of Wisconsin serve, Russell-Lange serve test

The information on the questionnaire and the related information sent with many questionnaires seemed to indicate that two basically different kinds of proficiency testing programs are developing. One can appropriately be called "proficiency testing," while the other would be more aptly called "deficiency testing."

The proficiency testing programs, in general, require students to reach a certain standard in order to receive exemption from a requirement or course credit or placement. These are used for both majors' and required programs. Some majors' programs are using this type of testing to screen applicants for their programs, while others are using it as a means of passing certain requirements for entering specific phases of the teacher training program or for graduation. A different approach in

general college programs is emerging. Two colleges have developed programs in which the student must either reach a degree of proficiency in two activities or a higher degree of proficiency in one activity in order to meet the Physical Education requirement. These programs appear to be based on the idea of developing enough skill in an activity to maintain an interest in it for a long period of time.

The deficiency testing programs, on the other hand, are similar to the remedial courses offered in other disciplines. Generally, all of the freshman class is tested for their basic skills and knowledges in physical activity. Those who do not pass must take a remedial type course before they are allowed to elect other activities.

Programs for Physical Education Majors

Dowell reported on the proficiency testing program used in the men's Physical Education majors' curriculum at Arkansas State University. (23) This program was used to screen men students in the majors' program. Each major, at a specific point in his program, had to present evidence of proficiency in a total of fifteen activities chosen from four groups. Those not having the required proficiencies were asked to seek another major. The proficiencies could be established through course work, skill in competition, or skill tests. If the proficiency was established through course work, the instructor signed a proficiency slip for the activity if the student reached the eightieth percentile for an advanced class. Students could be considered proficient through participation if they lettered in a varsity sport or played on a championship intramural team. Finally, the student could establish proficiency by passing the proficiency skill test for an activity.

Another proficiency testing program used for screening major students was reported by Paul and Welch (56) at East Carolina University. This program was for both men and women students. Students were evaluated in five areas: (1) Physical Fitness, (2) General Motor Ability, (3) Weight Control, (4) Basic Skills, and (5) Academic Record. The Iowa Physical Fitness Test was given to the men students and the North Carolina Fitness Test was given to the women students for the Physical Fitness evaluation. The standard for passing was the 65th percentile for the three and five items respectively. The Barrow Motor Ability Test and the Scott Motor Ability Test were given to the men and women students respectively for testing General Motor Ability. A T-score of fifty-five for each was required for passing.

Sheldon's Class Fixation was used to judge the condition of the student in regard to weight control. If a student was judged to be either over or under weight at the beginning of the semester in which the tests were given, he or she had to show progress toward correction at the beginning of the following semester. The degree of progress was not given. The following sports were taught in the majors' classes and tests were given at the end of each unit over an academic year: archery, tennis, soccer, volleyball, swimming, rhythms, recreational activities, body conditioning, track, field, gymnastics, wrestling (men) and modern dance (women). Valid skill tests coupled with subjective ratings were administered for each activity. Written knowledge exams were also given for each activity. Skill grades were weighted 2/3 and knowledge 1/3. A composite of the grades for each activity was made to determine if the student met the fourth requirement of Basic Skills. The fifth

requirement, Academic Record, was made by reviewing the record of the student. The general impression of the instructional staff that had taught the student was the decisive factor.

Wilson reported in Assessing Competency in Physical Education Activities (14) on the research carried out at the University of Washington in developing a competency testing program for women professional students. She cited the following rationale for the study:

> In institutions of higher education, various provisions for recognizing knowledge secured outside of educational institutions have long been made. The extent and manner of assessing such knowledge have varied greatly. Recently the "college proficiency" test concept has been embraced quite widely. For those who pass by meeting the test standards, in some colleges and universities, course credit is allowed and in others advanced placement or waiving of requirements and prerequisites may occur. Experience with these tests has indicated that they could be of value for classifying, and diagnosing the problems of those who are deficient.
>
> Just as these other disciplines in higher education are using competency or proficiency assessment to provide better educational opportunities for each student, so must physical education. (14:3-4)
>
> This study was envisioned as one which might lay a foundation for more extensive work. If effective evaluative devices could be found, they would provide a solid basis for future research studies which could lead to:
>
> (1) More accurate placement of university students in physical education activity classes;
>
> (2) Adequate prerequisite standards for admission to advanced skills courses for all students;
>
> (3) Skill and knowledge standards required for admission to upper-division theory courses in physical education. These standards should be particularly valuable to junior and community colleges preparing students for transfer to four year institutions of higher learning.
>
> (4) Motivation of high school girls who plan to major or minor in the field to achieve a higher degree of skill and knowledge in their high school physical education courses;

(5) Skill and knowledge standards which high school teachers might expect of their students and which should motivate them to higher levels of achievement. (14:4-5)

Four methods of assessing competency were utilized:

(1) Background information sheets filled out by each incoming freshman

(2) An interview with each student concerning her past experience

(3) Performance tests in each activity

(4) Knowledge tests in each activity

The activities studied were aquatics, badminton, basketball, bowling, folk dance and square dance, tap dance, tennis, tumbling and softball. Students showing "moderate" experience or "extensive" experience in an activity through their background information sheet or interview were recommended for testing. Scales were developed for equating background experience into: "extensive," "moderate," "minimal," and "none."

Knowledge tests were administered prior to skill tests. Standards for exemption were determined by the faculty after three years of study. Generally, a total T-score of 104 (knowledge test + skill tests) seemed to be an acceptable standard.

The study showed that

(1) the background information sheets and interviews are helpful in determining deficiencies, advanced placement and exemptions.

(2) knowledge and performance measures should be chosen with extreme care; only those giving reliable and valid results should be used.

(3) in many activities a satisfactory score on a knowledge test that examined "understanding of techniques and principles of movement as well as strategy, rules, etc., can be the sole examination device used for the superior student." (14:16) No performance test was needed for this type of student.

Wilson recommended three uses for competency tests:

(1) a means of determining minimal level of ability as a prerequisite for enrollment in an appropriate majors' course

(2) a means of classifying students in ability groups for instruction in activities

(3) a means of determining if a student should be exempt from a requirement.

Skill performance was evaluated by general subjective ratings, by very specific subjective rating scales, by objective tests, and by game scores. Standardized and departmental skill tests were used. Standardized tests included the Broer-Miller tennis test, and the Miller badminton test.

Correlation coefficients were calculated to determine the relationship between the various methods used to assess competency levels in badminton and volleyball. These coefficients are listed in Table 3.

It is evident that neither the background information sheets nor the interviews gave very good indications of skill or knowledge achievement as measured by the skill and knowledge tests. The background information sheets gave better indications of skill and knowledge than the interviews. The background information sheets plus the

TABLE 3

CORRELATION OF VARIOUS METHODS OF ASSESSMENT
USED IN BADMINTON AND VOLLEYBALL

Types of Assessment	Badminton No.	Badminton r	Volleyball No.	Volleyball r
Background--Interview	82	.69	82	.48
Background--Back. & Int.	82	.97	82	.95
Interview--Back. & Int.	82	.75	82	.58
Background--Knowledge	63	.66	82	.20
Interview--Knowledge	63	.61	77	.39
Back. & Int.--Knowledge	63	.67		
Background--Skill	51	.52	Tests (Total T) 86	.31
			Subjective 88	.29
			Av. Skill (Tests & Subj.) 80	.33
Interview--Skill	51	.43	Tests (Total T) 82	.32
			Subjective 82	.21
Back. & Int.--Skill	51	.54		
Skill--Knowledge	63	.63	Tests	.43
			Tests & Judg.	.34
Skill--Subjective Judgment	Ave. Skill T		Actual Subj. Score 89	.55
	Ave. Skill T		T-Score Subjective 90	.57

(14:70)

interviews were only slightly better than the background information sheets alone.

This was the only study of its kind in the literature. It was unique in that it showed the procedure followed in developing the study and it used a variety of methods in attempting to assess competency.

Arrasmith reported on the "Exemption Testing Program" for women majoring and minoring in Physical Education at the University of Denver. (15) The faculty identified twelve activities in which they felt all major and minor students should have some degree of proficiency: soccer, volleyball, basketball, badminton, tennis, golf, gymnastics, swimming, track and field, modern dance, ballroom dance, and folk and square dance. Ballroom and folk and square dance were later eliminated from the exemption program because of the varied backgrounds students had in these activities.

An "intermediate" level of skill in performance and a "high" level of knowledge was required for exemption in an activity. The definition of "intermediate" or "high" level of skill was left to the individual instructor.

Students went through a three-quarter course in their freshman year that met twice a week. Teaching sessions and performance and knowledge testing sessions were included for the ten activities. Those students failing to pass the exemption test in an activity were required to make up their deficiency before their junior year. This could be done by university activity course credit or by help from outside the university. Existing skill tests were used when available. Adaptations of existing tests and departmentally constructed tests were

also used. Subjective ratings were used when acceptable objective measures were not available. Subjective judgment of playing ability in a game situation was a part of each skill testing program.

All tests were put on a six point scale until norms could be developed: 5-excellent, 4-good, 3-intermediate, 2-deficient, 1-very poor, and 0-complete failure. Knowledge and performance scores were averaged. The student had to have at least a 3 average to be exempt.

The following were found to be among the advantages of the program:

(1) The longer contact time allowed the faculty more opportunity to know the students and their abilities.

(2) This arrangement allowed for a more extensive testing program than usually encountered.

(3) This program saved the students the time that would have been spent in taking all the activity courses.

The following were found to be among the disadvantages:

(1) Complete information was not available until the end of the freshman year, so making up deficiencies was slowed.

(2) Grading for university credit was difficult.

(3) The size of the group could cause serious problems. Many students could make subjective ratings of playing ability in game situations very time consuming.

(4) The lack of objective standards caused concern in making decisions on whether or not a student was proficient.

The Women's Department at Bowling Green State University developed an evaluation program for their students majoring and minoring

in Physical Education. (94) This program was initiated because "many freshmen arrived at Bowling Green with a high degree of skill in some sports and therefore did not gain much from the basic activity classes." (94:1-1) It was also felt that students who met all the criteria for these activities initially had the opportunity to elect other activities which they might not have had the opportunity to take otherwise.

Tests to determine proficiency and, if passed, exemption from basic skills and knowledges courses are given in basketball, soccer, volleyball, swimming, tennis and rhythmic fundamentals. The evaluations are made in a freshman course for majors and minors. All other students have the opportunity to take the tests at a time established each quarter. Skill evaluations are given in all activities. No knowledge test is given in swimming, and knowledge tests are given in other activities only to students on the borderline between passing and failing. Students who do not pass must elect a majors' activity course in that activity.

The program utilizes the following skill tests in their evaluations:

Basketball	Bounce and Shoot Test Scott revision of the Edgren Wall Pass Test
Swimming	Departmental Test
Tennis	University of Wisconsin Forehand, Backhand and Serve Test; Departmental Ball-Boy Test
Volleyball	Liba and Stauff Pass Test; Departmental Wall Volley and Serve Test
Rhythmic Analysis	Heskett Test (to be published)

The Women's Department at Michigan State University had developed a "Competency Testing" program for their professional students. (119) Activity requirements may be fulfilled by passing the competency tests or earning a "C" grade in the basic instruction course. The competency tests are administered during the fifth week of each term. Tests are administered in archery, badminton, basketball, bowling, field hockey, folk dance, golf, gymnastics, modern dance, softball, swimming, tennis, track and field, and volleyball. Skill evaluations are made in each activity and knowledge tests were given in sports areas but not in dance or gymnastics.

The skill testing in this program was generally of the subjective rating type, although in some activities subjective ratings were combined with objective measures. The knowledge tests were concerned primarily with rules, but some technique, some strategy, some terminology, and some safety is included in various activities.

This program was presented here because it contained many elements found most frequently in the programs reviewed. It could be said to be typical, even though there is great variety in the proficiency programs being conducted in various departments.

Programs for General College Students

A different type of proficiency testing program was reported by Plotnicki at the University of Tennessee. (58) It was developed for the men's required physical education program. Tests were administered in ten activities: badminton, bowling, golf, gymnastics, handball, intermediate swimming, physical fitness, tennis, volleyball and wrestling.

The examination consists of a skill or ability test and a written test covering knowledge of skills and rules. The student must reach the standard that would be necessary for him to receive a B in the course, had he taken the course, in order to pass the examination. The student received credit toward graduation for one required Physical Education activity class upon passing the tests. Plotnicki reported that the students have been enthusiastic about the program, and that over 500 have passed proficiency tests. He remarked, also, that it has strengthened the Physical Education program at the University of Tennessee and updated the program in keeping with the trend "toward accelerated and honor courses of study." (58:40)

Ewers developed proficiency tests for six activities of the required activities program for men at The Ohio State University. (80) The six activities were archery, bowling, golf, swimming, tennis, volleyball and fitness. Knowledge and skill tests were used in assessing competency for each activity except swimming and fitness. The skill measures used by Ewers were as follows:

Archery	Junior Columbia Round
Bowling	score for six games
Golf	score for eighteen holes
Swimming	Hewitt Swimming Test (short form)
Tennis	Dyer Wall Test (twenty foot restraining line)
Volleyball	Brady Test
Fitness	U. S. Air Force Fitness Test

The performance measure for golf was eliminated after the data were collected.

Ewers did not calculate reliability or validity coefficients on any of the tests when establishing the norms for the proficiency tests. He did make a study of the Dyer Test prior to the testing period. He found the validity of the test, as he used it, to be .85, and he found the reliability to be .82. The criterion measure used for establishing validity was a round robin tournament, and the method of establishing reliability was by correlating the scores on the first and third trials.

The questions on the knowledge tests were multiple choice. They covered history, rules, techniques and fundamentals, strategy, etiquette, terminology, scoring and equipment. Ewers used the Flanagan method to determine the statistical validity of each item and the Odd-Even method to determine the reliability of each test. There were forty to fifty questions on the original tests and thirty to thirty-five questions on the revised form of each test. The mean scores for the tests were approximately fifty per cent of the questions, but the spread of scores was rather small. The reliability coefficients ranged from .67 to .88.

Ewers reported the level of proficiency was based upon the requirements fulfilled by students who had completed classes in the respective activities. The cut-off point for exemption was set at a T-score of sixty or above.

A rather unique and interesting program was reported by Shepard at Denison University. (68) The University previously required each student to complete four hours of required Physical Education. Now the University requires only one credit to be earned. To earn this hour credit the student must achieve an intermediate level of skill.

The student enrolls for an activity each semester, but she receives no grade or credit for this activity until she meets the requirements for the intermediate or advanced level of achievement. Standards are set for each activity within the curriculum. Shepard points out that this program takes the emphasis off of spending time in four activities and puts it on the pursuit of excellence in one or two activities. It also places the responsibility on the student.

Grinnell College has developed a program in many ways similar to the program at Denison University. (102) Information on this program was received in connection with the Survey conducted by the writer. Since the survey was concerned with programs for women, most of the material received from Grinnell College was related to their program for women, but it was noted that many of their classes were co-educational.

Each woman student is required to complete the following requirement in order to graduate from Grinnell College:

(1) Pass Grinnell Swimming Test

(2) Pass Physical Fitness Tests

(3) Complete major carry-over sports requirement

(4) Complete minor carry-over sports requirement.

The major sports requirement is defined by Grinnell as follows:

> In general, a student must show playing skill at a prescribed level or pass progressive course work up to a maximum of 4 quarters (2 semesters) to be awarded the major. This may mean that in certain cases the student will start with beginning, and by working on his own, at home or here, be able to complete the course work in less than the normal 4 quarters. Or, he may, because of a background of skill, be able to start at a point higher in the progression, and accomplish the course work in one of two quarters. . . . If one has to repeat a course, say tennis II, then he would perhaps have to take 5 quarters to complete the major. (102:n.p.)

The minor sports requirement is defined as follows:

> As with the major, there are some differences between activities, but in general no more than 2 quarters of progressive course work is necessary for the minor. Sometimes the student may start in Tennis II, for instance, and after a few days be awarded the minor. Or, she may be asked to take a whole quarter. In many cases a student can test out without taking course work. (102:n.p.)

The list of major activities includes Bowling, Golf, Synchronized Swimming, Camping, Modern Dance, Water Safety Instructors, Folk Dance, and Tennis.

The following activities are added to make up the minor list:

Archery	Fencing	Skiing
Badminton	Figure Skating	Swimming
Canoeing	Sailing	Senior Life Saving

The four requirements combine to give the student two hours of credit on a pass-fail basis. It is not necessary to take any classes to fulfill the requirements. The student can "test out" of any or all of the requirements. The requirements must be passed prior to the end of the Junior year.

All Freshman women students attend several orientation sessions at the beginning of their first semester when the staff in the Physical Education Department goes over materials to help the students see that the staff is there to help them "learn skills that will be of life-long interest, as quickly and efficiently as possible." (102:n.p.) The students are then given a series of motor ability tests to help them make intelligent choices. Each student also has a half hour conference with a member of the staff during the first six weeks of the semester. The staff member tries to help the student see the relevance of the program, helps the student with her course selections, and interprets her tests scores.

Some objective skill measures are used and some rating scales are used to assess skill achievement. The individual instructors in each class are responsible for their own tests. Two instructors in the same sports activity may give different types of skill measures. Instructors are also responsible for knowledge testing. Some give knowledge tests and some do not. The Department has outlined, generally, what the student should know and be able to do in order to pass the various skill levels, but the choice of tests and judgment of achievement are left to the instructor of each class.

The rationale for the program at the University of Texas (130) is stated as follows:

> There should be a more systematic approach to screening and directing students to activities that will enhance their physical skills, similar to advanced standing examination in academic subjects. . . . It is possible that a few students could be excused from the requirement on a basis of a demonstrated proficiency in two or more activities with a carry-over value.
>
> It is recommended that a student in the Department of Required Health and Physical Education for Women may receive credit for the fourth semester of the requirement through advanced placement examinations in which a high proficiency in the knowledge and skills of an activity is demonstrated. (130:n.p.)

Both skill and written tests are given for each activity. Skill is evaluated by the subjective ratings of three judges. Written tests include true-false and multiple choice questions covering rules, terminology, strategy and analysis of skills. All written tests are given first. The student must score eighty points on the written test in order to be eligible to take the skill tests. The student must receive a composite average score from the three judges of eighty in order to pass the skill test. Students who pass are given credit for one hour of physical

education and are required to take three activity courses to meet their physical education requirement.

The following administrative procedures govern the program:

(1) A student must initially attempt advanced placement examinations in the semester she enters the University of Texas at Austin.

(2) A test may be repeated once in a subsequent semester if failed on the initial attempt.

(3) A student is limited to examination in two knowledge tests per semester. If the grade is satisfactory on both tests, she may choose the activity in which she is to be examined on skills.

(4) Advanced placement examinations are given at the highest level of activity offered in the Required Physical Education Women's schedule. (130:n.p.)

Tests are given in the following activities:

Archery	Golf	Tennis
Badminton	Gymnastics	Volleyball
Basketball	Modern Dance	Recreational Sports
Bowling	Swimming	Fencing
Conditioning		

The Women's Department at Furman University has developed a proficiency testing program for the students in their required program. (125) Four areas are required in the program: (1) the fitness area, (2) the swimming area, (3) the life time activity area, and (4) the participation area.

Students are given an entrance test; those who do not pass go into the basic lecture-laboratory course. The lecture is basically an "introduction to the philosophy of proficiency program, the opportunities at Furman and the physiological bases for fitness. The laboratory sessions introduce the students to various methods for developing and

maintaining fitness, now and later." (125:n.p.) This course meets the requirement for the fitness area. The swimming area may be passed by the student having an American Red Cross Intermediate card or by three members of the staff judging them to be "comfortable and safe" in the water.

There are twelve-fourteen activities in the area called Life Time Activity. An intermediate level of skill and knowledge is needed to pass one of these activities. Skill tests are given during the semester at posted times; they are not given in classes.

To pass the Participation area a student must participate in one varsity or intercollegiate sport, or two from classes, clubs, interest groups or intramurals. A student may not use a class if that is his proficiency area. He must pass that class and then he may use a club, interest group or team participation from that activity for participation credit.

The program being used at the University of Missouri for the women students in the required program is unique. (118) It is the only one which utilizes only knowledge tests as a means of establishing proficiency. No skills tests are given. It is a program that was developed to meet a specific need within that department. The University of Missouri has a two year requirement. At the end of the freshman year, students are given a test from which they may select questions on several activities. "The top 30 to 35 percent pass and are excused from the second year of the requirement. This is done because present facilities are inadequate and 30 to 35 percent of the sophomores cannot be accommodated in classes. This is obviously a stop gap measure forced upon us." (118:n.p.)

Garland, Wilson and Carr (32) reported on the program developed for the women in the required Physical Education activity program at the University of Washington. The basic reasoning for their program is that "before graduation from a university, students should be able to demonstrate reasonable proficiency in gross movement." (32:34) The objectives of this program are as follows:

1. To permit each student to determine and pursue an individualized program within the course structure.

2. To assess the individual's movement proficiencies and potential.

3. To assess the individual's understanding of self, of personal activity strengths and needs, and of means to develop an individualized program of physical activity. (32:34)

They decided that there are four areas in which every woman student should be proficient:

1. Basic skills--knowledge and understanding of the principles of movement, and the ability to efficiently perform movements involving propulsion of the body, manipulation of objects, and muscular relaxation.

2. Aquatic skills--understanding and knowledge of safety procedures and demonstration of minimum swimming skills necessary for survival.

3. Recreational skills--understanding and knowledge of the values which can be gained through participation in various specific activities and of the adaptability of these activities to different age levels and varying physical capacity. Proficiency in two recreational activities of the student's choice.

4. Physical fitness--understanding the importance of physical activity to total fitness; the contributions of various types of exercises, and the methods by which a state of fitness can be maintained or regained in the future. Ability to demonstrate a reasonable degree of strength, flexibility, cardiorespiratory endurance and agility. (32:34)

Written tests were given in each area. Students passing the written test were eligible to take the skill tests. No standards were given.

The Women's Physical Education Department of the University of Wisconsin has developed a proficiency testing program to exempt students from the basic course in Fundamentals of Movement. (135) A series of four tests is given: (1) a softball throw of velocity, (2) a slide shuttle test, (3) a posture picture, and (4) a written examination. Performance results on these four tests determine if a student is exempt from the basic skills course or is exempt from the basic skills course with provisions. If a student passes all the tests, she is exempt. If a student passes all but one and sometimes two tests, she can still be exempt if she agrees to attend special laboratories to make up deficiencies in the areas in which she failed.

In the Fall and Spring semesters of 1967-68, 294 and 157 students took the tests in the respective semesters. Eighty-six and thirty-three respectively were totally exempt; seventy-four and sixty-two respectively were not exempt. The remainder fell in the partially exempt group.

Knowledge Tests

Published knowledge tests or test items for the five selected activities were reviewed. These tests were evaluated according to the suggestions made by Barrow and McGee (1) for constructing and evaluating knowledge tests. Two areas were considered: (1) content balance, and (2) validity and reliability. The series of tests in varying activities constructed by one individual or group were reviewed first in the hope of finding a series suitable for this study. Then, tests constructed for a single activity were reviewed. Each was evaluated on its usefulness for this study in terms of (1) the multiple choice format chosen for

this study, (2) whether or not the test was up-to-date, and (3) the criteria given below.

Criteria for Evaluation

Content Balance

Barrow and McGee state that, "A unit test should follow the unit plan in its points of emphasis and its general content. If 50 per cent of the unit was spent on skill techniques, then 50 per cent of the questions should investigate the knowledge and understanding about the execution of the techniques." (1:357) They further state that, "The suggested content balance will change from unit to unit and from sport to sport." (1:498)

Validity

Two types of validity are considered in constructing and evaluating knowledge tests: (1) empirical or content validity, and (2) statistical validity. Both attempt to measure the honesty of the test.

Empirical Validity.--Empirical or content validity "is achieved if the content of the test is in agreement with the unit of instruction . . . . If approximately parallel emphasis is evident, validity is assumed." (1:509)

Statistical Validity.--Statistical Validity "answers the more technical question of the internal ability of the test to discriminate between those who 'know' and those who 'do not know.'" (1:509) The process of establishing statistical validity includes finding for each test item (1) the difficulty rating, (2) the index of discrimination, and (3) the number of functioning responses. Several methods can be

used to find this information. The one that has been used most frequently in the field of Physical Education is the Flanagan Method. Generally, this method makes the assumption that using the papers with high and low scores is just as effective as analyzing all the papers. Several variations of this method can be used. The papers scoring in the top and bottom twenty-seven per cent can be used, or the papers scoring in the top and bottom twenty-nine per cent can be used by giving the top and bottom nine per cent of the papers a weighting of two and the remaining twenty per cent a weighting of one. There are other variations, but these two have been used most frequently. (8)

Reliability

Barrow and McGee define reliability as indicating the "consistency with which a test can rank the students from good to poor." (1: 519) It is influenced by "the length of the test" and the "ability of the items to discriminate." (1:519) There are several ways test reliability may be established. The two most frequently used in the field of Physical Education have been the Split-Halves Method and the Kuder-Richardson Formula. Both indicate the internal consistency of the test. The Split-Halves method correlates the score made on the odd-numbered questions against the score made on the even-numbered questions. This correlation coefficient is then stepped-up by the Spearman-Brown Prophecy Formula to find the reliability coefficient for the entire test. The Kuder-Richardson Formula has many variations for written tests. It utilizes the number of items on the test and the mean and standard deviation of the scores in making the necessary calculations. It is

"considered to provide the lower limit of what the real reliability of a test may be." (1:521)

Test Series

The Snell Tests (69,70)

The earliest series of tests were constructed by the Department of Physical Education for Women at the University of Minnesota and reported by Snell in 1935 and 1936. The tests were made for ten activities: archery, basketball, baseball, field hockey, golf, horseback riding, soccer, tennis, volleyball and fundamentals. The original form of the test for each activity had seventy questions and the revised forms had forty-five questions. The questions were the five response multiple choice type. The formula used for scoring the test was the number of questions correct minus the number of questions incorrect. The number of subjects taking each test varied from 10 to 102.

Expert opinion was used as the criterion for establishing content validity. The areas of content and the content balance of the tests were not given but can be calculated by analyzing the tests. No statistical validity was determined. The reliability coefficients for the revised forms of the tests ranged from .51 to .93.

Most of the tests were too heavily weighted with rules and terminology questions to be of use in this study. This series did not include all of the activities of this study, which made it impossible to adopt this series totally. The tests are also now out of date because of changes in the techniques, strategies, rules and equipment.

The Hennis Tests (36)

Hennis constructed tests in seven activities for college women's instructional programs. The activities included badminton, basketball, bowling, field hockey, softball, tennis and volleyball. While the tests reported by Snell were in effect departmental tests based on the scores of students at the University of Minnesota, Hennis' tests were standardized tests based on the scores of students from a wide geographic representation of public and private colleges, coeducational colleges and universities, and teachers' colleges.

Hennis sent checklists to 117 colleges and universities asking them to indicate the time they devoted to each general content category of each activity. The results of these checklists were used to make the table of specifications for each test except tennis. A similar study had just been reported for tennis, and the results of it were used to make the table of specifications for this activity. The content areas included generally were history, skills and techniques, team tactics, selection and care of equipment, safety, terminology, etiquette and rules.

There were fifty to sixty questions on the original forms of the tests. All of the questions were multiple choice. The tests were given to students in thirty colleges and universities. All tests were not administered in all colleges.

The Flanagan method was used to determine the statistical validity of the field hockey and softball tests and the Achenbrenner method was used to determine the statistical validity for the remaining tests. The latter method involves analyzing only the top and bottom ten per cent of the papers. The questions selected for the final form of the tests

had a difficulty rating between .10 and .90, an index of discrimination above .16 and at least two functioning responses. The revised forms of the tests had from thirty-three to thirty-seven questions. The Kuder-Richardson formula, number eight, was used to establish the reliability of the tests. These coefficients ranged from .72 to .81.

Hennis made the following conclusions:

1. The tests were satisfactory measures of knowledge in their respective areas.

2. The tests could be used in their entirety if the table of specifications was close to the unit of instruction that had been taught.

3. The norms from the study could be used for comparison purposes when the entire test was used.

4. When a whole test was not suitable for use, it could be used as a guide in constructing a suitable test.

This test series did not include all of the activities of this present study, and so could not be adopted as the series for this study. Some of the questions in the various tests needed to be brought up to date because of changes in the games. The revised tests were slightly shorter than it was thought desirable for this study. However, some test items from these tests were used in constructing suitable tests for this study.

The Ley Tests (87)

Ley constructed test items instead of entire tests for nine activities. The emphasis was on the application of knowledge rather than recall of facts. Ley used many diagrams to get at this aspect of

learning. Most of the test items were on technique and strategy. The activities included were archery, badminton, bowling, golf, basketball, soccer, softball, and volleyball.

The test items were given to students in the service programs and the Physical Education majors' programs in selected schools from a wide geographical area. The questions on the tests were multiple choice. The number of items on the preliminary tests ranged from thirty-six to fifty-five. The Flanagan method was used to determine the index of discrimination and the difficulty rating of each question. Statistical data were presented for service class students and Physical Education major students separately.

The test items in any activity could not be used as the entire test for an activity in this study. Ley did not intend these items to be a complete test. Test items were drawn from Ley's study for all the activities in this study except tennis.

The Hooks Tests (42)

Hooks constructed and standardized tests in badminton, softball, tennis and volleyball for college men. The final forms of the tests were administered to students from eighty-nine colleges and universities throughout the United States.

Each test contained fifty items. Each item was best answer multiple choice in format.

The table of specifications for each test was developed through the analysis of recently published textbooks in each activity and through the evaluation of experts. The preliminary forms of the tests were given

to students at Campbell College. There were 185 subjects who took each test. The revised form of the examinations were given to 2,832 badminton subjects, 3,513 softball subjects, 2,740 tennis subjects and 4,140 volleyball subjects throughout the United States.

After each of the administrations of the tests the Fan item analysis table was used to establish the index of discrimination and difficulty rating for each item. This method utilizes the upper and lower twenty-seven per cent of the scores. The fifty questions selected for the final form of the examinations had an index of discrimination of .20 or above, a difficulty rating between .10 and .90, and at least three functioning responses. The reliability coefficients for the tests were determined by the Split-Halves method. They ranged from .73 to .85 for the final forms of the tests. National norms were developed for each test. Norms were developed, also, for each of the AAHPER districts.

Hooks made the following conclusions:

1. The badminton, softball, tennis, and volleyball tests were acceptable measures of achievement of knowledge and understanding.
2. The four knowledge tests were valid and relatively reliable.
3. The tests were economical of time and materials and easy to administer and score.
4. The district and national percentile norms permitted meaningful interpretation of results.
5. Local norms should be developed in any school where the individual tests or the test battery are used. (42:513)

This series of tests could not be used for this study because it did not cover all the activities in this study. Individual questions could not be used in constructing tests for this study without permission from the author as the tests are copyrighted.

The Brown Tests (11)

The William C. Brown Publishing Company has developed a test manual to go with each activity book in its Physical Education Activities Series. Each test manual contains one hundred objective questions. They are true-false, completion, and multiple choice type items. The tests are keyed to the respective activity book and were constructed by the author of that book. No data are presented on the tests. From an analysis of several, however, some seem to be more heavily weighted on rules than was desirable for this study. Individual questions from these manuals were used to construct tests for this study.

Tests for Individual Activities

Tests have been constructed for badminton, golf and tennis by various authors. No tests for archery or bowling were found in the literature.

Badminton

The Scott Test (64)

Scott reported knowledge tests for beginning and intermediate badminton which were constructed by the Research Committee of the Central Association of Physical Education for College Women in 1941. There were 351 students from eleven schools who participated in the study. The number of lessons that the groups had prior to testing varied from fifteen to twenty.

One hundred papers were randomly selected for the analysis of the test. There were forty-seven multiple choice and thirty-three true-false questions on the tests. An index of discrimination and a difficulty rating were computed for each item. The formula used for establishing the index of discrimination was the mean test score of students answering the questions correctly minus the mean test score of students answering the questions incorrectly. The minimum accepted for retaining a question by this method was 5.0, The difficulty rating was determined by the per cent of students answering each question correctly. Questions with ratings over .95 were omitted.

The reliability for the multiple choice questions was .79, and for the true-false questions was .72. These coefficients were calculated by the Split-Halves method.

Scott found little difference between the means and standard deviations for the beginners and intermediates. The means respectively were 53.4 and 54.1, and the standard deviations respectively were 6.3 and 6.7.

This test could not be used in its entirety for this study because of the number of true-false questions on it. Many of the questions were out-of-date because the game has changed considerably since the publication of this test. Some test questions were used from it, however, in constructing a test suitable for this study.

The Phillips Test (57)

Phillips constructed a badminton knowledge test that was given to beginning and intermediate service classes and Physical Education

majors' classes. The objectives for the test were based on the analysis of badminton textbooks and on the analysis of courses of study from three colleges. The objectives selected were sent to fourteen experts who were asked to approve or disapprove the objective and suggest a weighting for each. Rules, fundamental techniques, strategy, flight of the shuttle, equipment, terminology and history were content areas for the test.

The original test was composed of 124 true-false questions and 54 multiple choice questions. The test was completed by 648 subjects in seventeen colleges and universities. The reliability of the original test was .929 when the true-false questions were scored right minus wrong. Phillips found that the students taking the test had had from ten to sixty class periods of instruction before the test administration.

The final form of the test was composed of 100 questions. It was completed by 1,471 subjects from thirty colleges and universities. The questions for the final test were selected on the basis of their index of discrimination, their difficulty rating and their contribution to the content balance of the test. The formula used for the index of discrimination was the difference between the means of students answering the question correctly and those answering it incorrectly; the Votaw curve was used. The difficulty rating for the final form of the test was approximately 50 per cent. The reliability coefficient was found to be .921 when the true-false questions were scored right minus wrong.

This test could not be used in this study because of the large number of true-false questions. Some of the questions also needed

up-dating. Questions from it were used in constructing a test suitable for this study.

The Fox Test (28)

Fox constructed a knowledge test for college women enrolled in service classes. The content areas and balance of the test were decided by a departmental committee. The original test consisted of ninety questions. The types of questions were multiple choice, multiple true-false, true-false, short answer and identification. The original test was given to eighty-nine students. The multiple choice questions were eliminated after the test analysis on the score sheets showed they failed to discriminate.

The first revision of the test had 107 questions. Some new questions were added after the analysis of the original test. This revision was taken by 269 students. Eighty questions had sufficiently high indices of discrimination to be included in the next revision of the test.

The final form of the test had 106 questions. It was given to 343 students. Statistical validity was established for this revision of the test. The index of discrimination was calculated using the upper and lower thirds of the papers. Ninety per cent of the items discriminated at the five per cent level and eighty-two per cent discriminated at the one per cent level of significance. A few questions did not discriminate. The difficulty ratings for the items on the test ranged from .02 to .70. The reliability of the test was calculated by the Split-Halves method and found to be .88.

This test could not be used for this study first because it had no multiple choice questions. It also had too many rules and terminology questions for the situation being tested in this study. Questions from this test did suggest questions or responses for questions for this study.

The Goll Test (81)

Goll constructed a badminton knowledge test for high school girls. It was too elementary for college women and had too heavy an emphasis on rules questions to be helpful in this study.

Golf

The Murphy Test (54)

Murphy reported the first golf knowledge test in 1933. The items for the test were true-false, short answer and matching. The content areas and their percentages of emphasis were determined by the analysis of six textbooks. There were 100 questions on the test. Murphy reported the reliability of the test to be .86 by the Split-Halves method. The test was given to 408 students. This test could not be used in this study because of the format of the questions.

The Waglow and Rehling Test (73)

Waglow and Rehling constructed a golf knowledge test for college men. It contained 100 true-false questions. The content of the items was determined by analyzing materials from a number of references. The test was given to 100 students. The difficulty rating and index of discrimination were calculated for each question.

The reliability of the test calculated on the Split-Halves method was found to be .82. Norms were reported and letter grades suggested.

This test could not be used in this study because of the format of the questions. The questions were used to suggest ideas for constructing items or responses for items suitable for this study.

The Crickenberger Test (22)

Crickenberger presented a golf knowledge test composed of completion, multiple choice, matching, classification, listing and true-false questions. The test had not been given to any group when it was published, so there were no statistical data for it.

This test could not be used in this study because of the format of the questions and because it more heavily emphasized rules, scoring and terminology than was desirable for this study. Some questions from this test were used in constructing a test for this study.

Tennis

The Hewitt Test (37)

Hewitt constructed a tennis knowledge test of 100 questions in 1937. The questions were multiple choice, true-false, diagrammatic, completion, yes-no and matching. No table of specifications was given for the content of the test. The items were scored as follows: (1) right minus wrong--true-false, yes-no, and matching, (2) right minus wrong divided by four--multiple choice and (3) number correct--all other questions.

Face validity was assumed for the test. No item analysis was given. The reliability of the test was figured by the Split-Halves method and found to be .947.

The test was divided into two fifty question tests, Form A and Form B. Neither could be used for this study because of the format of many of the questions, and because some questions were out of date.

The Hewitt Test Revised (38)

Hewitt revised the test presented above in 1964. In the twenty-six years between the publication of the first test and the revision, over 10,000 copies of the tests were used.

The content of the revised test was based on the emphasis placed on the various areas by textbooks. Hewitt found the percentage of emphasis for each area to be as follows: (1) fundamentals--forty per cent, (2) rules--twenty-five per cent, (3) playing situations--twenty-five per cent, (4) history--five per cent, and (5) equipment--five per cent.

The validity of this test was calculated by correlation of the results of it with the results of the Snell Tennis Test and the Scott Tennis Test. Hewitt found that the test correlated .81 with the Snell Test and .86 with the Scott Test. Reliability was calculated by the Split-Halves method and found to be .95.

The 100 question test was divided into two fifty question tests, Form A and Form B. Grading norms were presented for first and second semester students.

This test could not be used in this study because of the varied formats of the questions, but questions from it were used in construction of a test suitable for this study.

The Scott Test (65)

Scott reported tests for beginning and intermediate college women developed by the Research Committee of the Central Association of Physical Education for College Women. The test for beginners had sixty-six multiple choice and true-false questions. The intermediate test contained fifty-one multiple choice and true-false questions.

The tests were given in nineteen colleges and universities to 404 beginners and 296 intermediates. The same methods were used in establishing the validity and reliability coefficients of these tests as were used in the badminton test Scott developed. The reliability was found to be .87 for beginners and .78 for intermediates. Grading scales were included in the report.

This test could not be used in this study because of the format of many of the questions and because some of the questions were out of date. Questions from it were used in constructing a test suitable for this study.

The Broer and Miller Test (17)

Broer and Miller reported a tennis knowledge test for beginners and intermediates. The content of the test was determined by the content of the courses taught in their department, and the percentage of emphasis for each content area was based on the emphasis in these courses.

The preliminary test was composed of 100 true-false, multiple choice, completion, matching and identification questions. Validity was determined by using the upper and lower thirds of the scores and the Phi coefficient. The reliability of the test was calculated by the Split-Halves method and found to be .84.

The test was revised to include 128 items. It was given to 297 beginners and 46 intermediates. The same procedures for validity and reliability were followed. The reliability of the revised test was .82 for beginners and .92 for intermediates. Seventy items were found to have a high index of discrimination and the difficulty ratings of the test items ranged from .04 to .94. The scores on the test ranged from thirteen to eighty-two. Broer and Miller concluded that this test could be used for grading purposes.

This test could not be used in this study because of the format of many of the questions. Questions from it were used in constructing a test for this study.

The Droste Test (24)

Droste reported a tennis knowledge test in which all the questions were multiple choice. No statistical information was given for the test. This test could not be used in this study because the emphasis of the test was not the same as that desirable for this study. Questions from it were used in constructing a test for this study.

The Varner Test (72)

Varner constructed tennis knowledge tests for beginners and intermediates. The beginners' test included classification, multiple

choice, short answer, completion, matching, identification and true-false questions. The intermediate test was made up of true-false questions. No statistical data or table of specifications were given for the tests. These tests could not be used in this study because of the format of most of the questions. Some questions from it could possibly be used in constructing a test for this study.

The Johnson Test (44)

Johnson presented a tennis knowledge test composed of twenty-five multiple choice items. No statistical data were given for the test. It could not be used for this study because of its length, but questions from it were used in construction of a test for this study.

The Miller Test (53)

Miller constructed a tennis knowledge test for students majoring in Physical Education to take after completing a methods course. The content of the test was based on three textbooks, and on courses of study and completed questionnaires from thirteen colleges and universities. The test questions were true-false, multiple choice and multiple response. There were 326 items on the original test. It was taken by 381 subjects in twenty-seven colleges. The original test was analyzed statistically. The Flanagan method was used in determining the index of discrimination for each question, and the percentage of questions answered correctly by all the subjects determined the difficulty rating. The questions selected for the revised test met the statistical standards

set by Miller, and the selection of questions maintained the content balance of the original test. The final form of the test included 100 items, utilizing the true-false and multiple choice formats. When there was a choice between two questions of different formats, the multiple choice question was used.

The final form of the test was administered to 612 subjects from forty-five schools. The index of discrimination and difficulty rating were calculated for each question. The reliability was calculated on the bases of the number of questions answered correctly and found to be .788. The reliability was also calculated on the basis of the number of multiple choice questions correct and the number of true-false questions correct minus incorrect. This coefficient was .90.

This test was not used in this study because it was not written for a group like that being tested here. Questions from it were used in constructing a test suitable for the group in this study.

Performance Tests

Performance test batteries and test items were reviewed for the five selected activities. The tests were evaluated according to the suggestions made by Barrow and McGee (1) and Scott and French (13) for the construction and evaluation of performance tests. These included practical considerations and technical standards. The tests reviewed are grouped by activity. Each was evaluated in terms of its usefulness for this study according to the criteria described below and the situations encountered in this study.

Criteria for Evaluation

Practical Considerations

Barrow and McGee (1) include, in administrative considerations that should be made in selecting tests, (1) equipment, (2) money, (3) time, and (4) utility. They explain that the equipment should be readily available, or easy and inexpensive to construct. It should be of good quality to help the performance of the students and should be the type and quality which the students normally use in classes. Time must be considered in two ways: (1) the amount of time it takes to set up the test and (2) the amount of time it takes to administer the test to a class. Barrow and McGee state that, "The equipment, floor and wall markings, and all preliminary arrangements should be refined to such a degree that they can be efficiently readied with a minimum of extra preparation." (1:49) Tests are impractical which require a performance of several minutes from one student while the rest wait. The scoring of the test should not be complicated; no lengthy and time consuming calculations should be necessary to arrive at the score for each student.

In addition to the administrative considerations listed by Barrow and McGee, Scott and French list seven other practical considerations to make in selecting and evaluating performance tests.

1. Tests should measure important abilities. . . . The significance of a specific ability as a measure of success in playing the game is dependent upon its relative importance to all of the techniques required in the game. (13:11-12)

2. Tests should be like the game situations. . . . A combination of skills does not necessarily make a test gamelike. (13:12)

3. Tests should encourage good form. . . . In selecting tests, care should be taken to avoid tests in which players using poor form can score higher than players using good form. (13:13-14)

4. Tests should involve one performer only. . . . Recognition of this need has resulted in many tests using rebounds or repeated plays as a wall. . . . A rebound test represents a compromise between the criteria of game similarity and a single performer. (13:14)

5. Tests should appeal to the students if best efforts are to be obtained. Tests frequently have certain inherent qualities which attract or repel student interest. (13:15)

6. Tests should be of suitable difficulty. The difficulty level of the test should correspond to the ability of the group being tested. The scores should show a reasonable distribution with no massing of scores at any point. (13:16)

7. Tests should differentiate between levels of ability. . . . If a group is highly variable in ability, the test scores should indicate that. If the group is homogeneous in ability, there are still differences between individuals which we need to determine. (13:16-17)

Technical Standards

Three factors must be considered in determining the technical standards of a test: (1) validity, (2) reliability, and (3) objectivity. A test must meet the standards set for each if it is to be useful.

Validity

Validity "expresses the degree of relationship between a criterion and the test." (13:21) Four methods of determining test validity have been used frequently with performance measures: (1) face validity, (2) subjective ratings, (3) previously validated tests, and (4) tournament standings. Barrow and McGee state that a validity coefficient must be .70 or above to be acceptable. (1:42)

Face Validity.--Face validity has been used mainly in situations in which logic and common sense indicate that a test is inherently a measure of the skill in question; such a test would be the running of the fifty yard dash as an indication of sprinting ability.

Subjective Ratings.--Subjective ratings have long been used to establish the validity of performance tests. Usually at least three judges are used in the ratings, and they evaluate the performance by a prepared rating scale. Most motor tests were originally validated by subjective ratings. This is a time consuming process.

Previously Validated Tests.--Some new skill tests have been validated by comparing them with similar previously validated tests. This method has been used in developing a new test for a skill where a valid test already has been developed but is impractical for use for some reason.

Tournament Standings.--Validating skill tests by tournament standings has been used frequently with individual sports performance measures. It is time consuming because it must be based on a fairly extensive ladder or round robin tournament, but it does give a direct measure of playing ability.

Reliability

A test is said to be reliable if similar results occur when the test is repeated by the same group under the same conditions. Reliability of performance measures has been determined primarily by two methods: (1) test-retest and (2) Split-Halves. Barrow and McGee state that a reliability coefficient of .80 or above is acceptable. (1:42)

Test-Retest.--The test-retest method is used when it is logical and practical to give the test one day and then give it again a second day. It is thought to give the lower limit of reliability for a test because it takes into consideration the administration to administration variance.

Split-Halves.--The Split-Halves means of determining reliability does not take into account the day to day variation in performance. The test by this method is given in one session and then the scores of the odd numbered trials are compared to the scores of the even numbered trials. This gives the reliability coefficient for half of the test. Then the Spearman-Brown Prophecy Formula must be used to determine the reliability for the entire test. This method is said to give the upper limit of the reliability of a test because it does not account for day to day variance.

Objectivity

Objectivity refers to the lack of any personal influence of the administrator or scorer on the test results. Most objective skill tests have objectivity inherently if the test has clear test directions and precise scoring methods which are adhered to by the test administrator. Barrow and McGee state that an objectivity coefficient of .80 or above is acceptable. (1:42)

Archery

The Hyde Test (43)

Hyde presented the first scales for archery achievement. The number of class meeting before the test administration, from which the

scales were developed, was not given. The Columbia Round was used in making the scales because Hyde found that most schools had students shoot from thirty, forty, and fifty yards.

The Bohn Test (78)

Bohn's research indicated that shooting from thirty and forty yards was highly reliable and that shooting from distances less than thirty yards yielded low reliabilities. He also found that a small number of trials leads to results that are not trustworthy. The test which he used was shooting five ends from thirty yards. Standard scoring procedures were used.

The test was administered in two successive class periods. The reliabilities of the test by the test-retest method ranged from .662 to .834. The validity of the test was determined by comparing it to the tournament rankings of performers. One hundred and eight performers were from beginning archery classes and nine were from an archery club. The validity of the test for the beginners was .792 for the first day and .731 for the second day. The test when given to club members yielded a validity coefficient of .933.

The Zabik and Jackson Study (77)

Zabik and Jackson studied the reliability of two measures of archery achievement frequently used indoors, the modified Chicago and modified Flint Rounds. The modified Chicago Round consists of shooting eight ends from twenty yards at three foot targets. The modified Flint Round consists of shooting four arrows from each of seven shooting positions at targets of thirteen and eighteen inches. They found

the reliability of the modified Chicago Round to be .86 and the reliability of the modified Flint Round to be .87. They concluded that both were reliable measures. They found the intercorrelation of the two to be .56 which indicated the tests did not measure the same type of achievement.

The AAHPER Skills Test Manual Study (2)

The objective skill tests used in this study were "designed to measure skill in shooting at the standard 48-inch archery target from different distances by boys and girls ages 12 through 18." (2:12) A simple test was selected instead of a standard round. It was designed originally for both boys and girls. "However, when scores were tabulated it was found that shooting from 30 yards was too difficult for many girls at each age because 65 percent at ages 12 and 13 and 35 percent at ages 17 and 18 were unable to score at that distance." (2:12) The test consisted of shooting two ends from each of three distances; 10 yards, 20 yards and 30 yards.

These tests were administered to students throughout the United States. There were from 600 to 900 scores for each sex and for each age group.

The reliability coefficient was reported to be at least .70, which the Committee preparing the test felt was acceptable for an event scored on the basis of accuracy. Norms were presented for each sex and for each age group.

Badminton

Many different types of objective skill tests have been developed for badminton skills. The batteries of tests which have been developed will be presented first in the review followed by the tests for the individual strokes and elements of the game.

Skill Test Batteries

The French and Stalter Battery (31)

The French and Stalter battery consisted of six tests: (1) the serve test, (2) the clear test, (3) the smash test, (4) the wrist volley test, (5) the diagonal footwork test, and (6) the shuttle footwork test.

The Short Serve Test.--The idea of this test was for the student to hit a legal serve between the net and a restraining rope stretched twenty inches directly above the net into a target area marked off in concentric quarter circles. The court set-up and target scoring areas are shown in Figure 1. Each student received twenty trials from the right hand service court. In order for a trial to score, the shuttle had to go between the rope and the net and into the right doubles service court of the opposite court.

The Clear Test.--The basic idea of this test was for the student to clear a shuttle set up by a test administrator. In order for the shot to score it had to go over a rope fourteen feet from the net and

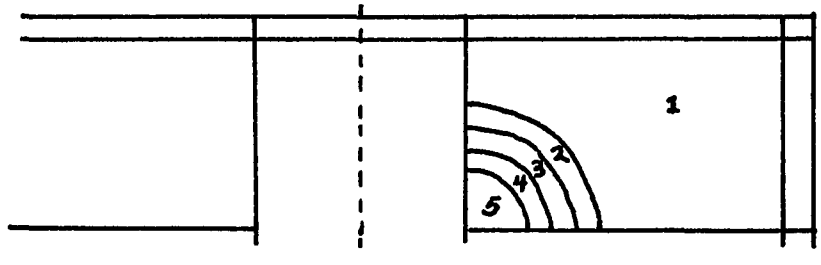


Fig. 1.--Court Diagram for Short Serve Test.

eight feet from the floor and into the target area. The court set-up and scoring areas are shown in Figure 2. Twenty consecutive trials were given each student.

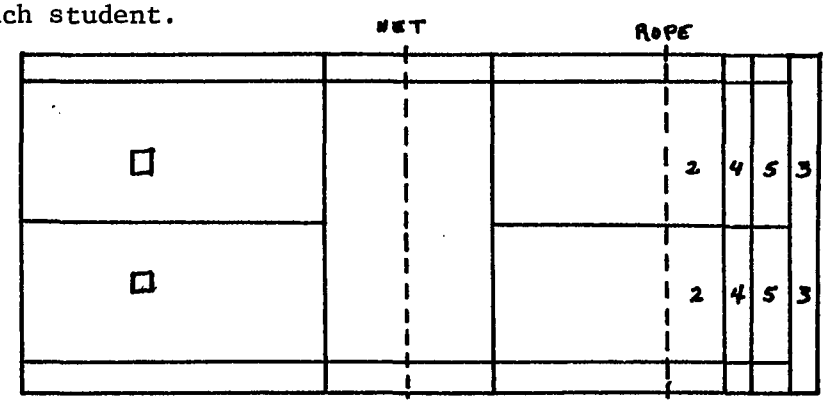


Fig. 2.--Court Diagram for the Clear Test.

The Smash Test.--The idea of the smash test was for the student to hit a shuttle set-up by the test administrator over the net and into the scoring area with a smash. The scoring area and court set up are illustrated in Figure 3. A rope was placed parallel to the net two feet from the net and seven feet above the court. The examiner was to set the shuttle so that it cleared this rope and went at least as far as the short service line. Each student received twenty trials.

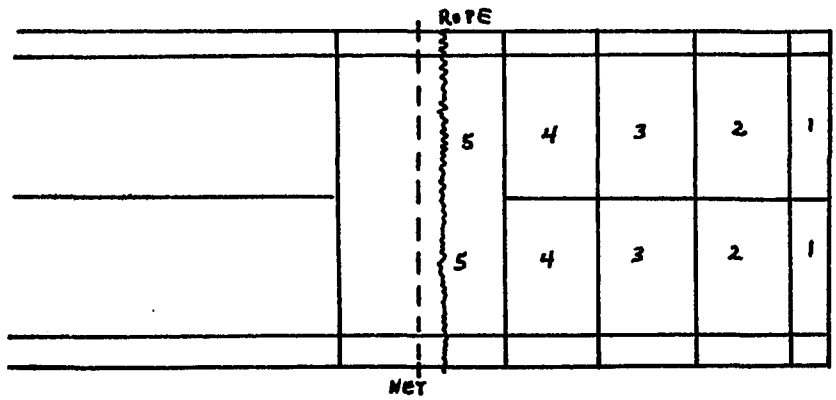


Fig. 3.--Court Diagram for the Smash Test.

The Wrist Volley Test.--The wrist volley test used no line on the wall and a six-foot restraining line on the floor. Players were given four thirty-second trials. The player had to stand behind the restraining line, serve the shuttle legally to begin the test and to restart the shuttle if it were missed, and then make as many hits against the wall as possible in the time limit.

The Diagonal Footwork Test.--The diagram for this test is given in Figure 4. The player stands on the position marked X on the diagram; the player is holding a racket. On the starting signal the player moves in the pattern indicated on the diagram. The player must be in position to hit a forehand shot when moving from the front left corner to the back right corner. The score was the number of times the student touched a corner or the X position in fifteen seconds. Each student was given four fifteen-second trials, and the score for the test was the total score from the four trials.

The Shuttle Footwork Test.--The diagram for this test is given in Figure 5. The player stands facing the net on the position marked X in the diagram; the player is holding a racket. On the starting signal the player begins moving back and forth between lines A and C using a

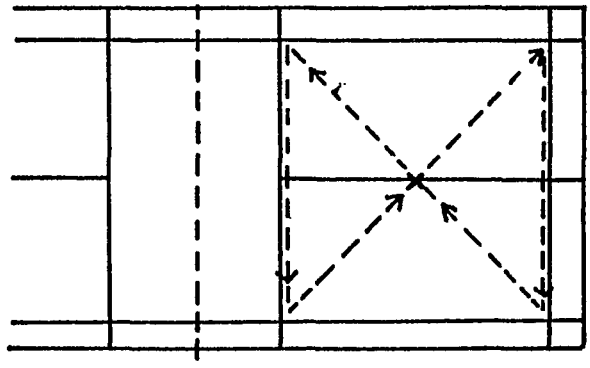


Fig. 4.--Court Diagram for Diagonal Footwork Test.

sliding step for a period of fifteen seconds. The student must face the net throughout the test. Each student is given four trials and the score is the total for the four trials. One point is scored each time the student crosses lines A, B, and C.

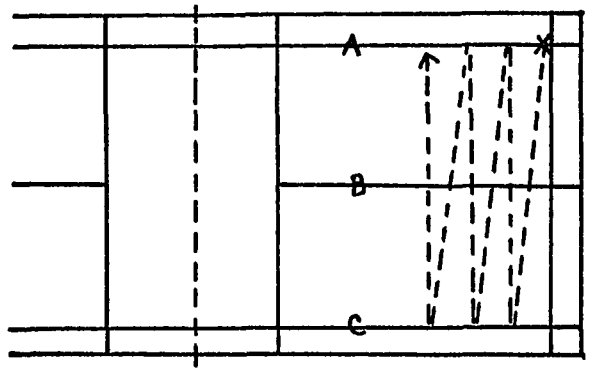


Fig. 5.--Court Diagram for the Shuttle Footwork Test.

French and Stalter administered this test battery to fifty-nine women Physical Education majors in beginning badminton classes. The criterion used for establishing the validity of the test was the playing ability of the students as indicated by the subjective ratings of four judges. The resulting validity coefficients are given in Table 4.

TABLE 4

VALIDITY AND RELIABILITY COEFFICIENTS FOR FRENCH-STALTER BATTERY

Test	Validity	Reliability
Serve	.411	.511
Clear	.449	.698
Smash	.135	.734
Wrist Volley	.523	.830
Diagonal Footwork	.402	.933
Shuttle Footwork	.424	.937

(31:260-61)

The validity coefficient for the wrist volley test was the highest and the coefficient for the smash test was the lowest. None were sufficiently high to be considered single valid measures of badminton playing ability.

The reliability of the tests was found by using the Split-Halves method and the Spearman-Brown Prophecy formula. These are given in Table 4. The coefficients of the first three tests did not reach the acceptable range suggested by Barrow and McGee. The last three tests did.

Multiple correlations were calculated for the various combinations of tests in the study. The highest multiple correlations were .698 for the serve, clear, wrist volley and shuttle footwork tests combined, .679 for the clear, wrist volley and shuttle footwork tests combined and .650 for the serve, clear and wrist volley tests combined. The first two combinations yielded coefficients bordering on acceptability for validity coefficients.

Neither could be used in the present study because both contained the wrist volley test. There is no wall space on which this test could be given in the gymnasium at Memphis State University where badminton is taught.

The Hicks Battery (84)

The Hicks battery of badminton skill tests included five tests: (1) the clear test, (2) the smash test, (3) the drop shot test, (4) the footwork test, and (5) the strategy test. The battery is in many ways similar to the French and Stalter battery. The main difference is in

the focus on making the tests more game-like than the tests of the French and Stalter battery.

The Clear Test.--The Hicks clear test was similar to the French clear test. The placement of the ropes and scoring areas was only slightly different. The main difference in the two tests was that instead of the test examiner hitting the shuttle to the player, the examiner hit the shuttle so that it went into an area behind the player. The player had to move backward and sometimes laterally also in order to return the shuttle. The examiner hit the shuttle randomly to the right, left and center of the back court. The set up for the court is diagrammed in Figure 6. The subject stands on the position indicated by the X in the diagram. The area into which the set-up must be hit by the examiner is indicated by the dotted lines in the diagram.

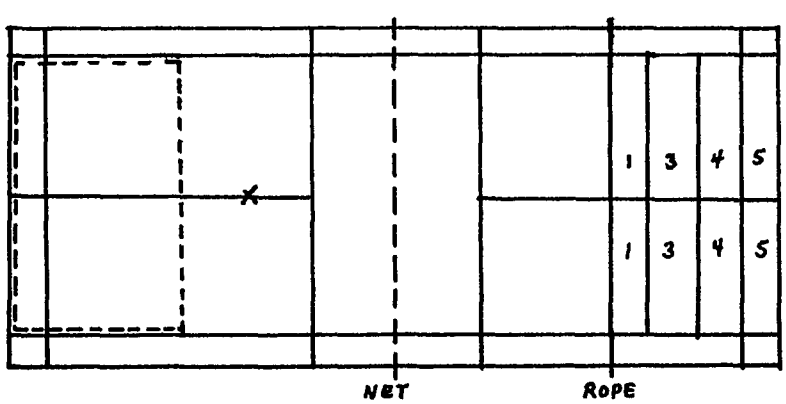


Fig. 6.--Court Diagram for Hicks Clear Test.

The Smash Test.--This test was designed to measure the ability of a student to move to a shuttle and execute the smash shot effectively. It measures accuracy and to some degree trajectory, but not speed. A rope is stretched three feet directly above the net. Lines are drawn on the court as indicated in Figure 7. The shuttle is set up by the test administrator to fall within the area designated by the dotted

lines in the diagram. The examiner sets the shuttle randomly to the left, right and center. The student stands at the point indicated on the diagram by the X. As the shuttle is set up, the player moves into position to execute the smash shot. The smash must be hit between the net and the rope and into the target area in order to score. A shot contacted by the student below the top of her head was considered a drive rather than a smash and was not allowed. Twenty trials were given.

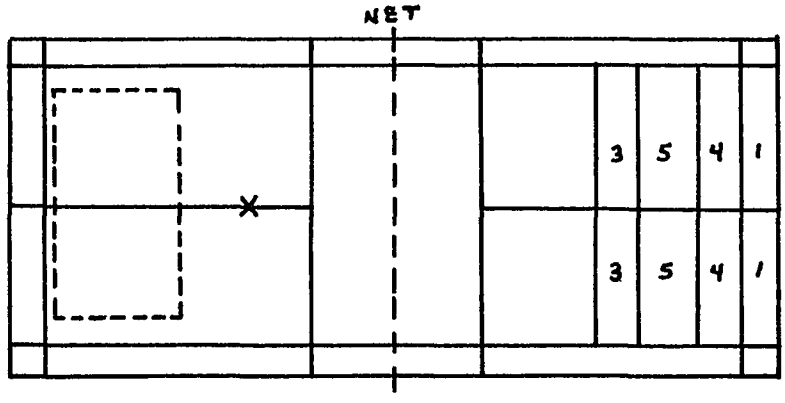


Fig. 7.--Court Diagram for Hicks Smash Test.

The Drop Shot Test.--The test consisted of the student hitting a drop shot from a shuttle set up by the test examiner. The examiner followed the same procedures for setting up the shuttle used in the Hicks clear and smash tests. The student was to move into position to execute the drop shot and hit the shot over a rope stretched eight feet and three inches above the court thirteen and a half feet from the net and under a rope stretched two and one half feet directly above the net. The shuttle had to land in the target area diagrammed in Figure 8. Twenty trials were given each student.

The Footwork Test.--The Hicks footwork test used a pattern similar to the French-Stalter diagonal test. The pattern for the test

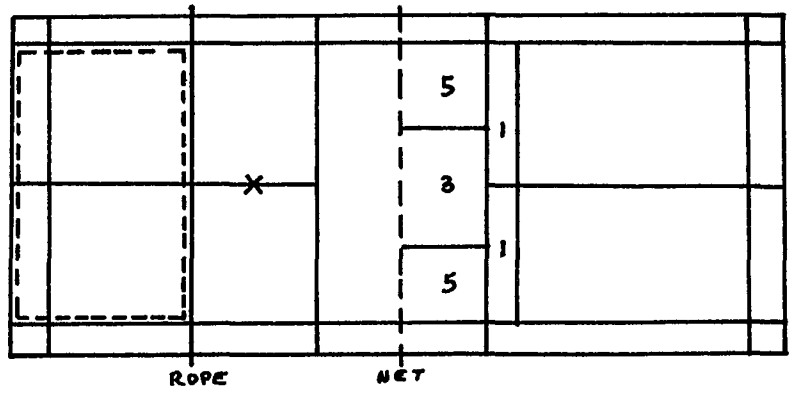


Fig. 8.--Court Diagram for Hicks Drop Shot Test.

is given in Figure 9. The player begins on the position marked by the X, moves to A and back to X, then to B and back to X, then to C and back to X and to D and back to X. The player completes this pattern as many times as possible in thirty seconds. One point is scored each time the player touches the positions A, B, C, D, or X. Three trials are given.

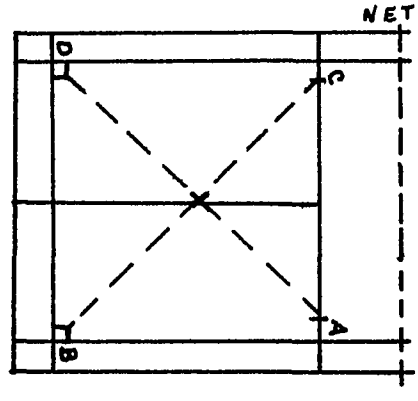


Fig. 9.--Court Diagram for Hicks Footwork Test.

The Strategy Test.--The Hicks strategy test utilized the court markings for the smash, clear and drop shot tests. One rope was stretched eleven and one half feet from the net and eight feet three inches from the floor and a second rope was stretched three feet directly above the net. The test administrator set the shuttle so that

it went into the same area as used in the clear, smash, and drop shot tests. The examiner set the shuttle for the clear, drop shot and smash in random order. Each student was given twenty trials. Each trial was scored on whether or not the correct shot for the situation was attempted and then on whether the shot landed on the appropriate target.

Sixty-four students enrolled in badminton classes for the required physical education program at Texas Women's University were the subjects of this study. Four criteria were used to determine the validity of the tests: (1) the subjective rating of the particular skill by three judges, (2) the subjective rating of playing ability by three judges, (3) the tournament standings of the players, and (4) the combined totals of (2) and (3). The validity coefficients determined by the various criteria are given in Table 5.

The validity coefficients for the drop shot and footwork tests are considerably lower than those of the other three tests. None of the tests by any of the criteria was valid according to the standards suggested by Barrow and McGee. The clear and strategy tests approached acceptable validity when the criterion of the judges' ratings of the students' playing ability was used.

The reliability of the tests was calculated by the Split-Halves method and the Spearman-Brown Prophecy formula. These are given in Table 5. The clear and smash tests were acceptably reliable and the footwork test was close. The reliabilities of the drop shot and strategy tests were low.

TABLE 5

VALIDITY AND RELIABILITY COEFFICIENTS
FOR THE HICKS BATTERY

	Validity				Reliability
Test	(1)	(2)	(3)	(4)	
Clear	.64	.66	.46	.61	.89
Smash	.56	.63	.48	.55	.83
Drop Shot	.22	.21	.15	.17	.62
Footwork	.36	.33	.35	.36	.77
Strategy	.64	.68	.54	.61	.42

No multiple correlations were given for the battery. The only single test that approached being a valid measure of badminton playing ability, the strategy test, had an extremely low reliability coefficient. Neither this battery nor the tests within it seemed to be practical for the situation of this study. The test items called for too many lines and ropes. The time it would take to set up the gymnasium for the test would be great, and the time it would take to administer the test would be prohibitive.

Individual Skill Tests

The McDonald Clear Test (88)

McDonald developed a clear test similar to the French test. It, however, had more scoring areas and more ropes. One rope was placed seven and one half feet directly above the net. Others were placed fourteen feet from the net at heights above the floor of seven, nine, eleven and thirteen feet. The floor markings and rope set-up are given in Figure 10. There were three possible scores for each shot: (1) a shuttle going over the net rope scored one point, (2) points were scored according to which ropes the shuttle went above, and (3) points were scored according to the place the shuttle landed on the court.

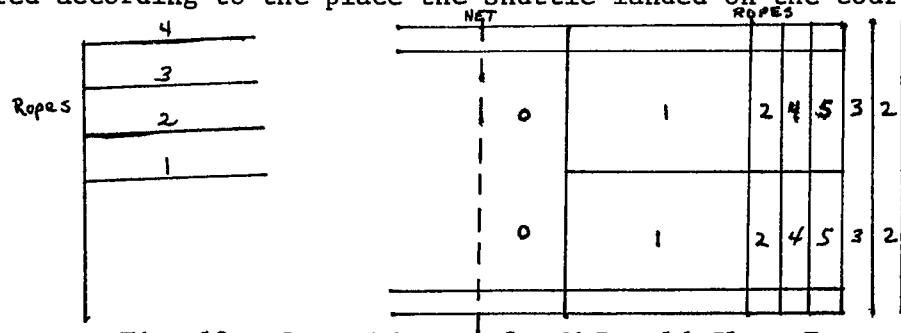


Fig. 10.--Court Diagram for McDonald Clear Test.

The test was administered to 109 subjects in four classes; some were beginners and some were advanced students. Ten trials were given each subject on each of two consecutive class meetings. McDonald used the criterion of a ladder tournament to determine the validity of the test. The coefficients ranged from .63 to .74 for the four classes.

The reliability was calculated for the height scores only, the distance scores only and the height and distance scores combined. They were, respectively, .80, .68 and .93 for beginners and .25, .64 and .80 for advanced players.

McDonald concluded that the test was difficult to administer because of the number of ropes and the number of elements in the scoring procedure. This test was not chosen for this study for the same reasons basically.

The Griot Clear Test (104)

The Griot Clear Test utilized a rope two feet directly above the net and a fan-shaped target. The target was constructed to give the clears to the corners more points than those to the middle. The court markings and scoring areas are shown in Figure 11. The shuttle was set up by the test administrator to the student standing in the position marked X in the diagram. The subject was to hit the shuttle over the rope and into the target area to score. Twenty trials were given.

The test was administered to forty-five students enrolled in beginning classes at the University of North Carolina at Greensboro.

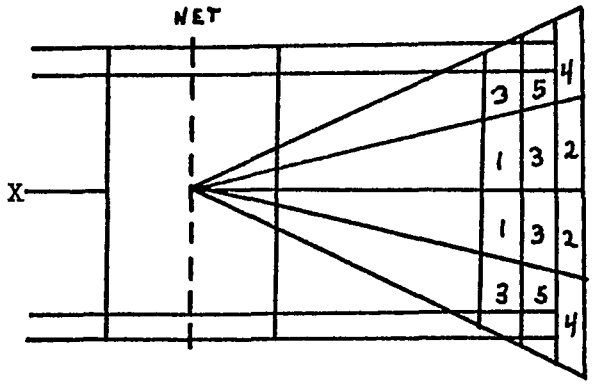


Fig. 11.--Court Diagram for Griot Clear Test.

The validity of the test was determined by comparing the results with two other tests, the French Clear Test and the Miller Wall Volley Test. A coefficient of .76 was obtained for the comparison with the French test, and a coefficient of .45 was obtained for the comparison with the Miller test. The test reliability, calculated on the Split-Halves method using the Spearman-Brown Prophecy formula, was .88.

This test was compared to the French Clear Test for establishing validity and reached an acceptable level. When compared with the Miller Test, however, it was low. Consequently, it did not seem practical to give this test instead of the French Test because of the difficulties involved in laying out the target.

The Miller Wall Volley Test (52)

The Miller test used a restraining line on the wall of seven and one-half feet and a restraining line on the floor of ten feet. Outdoor shuttlecocks were used in the test administration. The player served the shuttle in a legal manner against the wall and then hit it, as many times as possible, above the restraining line in thirty seconds. Three trials were given. The score was the sum of the trials.

The test was administered to 100 college women in beginning classes. Twenty of these students participated in a Round Robin tournament to act as the criterion measure for validity. The validity of the test was .83. The test was given on a test and re-test basis to determine the reliability of .94.

This test could not be used in this study. There was not a suitable wall space available in the gymnasium where all the badminton classes were taught.

The Revision of the Miller Test (89)

Susan Miller revised the original Miller test for use with high school girls. The backboard which she used was wood and did not give enough rebound for the ten-foot restraining line of the original test. The restraining line on the floor was moved to eight feet. No validity was given for this revision. The test was found to have a reliability of .63 for two trials using the Split-Halves method, and a coefficient of .83 was predicted for three trials.

This test could not be used in this study. There was no suitable wall space available.

The Lockhart and McPherson Wall Volley Test (47)

This test utilized a five-foot restraining or net line on the wall and six and one-half and three feet restraining lines on the floor. The player had to stand behind the six and one-half-foot line and serve the shuttle legally against the wall. After the serve the player could move up to the three foot line in hitting the shuttle as

many times as possible in a thirty second period. If the player missed the shuttle during the trial, she had to return behind the six and one-half-foot line to begin another shuttle with a legal serve. Three trials were given and the score was the sum of the three trials.

The test was given to fifty students. Twenty-seven of these played a round robin tournament for the criterion measure for test validity. It was found to be .60. The test was given on the re-test basis to determine reliability. It was found to be .90.

None of the wall volley tests could be used in this study. There was not a suitable wall in the gymnasium where badminton was taught.

The Greiner Short Serve Test (82)

The Greiner serve test was designed to measure the deviation of the short serve from its desired flight and target. Greiner placed four ropes directly above and parallel to the net. There were ten inches between each of the ropes. A fan target showing both lateral and length deviation from the target center was marked on the court. The court set-up is shown in Figure 12. Each serve was scored by its height in crossing the ropes and by both its lateral and length deviation from the target center.

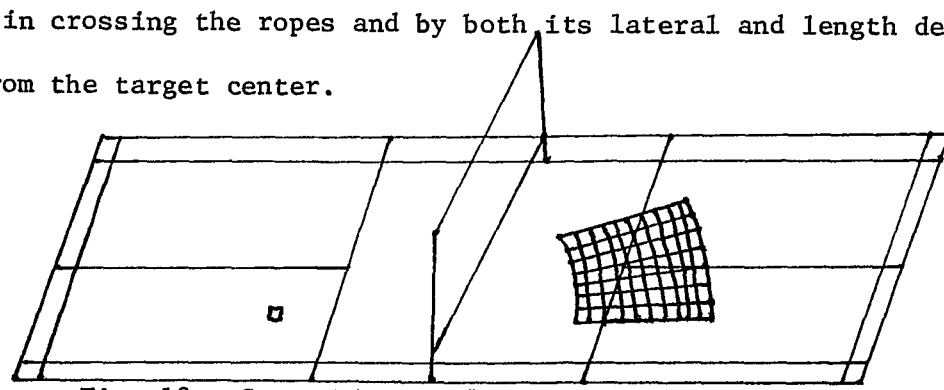


Fig. 12.--Court Diagram for Greiner Serve Test.

This test was given to ninety-three beginning badminton players who were high school senior girls. Ten trials were given to each student on each of two days. Logical validity was assumed for the test and the reliability coefficient was found to be .75. Greiner concluded that more than twenty trials were necessary for a reliable score. Greiner gave the French serve test to the same group of students using the same procedures. The reliability for the French test was .729. The Greiner test may have been slightly more reliable than the French test when given to this group.

The target area for this test would be difficult to construct and the rope set-up difficult to install. The small difference in reliability between this test and the French test probably would not warrant the added difficulty in administration.

The Scott and Fox Long Serve Test (13)

This serve test utilized a restraining rope fourteen feet from the net and eight feet above the court. The court markings and scoring areas are given in Figure 13. Each student received twenty trials from the left service court. The test was given to forty-five subjects at the University of Iowa. The validity was .54 when correlated with subjective ratings made by three judges. For this same group, the reliability calculated by the Split-Halves method was .77. The test was also given to 332 players. The reliability calculated by the same method was .68 for this group.

The validity and reliability coefficients were fairly low for this test, but higher than the validity or reliability coefficients for

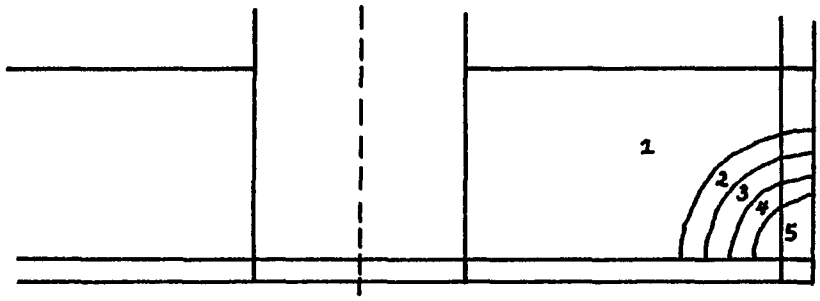


Fig. 13.--Court Diagram for Scott-Fox Serve Test.

the French short serve test. However, little consideration was given to using this test as a part of the battery in this study because the size of the classes prohibits the playing of many singles matches by the students. Consequently, the students do not have much opportunity to need this skill.

Bowling

The investigations in bowling relating to this study have involved setting up scales for beginners and intermediates and constructing learning curves. No studies were found that indicated the number of games or any other measure that yielded a statistically reliable and valid measure of bowling ability.

The Cottrell Scales (21)

Cottrell presented scales for beginning and intermediate women bowlers in service classes at Purdue University. A separate scale was made for each game number in the semester from the first game bowled to the nineteenth. Means, standard deviations and suggested grades were also given for each game number. Separate scales were made for beginners and intermediates.

The Martin Norms (50)

Martin presented norms based on data from 704 college men and women students classified as beginners, intermediates and advanced bowlers. These students had two periods of bowling a week for thirteen weeks. The test consisted of the students bowling three games. The first measure was made after the students bowled five games in class and the second measure was taken after they had bowled twenty-six games.

Martin found that there was a significant difference between men's and women's scores for each group. No difference was found between the improvement scores of men and women students. However, the improvement of intermediate students was only half that of beginning students although the standard deviation was almost the same for both groups.

The Martin and Keogh Norms (51)

Martin and Keogh developed norms for non-experienced and experienced men and women bowlers based on the performances of 320 men and women college students. The students were enrolled in bowling classes which met two times a week for thirteen weeks. The students who had bowled ten lines or less at the beginning of the course were classified as non-experienced bowlers; those who had bowled more than ten lines prior to the course were classified as experienced bowlers. Martin and Keogh found that men average about twenty pins more than women of similar experience. The non-experienced group improved

an average of about twenty-three pins while the experienced group only improved on an average about seven to eight pins.

The Phillips and Summers Norms and Learning Curves (57)

Phillips and Summers grouped the students into four categories according to the scores they made on the first five games bowled during the course. The students were classified as superior, good, average or poor. Each five games during the semester the scores for each group were averaged to build the learning curves for each ability group. Phillips and Summers found that the original groupings were maintained throughout the semester and that the group curves never overlapped.

Golf

Golf tests have been developed using various clubs, target areas and types of balls. These are presented in this review in the chronological order of their appearance in the literature.

The Clevett Tests (20)

Clevett developed three tests for measuring achievement in golf: (1) a test for the brassie and mid-iron, (2) a test for the mashie, and (3) a test for putting.

The Brassie and Mid-Iron Test.--Two mats two feet by three feet were placed twenty-one feet from the target. The player stood on one mat and hit the ball from the other. The target was ten feet square and marked off into twenty-five equal squares. It hung vertically. The values on the target were based on desired distance, accuracy and best hit. Best hit meant, for example, that it was better to hook

than slice. The scoring areas of the target are given in Figure 14. Ten shots were taken with the brassie and ten with the mid-iron.

4	6	6	6	2
4	8	10	8	2
4	9	10	9	2
3	7	10	7	1
3	5	5	5	1

Brassie-Mid-Iron

1	4	5	4	1
1	7	7	7	1
3	9	10	9	3
3	8	8	8	3
2	6	6	6	2

Mashie

Fig. 14.--Target Areas for Brassie-Mid-Iron Test and Mashie Test.

The Mashie Test.--The target was marked on the floor for this test. It had twenty-five equal areas each four feet square. The front edge of the target was fifteen feet from the mats used as the hitting area. The students were given ten trials. The scoring areas are shown in Figure 14.

The Putting Test.--The putting test used a strip of carpet twenty-seven inches wide and twenty feet long. The starting line was eight feet from the front of the target area. The target was divided into forty-eight areas each nine inches square. The students received ten trials. The test area is illustrated in Figure 15.

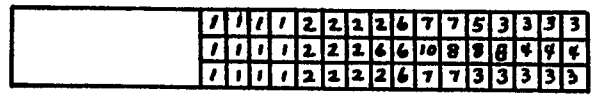


Fig. 15.--Test Target for Putting Test.

No results of the tests were given and, consequently, there was no statistical evidence to determine the validity or reliability of the tests. The test would not be very difficult to administer if adequate materials for constructing several targets for each test were available.

The McKee Full Swing Test (49)

McKee constructed tests to determine the range, velocity, angle of impact and angle of deviation of the ball using the five and two irons. She compared using hard balls to using cotton balls in administering the tests.

The Hard Ball Test.--The hard ball test used an area 80 yards wide and 175 yards long. The area was marked off at five yard intervals. Each student was given twenty trials. A ball rolling on the ground or in the air less than .6 of a second did not count as a trial. Distance was measured from the starting point to the point where the ball first touched the ground; distance was measured along the intended line of flight and by the deviation from this line. Time was measured by the length of time the ball was in the air from impact to touch down. The trigonometric functions were used to set up the tables for the range, velocity, angle of impact and angle of deviation of each shot.

The Cotton Ball Test.--The area for the cotton ball test was twenty feet wide and thirty feet long. Twenty trials were given each student. A ball in the air .4 of a second or less was not considered a trial. The range was determined directly and the trigonometric functions were used to determine the remaining measures. This test had

the advantage of taking less space to administer than the hard ball test.

McKee found that only ten trials were necessary to obtain a reliable score for the hard ball test. The reliabilities for the various measures ranged from .81 to .95. However, the range was the only reliable measure for the various measures of the cotton ball test. The correlation between the two tests for the various means ranged from .49 to .80. The highest relationship was between the ranges of the two tests.

The scoring procedures for the test seemed impractical for use with large groups of students. No validity was given for the test.

The Vanderhoof Test (92)

Vanderhoof developed a test for use indoors. The clubs used were the two wood and five and seven irons. Plastic balls were used. A target area seventy-four feet long and twenty-seven feet wide was set up. A rope was placed fourteen feet from the starting line and eight feet above the floor. Vanderhoof does not make it clear whether the ball must go over or under the rope. Behind the rope the target area is marked into three successive twenty-foot areas. These are given the scores one, two, and three, from the closest to the farthest. Each student is given fifteen trials.

Subjective ratings were used to determine the validity of the tests. The validity coefficient of the drive test was .71 and for the five iron test, it was .66. The reliability of the tests were .90 for

the drive test and .84 for the five iron test. When the scores for the two tests were combined, the multiple correlation coefficient was .78.

The results of this test would meet the standards for using it for this study. However, Vanderhoof reported that it took six trained test administrators forty-five minutes to give the test to six students. This would make it impractical for use unless a better system could be devised for testing. Whether the ball is to go over or under the rope also would have to be determined.

The Chui Test (19)

Chui developed tests for the four and seven irons for men and women students. The target area for all the tests consisted of three concentric circles with radii of ten, thirty, and fifty feet. The point values of the three were, respectively, three, two, and one points. The distance from the target to the hitting line for men was 115 yards and for women was 100 yards in the four iron test and 85 yards for men and 70 yards for women in the seven iron tests. In addition to the scores received for the target area, points were awarded each shot for the following characteristics: ball travelled ten yards or more in the air, no slice or hook and correct trajectory for the club. A shot received one point for each of these criteria which it met.

Each student was given five strokes with each club. The reliability of the test was calculated by the test-retest method. For men students, the reliabilities for the seven and four iron tests respectively were .87 and .86. For women students the reliabilities for the seven and four iron tests respectively were .84 and .75.

Three of the four reliability coefficients met the acceptable level. However, there was no evidence that the test was a valid measure of golf playing ability. It did not take into consideration either hitting with the woods or stroking with the putter.

The Purdy and Stallard Test (60)

Purdy and Stallard constructed two tests, one for distance and one for accuracy. Together they were considered a measure of playing ability by their authors. A five iron was used in the distance test and the student could use a five, seven or nine iron in the accuracy test. The field was marked off at five yard intervals for the distance test. Each hit was measured to the nearest yard. Fifteen trials were given. The field was marked off into fifteen concentric circles for the accuracy test. Each had a radius fifteen feet greater than the one preceding it. The hitting area was ninety yards from the center of the target. The target areas scored fifteen, fourteen, thirteen . . . and one points from the center to the outer most circle. Fifteen trials were given.

The reliability of the distance test was .82 and the reliability of the accuracy test was .81. Both the tests used irons. The authors considered the two tests together a measure of playing ability. However, the test did not cover either wood play or putting.

The West and Thorpe Test (74)

West and Thorpe constructed an eight iron test for the approach shot. A target of six concentric circles was constructed each with a diameter one and one half yards greater than the preceding one. The

score values for the circles were seven, six, five, four, three and two; one point was awarded if the ball did not reach the circles. The hitting line was twelve yards from the pin marking the center of the circles. In addition to the points scored on the target area, each hit was subjectively rated. One point was awarded for a topped ball; two points were given for a ball with a projection of less than thirty degrees, and three points were awarded for a ball with a projection of thirty degrees or more. Each student was given two practice shots and then twelve trials on each of two days.

The reliabilities of the test when twelve and twenty-four trials were taken on the same day were .82 and .90 respectively. The reliability for twelve trials taken on each of two days was .75. A limited study for validity was made. The scores for 10 experienced golfers and 424 beginners were compared to the mean averages of rounds of golf. The resulting calculations showed a difference significant at the .005 level.

This test measured only one skill. The number of hits necessary for a reliable score would be prohibitive for this situation because each shot had to be subjectively rated.

Tennis

Many different skill tests have been developed for the basic tennis skills. The batteries of performance tests are presented first in this review, followed by the ground stroke tests and serve tests.

Skill Test Batteries

The Edgren Battery (6)

The Edgren battery of tests consisted of a serve test for accuracy, ground stroke tests for accuracy, a volley test, and a ground stroke or volley test for speed.

The Serve Test.--The serve test consisted of the player serving five balls into a target area thirty-nine feet away. The target was two feet by ten feet and was divided into fifteen equal parts, as illustrated in Figure 16.

0	1	2	1	0
1	2	3	2	1
0	1	2	1	0

Fig. 16.--Target Area for Edgren Serve Test.

The Ground Stroke Test.--The forehand ground stroke test for accuracy consisted of the player beginning at the left end of the back-court, tossing the ball over a line fourteen feet away along the base-line and running to hit it on the first bounce. The scoring area was across the net and sixty-nine feet away from the starting line. The target was nine feet by twenty-seven feet and divided into nine equal zones. Five trials were given. The target area and scores for each zone are given in Figure 17.

1	3	1
2	5	2
1	3	1

Fig. 17.--Target Area for Edgren Ground Stroke Test.

The backhand test followed the same procedures, except that the student began from the right corner of the court and tossed the ball to his left.

The Volley Test.--The volley test consisted of rallying against the wall from fifteen feet away for fifteen seconds. One trial was given.

The Speed Test.--The speed test consisted of hitting the ball against the wall from fifteen feet away for fifteen seconds either volleying or using a ground stroke. One trial was given.

No statistical results were given for the Edgren tests. They appeared to be the forerunners of several later tests.

The Hewitt Battery (39)

The Hewitt battery consisted of a forehand test, a backhand test and a serve test. The tests were given to sixteen varsity and junior varsity men, thirty-six advanced men and women students and ninety-one beginners.

The Forehand and Backhand Tests.--The court was set up in the same way for both the forehand and backhand tests. A rope was stretched above the net seven feet from the court. The backcourt was marked off into four equal areas by lines parallel to the baseline. A diagram of

the court situation is given in Figure 18. The values of the various areas are indicated in the diagram. The student stood at the center of the baseline. The instructor stood on the opposite court near the center of the net. He hit balls to the student for the student to hit into the target area for score. The balls hit by the instructor were to bounce near the service line. The student received ten balls to the forehand side and ten balls to the backhand side. Balls going over the rope scored one-half the value of the scoring area where they landed.

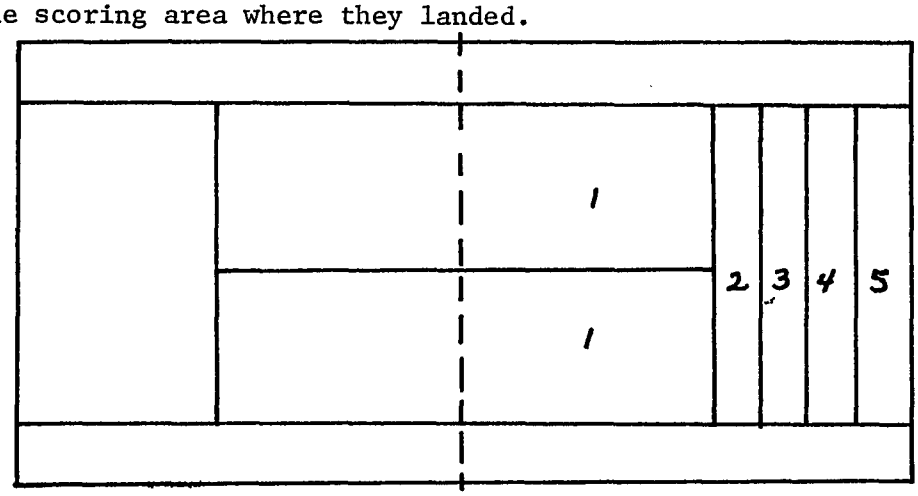


Fig. 18.--Diagram for Hewitt Forehand and Backhand Test.

The Serve Test.--The complete directions for the serve test are given in the Procedures Chapter. The right service court was marked off for the target area. Point values for this area were from one to six. Beyond the baseline two lines were drawn to measure the velocity of the ball. The first was ten feet from the baseline and the second twenty feet from the baseline. The areas for scoring on the velocity portion of the test were the backcourt, the two areas marked by the baseline and the drawn lines and the fence. The accuracy of the serve was measured by where it

landed in the service court. The velocity of the serve was measured by where it hit on the first bounce. The serve had to go under a seven foot restraining rope stretched above the net. Ten trials were given.

The validity of the battery was determined by the results of round robin tournaments. All the tests showed a significant relationship to the tournament results at the one per cent level except the drive tests for the varsity and junior varsity group. These were significant at the five per cent level. The reliabilities of the tests by the test-retest method were .75 for the forehand test, .78 for the backhand test, .94 for the serve placement test, and .84 for the serve speed test. Grading scales were presented for each of the ability groups.

The reliabilities for the drive tests were not high, but the reliability for the serve tests was very good. There was some question about the objectivity of the drive tests unless the same person hits all the balls to all the students. Hewitt suggests that a ball throwing machine may be used if available. The statistical evidence for the serve tests was very good. It appeared to be a suitable test for this study.

Individual Skill Tests

The Dyer Wall Volley Test (25)

The original Dyer wall volley test had no restraining line on the court and the net line was painted on the wall. The student was to hit the ball as many times as possible against the wall in

thirty seconds. Three trials were given. The score was the number of times the ball hit above the net line minus the number of balls over one used to take the test. The total of the three trials was the score for the test.

The test was given to 736 students in nineteen colleges and universities. The validity coefficient for the test given in the various colleges used criteria either of (1) grade and round robin tournament, (2) one judge, or (3) three judges. The resulting coefficients respectively ranged from (1) .38 to .70, (2) .61 to .96, and (3) .85 to .90. Reliability was determined by the test-retest method. The coefficients ranged from .87 to .90.

This test could not be used in this study. There was not a suitable wall available for giving this test.

Dyer's Revision of the Dyer Test (26)

The revision called for a five-foot restraining line on the court. A box of balls was provided for use by each player. The ball had to be bounced each time a new ball was started. Again, there were three thirty-second trials. The number of hits above the net line while the player was standing behind the court restraining line was the score. The sum of the three trials was the total score for the test.

Dyer found the validity of this test to be .92 with a criterion of tournament standings. The reliability coefficient for it was .92. Both coefficients for the revision were slightly better than those of the original test.

This test could not be used in this study. There was not a suitable wall available for giving this test.

The Scott Revision of the Dyer Test (13)

This revision of the Dyer wall volley test placed a restraining line on the court twenty-seven and one-half feet from the wall. The same procedures and scoring used in the Dyer revision were used in the Scott revision.

The test was given to 468 University of Iowa students to study the validity of the test. Three judges rated the stroke form and footwork of each student for the criterion measure. The coefficient was .61. No reliability coefficient was given.

Scott and French commented that the distance from the wall was increased to encourage better form. Consequently, they stated that probably it should never be closer than twenty-four feet, but could be increased to as much as thirty-six feet if the wall was very fast. This test could not be given in the study because there was not a suitable wall space for giving it.

The Hewitt Revision of the Dyer (40)

The Hewitt revision placed the restraining line at twenty feet. The time did not start until the first ball hit the wall. The score was the average of the three thirty second trials.

Hewitt tested ninety-one beginners and thirty-one advanced players. The validity coefficient was determined by comparing the best performance with the results of round robin tournaments. The coefficients ranged from .68 to .73 for beginners to .84 to .89 for

advanced players. The reliability was determined by the test-retest method and was .82 for beginners and .93 for advanced players.

This test could not be used in this study. There was not a suitable wall space available for administering it.

The Shay Wall Volley Test (67)

Shay used a seven-foot restraining line on the court to classify students from beginning to varsity players for a prep school tennis team. Sixty boys took the test. Shay classified twelve as varsity, twenty-four as intermediates and twenty-four as beginners. The students were placed on a ladder tournament according to the results of the testing. The tournament was played during the entire season. Shay found that only slight changes in positions occurred during the season.

This test could not be used in this study. There was not a suitable wall space available.

The Koski Wall Rally Test for College Men (113)

Clarke reported this test for college men. The restraining line was twenty-eight feet from the wall. The validity coefficient was determined by comparison of the test performances and the tournament rankings of the students. The coefficients ranged from .51 to .68. No reliability coefficients were provided.

The Broer and Miller Test (17)

The complete directions for this test are given in the Procedures Chapter. Basically, the student was to stand behind the baseline, drop the ball and hit it between the net and a restraining rope

four feet above the net into the opposite court. The opposite court was marked into scoring areas by lines parallel to the baseline. Each player received fourteen trials on the forehand and fourteen trials on the backhand.

Broer and Miller gave the test to thirty-two beginners and twenty-seven intermediates. The criterion measure used to determine the validity was the subjective ratings of three judges for the beginners and two judges for the intermediates. The resulting coefficients were .61 for beginners and .85 for intermediates. The reliability coefficient for each group was calculated by comparing the total of the first seven trials against the total of the second seven trials. The resulting coefficients were .80 for beginners and .80 for intermediates.

The validity coefficient for beginners did not reach the acceptable level, but for intermediates it did. The tests reached the lower limit of the acceptable range for reliability coefficients. It appeared that this test could be used for this study if it were combined with other measures to give a more complete picture of tennis playing ability.

The Fox Study of the Dyer Test and the Broer-Miller Test (29)

Fox studied the validity of each of these tests when compared to the subjective ratings of four judges and made a comparison of the two tests. She used eighty-four subjects who had had twenty lessons. The judges rated each student on the forehand, backhand and serve. Comparisons of the tests were made before the students had had any experience volleying against the wall and after practicing against the

wall. She found the validity of the Dyer test to be .53 and the validity of the Broer-Miller to be .61. Combining the scores from the Dyer and the Broer-Miller tests and comparing them to the subjective ratings, she found the coefficient to be .51 when the students had no experience hitting on the wall, and .81 when the students had practiced on the wall. Fox correlated the scores from the two tests and found this coefficient to be .69 with no wall practice, and .37 with wall practice. She concluded that practice against the wall improves the validity of the tests and that the low correlation between the two tests indicates that they measure different factors.

The Driver Test (5)

Driver published a test in 1936, in which the ball was either thrown by a machine or a test administrator. The court was set up as illustrated in Figure 19. A rope was placed ten feet from the ground above the net. The ball was tossed so that it landed in the circle. The player stood at point X. The player received ten trials on the forehand and ten trials on the backhand. Balls landing in the forecourt counted one point and balls landing in the back court counted two points. No statistical evidence was given for the test. It appears to be the forerunner of several tests.

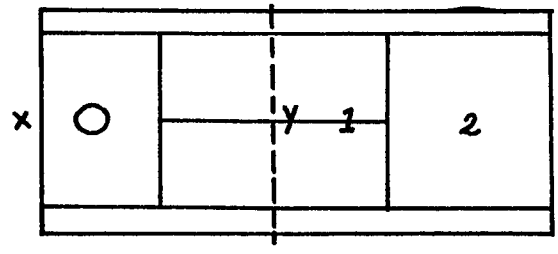


Fig. 19.--Court Diagram for Driver Test.

The Knuttgen Ball Boy Test (86)

Knuttgen developed a test to determine the velocity and accuracy of the ground strokes using the ball-boy machine. For the velocity test the machine was set on "soft hit" and placed at the intersection of the center and service lines. It was aimed so that the ball hit approximately half way between the base and service lines and one-third the distance from the sideline to the center of the court. A target three feet square was placed upright so that its lower edge was nine inches above the net. The velocity was measured by the time it took the ball to travel from the racket of the player to the target. Nine beginners and nine advanced players were tested. The reliability coefficients for the two groups were .92 and .84 respectively.

The ball-boy machine was set on "hard hit" for measuring accuracy. The machine was located at the intersection of the service and side line and projected the ball to the center of the backcourt. The center of the target was placed on the court sixty inches from the service line and eighty inches from the left side line. The radius of the center circle was two and one-half feet. Four concentric circles were then drawn, each with a radius two and one-half feet greater than the one preceding it. The scores from the center to the outer most circle were five, four, three, two, and one. Nine beginners and nine intermediates took the test. The reliability for the beginners was .74 and, for the advanced players, it was .85 using the Split-Halves method.

The reliability coefficients for this test were acceptable except for the beginners taking the accuracy test. No validity

coefficients were given. It would be a more time consuming and difficult test to administer than some others in the literature.

The Timmer Ball-Boy Test (91)

Complete directions for the Timmer Test are given in the Procedures Chapter. The test was developed for advanced players. The ball-boy machine was placed on the baseline and threw the ball so that it landed approximately half way between the service and baselines and half way between the side line and center of the court. The machine was set on high speed. The player stood in an area behind and adjacent to the center of the baseline. A rope was stretched fifty-one inches above the net. The player had to hit the ball between the net and rope and into the opposite court to score. The opposite singles court was divided into seven scoring areas. The entire forecourt had a value of one point. The backcourt was divided into six areas of approximately equal size by one line parallel to the baseline and two lines parallel to the sidelines. The corners received the greatest score value--five points. The player was to alternate hitting the ball to the right and left corners of the court. Timmer did not make it clear about the number of trials given for the forehand and backhand drives.

The test was given to sixteen students who either were members of the men's freshman tennis team or the women's extramural team. The test validity was based on tournament standings. The Spearman-Rho formula was used. The coefficients for the men and the women in the study were highly positive at the .05 level. No reliability coefficients were given.

The Kemp and Vincent Rally Test (46)

The Kemp and Vincent rally test had two students of similar ability take opposing positions on the court. Each player had two tennis balls. One player put a ball into play with a courtesy stroke, and the two players rallied the ball until it was unplayable. If the players used all the balls before the three minute rally period was up, they were responsible for retrieving the balls and continuing the test. The score for each player was the total number of hits for the two players, including the courtesy strokes, minus the number of errors by each player.

The test was administered to thirty beginners and twenty-four intermediates. The validity of the test was determined for each group by comparing the test performances to the results of a round robin tournament. The coefficients for beginners was .84 and for intermediates was .93. The test results compared to the results of the Scott revision of the Dyer test yielded a coefficient of .80. The reliability of the test was found to be .86 for beginners and .90 for intermediates.

Kemp and Vincent emphasized that players of similar ability should be paired. Properly pairing the students would be the biggest problem with this test. If players were not of similar ability quite different results probably would occur.

The Jones Serve Test (85)

The Jones serve test used velocity, trajectory and accuracy measures. The velocity was calculated by measuring the time it took

for the ball to travel from the release of the ball for the toss until it hit the court or an object. The trajectory was measured by determining between which of the ropes stretched directly above the net the ball travelled. Ropes were placed above the net at one foot intervals to a height of ten feet. The accuracy factor was measured by where the ball landed in the service court. The service courts were marked as indicated in Figure 20.

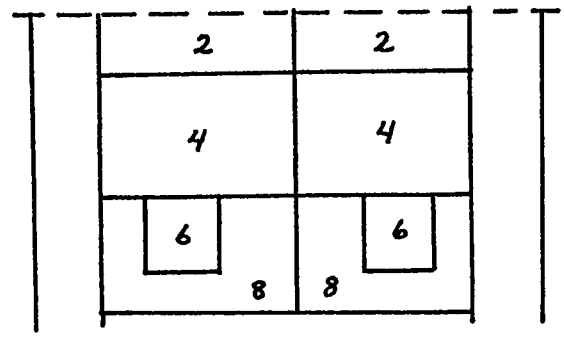


Fig. 20.--Court Markings for Jones Serve Test.

Twenty trials were administered, ten to the right and ten to the left service courts. The test was administered to eighty-nine twelfth grade girls. The validity of the test was determined by comparing it with the Driver Serve Test. This coefficient was .970. The reliability of the test was calculated to be .920 by the Split-Halves method.

The statistical evidence presented for this test is very impressive. The difficulty in administering it would be in stretching ropes at one-foot intervals for seven heights.

The Wisconsin Serve Test (79)

Edwards reported her findings on the serve test developed at the University of Wisconsin. The test measured both velocity and

accuracy. Complete directions for the test are given in the Procedures Chapter. A restraining line was placed forty-two and one-half feet from a wall. The wall was marked off with parallel lines at one-foot intervals from the ground to a height of eleven feet. The student stood behind the restraining line and served ten balls against the wall. The velocity was measured by the time it took the ball to travel from the racket (at impact) to the wall. The time score was converted to a number which could be added to the accuracy score. The accuracy was determined by the space in which the ball hit on the wall. The total test score was the converted scores for velocity plus the accuracy scores for each trial. Any ball which did not hit the wall directly from the contact with the racket did not count as a trial.

The test was given to forty-five subjects who varied in ability from beginner to advanced player. Edwards found that the test yielded a validity coefficient of .887 when subjective ratings were used as a criterion. Ten trials of the test were given on one day yielding a reliability coefficient of .844. Twenty trials of the test given over a two day period yielded a reliability coefficient of .956.

The statistical evidence for this test was very good. It appears to be a test that would be easy to administer and not very time consuming.

The Whackit Racket Serve Test (79)

Edwards used a racket developed by Dr. Frances McPherson to develop the whackit racket test. A light weight racket with a four and one half inch grip and no strings was used. A solid cloth cover

was placed on one side of the racket head. A cover was placed on the other side which had a circular hole at the center one inch wider at the center width and two inches wider at the center length than a tennis ball. The student tossed the ball for the serve and made the serve stroke trying to make the tossed ball enter the cover through the circular hole. Twenty trials were given. The test was scored from zero to four points, for each hit, according to the sound made by the ball as it hit in the cover.

The same students who took the Wisconsin serve test were the subjects of this study. No validity coefficient was given and the reliability coefficient was .451. The low reliability coefficient and the difficulty in constructing the racket for the test would not make it practical.

Summary

The related literature concerning the proficiency testing programs that have been developed in Physical Education indicated that there is a trend toward including more proficiency testing programs as a part of the Physical Education curriculum. More programs have been reported for the professional student's curriculum than for the required activities curriculum. Almost all programs use skill testing as a means of establishing proficiency; knowledge testing is not as widely used in the programs as skill testing. Most programs use skill and knowledge tests in some activities and only skill evaluations in others. Many more subjective skill measures are utilized than objective skill measures. Some programs use combinations of subjective and

objective measures for an activity. No standardized knowledge tests are being used. All knowledge tests are made by the department or instructor concerned. A meaningful description of the cut-off point being used for passing or failing is given very rarely. Very little statistical data have been reported for the tests being used in these programs. Validity and reliability coefficients have not been reported, nor have means and standards been reported. Almost all programs have been developed for either men or women. Only two that have been reported included both men and women students within the same program.

After reviewing the knowledge test series and individual tests related to the activities in this study, it was determined that no series or single test could be used wholly as a measure of knowledge for this study. However, many questions from these tests could be used in constructing tests for this study; other questions would suggest ideas for the construction of questions and responses for these questions.

It would appear from the evidence in the literature that either the test used by Bohn, the Chicago or Flint Rounds, or the AAHPER test could be used in assessing archery skill for this study. All were reported as reliable measures, and one was reported as statistically valid while the others assumed face validity. However, the Bohn test and the Chicago and Flint Rounds would be less appropriate than the AAHPER test for the situation in this study because the students, according to the archery instructors at Memphis State University, have not often experienced shooting from distances greater than twenty yards or at targets less than forty-eight inches in diameter. It would

appear more advisable, consequently, to adapt the AAHPER test to the age group in this study.

Neither of the batteries reviewed for assessing badminton skill appeared suitable for this study. The Wrist Volley Test in the French-Stalter battery could not be given because there was no suitable wall space available. The Clear and Serve Tests did appear to have possibilities for use in this study, although the reliability and validity coefficients presented by French and Stalter did not reach the acceptable level. The items in the Hicks' battery would be very difficult to administer because of the many lines and ropes and because of all the shuttlecock set-ups by a test administrator needed in the test. The McDonald Clear Test and Griot Clear Test are more complex versions of the French-Stalter Clear Tests. They would be much more difficult to set up than the French-Stalter Test. None of the wall volley tests could be used because there was no wall space available. The serve tests reviewed seemed either too impractical to set up or inappropriate for the students in this situation.

It would be impossible to know if any of the scales developed in the bowling studies could be used without testing the students at Memphis State University to determine their similarities or differences to the groups in the studies. None of the studies presented any statistical evidence of the reliability of the scores obtained. It seemed plausible, consequently, to develop norms for the students at Memphis State University rather than try to fit them into one of these scales.

None of the tests found in the literature related to golf appeared to be appropriate for determining golf playing ability. Most measure only one or two of the many aspects of the game.

Neither of the tennis batteries reviewed appeared totally suitable for this study. The Edgren tests appeared to be forerunners to several more sophisticated tests. The Hewitt Serve Test from the Hewitt battery appeared to have promise for this study, but there seemed to be better ground stroke tests than those of the Hewitt battery. Varying results were obtained by the different investigators who have experimented with the wall volley tests in tennis. Most of the results have shown acceptable validity and reliability coefficients. Unfortunately, none of these tests could be used for this study because there is not a wall of sufficient height with a good rebound surface. The ground stroke test which seemed most appropriate for this situation was the Broer and Miller Test. This could be easily administered and had acceptable validity and reliability coefficients. It was unlike actual tennis play in that the ball is not moving toward the player. It appeared that the Timmer Ball-Boy Test might be adapted for the level of ability being tested in this study. The Knuttgen test was considered too time consuming to administer. Two of the serve tests reviewed seemed inappropriate for this situation. The Jones test would be difficult to set up and administer and the Whackit Racket Test had a very low reliability coefficient. The Wisconsin Serve Test appeared easy to administer in terms of time and equipment and had acceptable statistical standards. It appeared usable for this study.

CHAPTER IV

PROCEDURES

The activities included in this study were from five courses of the required activities program at Memphis State University: Archery and Bowling, Badminton, Bowling, Golf and Tennis. Archery and Bowling was a combination course; archery was taught the first nine weeks and bowling the second nine weeks during the Fall semester and the procedure was reversed for the Spring semester. This was due to the weather since all archery at Memphis State was taught outdoors. Bowling was also taught as a separate course for a full semester as were Badminton, Golf and Tennis. Each course met three hours a week in either three one hour class periods or two hour and a half class periods. One semester hour credit was given for each course.

Procedures common to both the knowledge and performance tests are described first. These are followed by the procedures for all of the knowledge tests since they were identical for each activity. The procedures for the performance tests are grouped by activity because there was considerable variation among the activities.

Procedures for Knowledge and Performance Tests

Testing Periods

Tests were given in each activity as close to the end of the unit of instruction as possible in order to obtain the truest measure

of what students had achieved. This was thought to be the best basis for establishing a standard of achievement for proficiency.

Evaluations were made in only three activities during the Fall semester: badminton, bowling and tennis. The badminton and bowling evaluations were administered in the two week period between Christmas holidays and final examinations; the first class meetings after the holidays, however, were not included in the testing period. The tennis measures were administered the week prior to the Christmas holidays because of the possibility of poor weather conditions in January.

Only skill evaluations were made in the Fall semester because there was not sufficient time to construct both performance and knowledge tests before the testing period. Performance and knowledge measurements were made for all activities in the Spring semester. All testing in the Spring semester took place during the month of May except the bowling evaluations for the Archery and Bowling combination course which were administered the first week of April.

Subjects

The men and women students enrolled in the Fall, 1969 and the Spring, 1970 classes in the respective activities at Memphis State University were the subjects in this study. All class sections were used in each activity in order to get as broad a sample as possible. Both men and women students were included except for the Archery and Bowling combination classes which were taught for women students only. Badminton and Tennis were taught as coeducational activity classes. There were, however, many more women students than men students in each

class. Golf and Bowling were taught for both men and women students but not coeducationally. The number of subjects taking knowledge tests and performance tests for each activity varied due to the fact that no provision was made for students to make-up either type of test.

Procedures for Knowledge Examinations

A part of the purpose of this study was to develop knowledge examinations for each activity which could assess proficiency in knowledges and understandings for that activity. The design of this study proposed to determine statistically the validity and reliability of each of these tests. No single standardized knowledge test was found which would meet the needs of this study, so knowledge tests were constructed for each activity.

Content Balance Determination

Each instructor teaching each activity was asked to complete a form indicating the content of that activity course as he or she taught it. The content was to be expressed as the percentage of time the instructor spent on each aspect of the activity.

Each form included the broad categories of History, Equipment, Etiquette, Values, Safety, Rules and Scoring, Techniques, Strategy and Terminology. Some of these categories had sub-divisions varying with the nature of the activity. Each form also included a space for any additional categories the instructor wished to include. An example of the form is given in Figure 21.

A consensus of the content areas and weightings to be included on each examination was drawn from this information. The extreme

TENNIS

Please estimate the approximate percentage of instructional time your tennis classes spend on each item of the course content given below.

COURSE CONTENT		APPROXIMATE % INSTRUCTIONAL TIME
1. History		1. _____
2. Values		2. _____
3. Equipment		3. _____
4. Etiquette		4. _____
5. Rules and Scoring		5. _____
6. Safety		6. _____
7. Techniques		
A. Forehand	_____	
B. Backhand	_____	
C. Serve	_____	
D. Volley	_____	
E. Lob	_____	
F. Other	_____	
		7. _____
8. Strategy		
A. General	_____	
B. Singles	_____	
C. Doubles	_____	
D. Mixed Doubles	_____	
		8. _____
9. Terminology		9. _____
10. Other		10. _____
	T O T A L	100%

Fig. 21.--Sample of Content Emphasis Forms.

percentages for each category were eliminated and the remaining ones were averaged. These averages served as guides for the content balance that should be used for constructing the examinations. The forms had not, in some instances, taken into consideration the elements common to many of the sub-categories. For example, the form for tennis shown in Figure 21, lists the various strokes as the sub-categories under Technique. It does not include as a sub-category, however, the elements common to many of the different strokes such as grip, footwork, stance, and ready position. Consequently, it was necessary to add a "General" sub-category under most of the Technique and Strategy categories. The balance between categories was not changed in making these additions. Any changes in balance were made within the category, and the balance of the sub-categories was kept close to that originally indicated. Table 6 lists for each activity (1) the number of instructors completing the forms for each activity, (2) the areas of content listed on the forms, (3) the percentage ranges of course content listed by the instructors, and (4) the percentage of each area of content included on the examination.

Type of Item

An objective type of question was chosen to facilitate ease and objectivity in grading. All of the items on the examination were best or correct answer multiple choice type questions. This type of objective question was chosen because of the statistical evidence that can be calculated to indicate the test's reliability and the question's validity. Each question had four responses.

TABLE 6

CONTENT AREAS AND EMPHASES FOR ORIGINAL TESTS

ARCHERY

Content Areas	Range in Course Content	Test Content in Per Cents
History	0 - 2	0
Values	.5 - 3	0
Equipment	2 - 10	6
Etiquette	0 - 5	1
Rules and Scoring	4 - 15	9
Safety	2 - 15	6
Techniques	45 - 97	71
Terminology	1 - 10	7
		100%

Number of Instructors = 6

BADMINTON

Content Areas	Range in Course Content	Test Content in Per Cents
History	.5 - 3	1
Values	.5 - 8	0
Equipment	1 - 5	3
Etiquette	.5 - 3	3
Safety	0 - 5	0
Terminology	3 - 6	6
Technique	50 - 72	57
Strategy	8 - 20	13
Rules and Scoring	10 - 20	17
		100%

Number of Instructors = 5

TABLE 6 (Continued)

BOWLING

Content Areas	Range in Course Content	Test Content in Per Cents
History	1 - 5	2
Equipment	1 - 10	5
Etiquette	2 - 5	5
Rules and Scoring	0 - 20	11
Terminology	2 - 10	6
Safety	1 - 10	3
Strategy	10 - 20	17
Values	2 - 6	1
Techniques	40 - 60	50
		100%

Number of Instructors = 7

GOLF

Content Areas	Range in Course Content	Test Content in Per Cents
History	0 - 5	1
Values	1 - 5	0
Equipment	1 - 5	2
Etiquette	1 - 7	4
Rules and Scoring	3.5 - 10	10
Safety	1 - 5	1
Techniques	60 - 80	66
Club Selection & Strategy	1 - 14	10
Terminology	0 - 10	6
		100%

Number of Instructors = 5

TABLE 6 (Continued)

TENNIS

Content Areas	Range in Course Content	Test Content in Per Cents
History	0 - 2.5	1
Values	0 - 5	0
Equipment	1 - 5	3
Etiquette	1 - 5	3
Rules and Scoring	5 - 20	11
Safety	0 - 5	0
Techniques	30 - 75	66
Strategy	5 - 70	10
Terminology	1 - 10	6
		100%

Number of Instructors = 7

Number of Items

Barrow and McGee state that "The number of questions in a test should be sufficient to assure some degree of reliability, but not so many that few students are able to complete it. Fifty questions is a good 'rule of thumb,' especially if they are mostly multiple-choice questions." (1:506) To insure approximately fifty good questions in the final form of the examinations, it was necessary to make the original tests longer. The first examination constructed and administered was the Bowling Examination. It was administered at the end of the first nine weeks to the Archery and Bowling classes. It contained one hundred questions. One problem was identified during its administration which caused the number of items on the remaining four tests to be reduced to seventy. All of the Archery and Bowling classes were taught in hour and a half periods, and it took almost the full period to administer the test. Many of the other classes in the other activities were taught in one hour sessions. It was evident that the tests had to be shorter if they were going to be completed. The number of items on the remaining tests was seventy. This would hopefully yield enough questions to select fifty questions for the final form of the examinations. The original Bowling Examination was maintained at one hundred questions because all of the Bowling classes met in one and a half hour periods.

Test Item Selection

Test items were selected from many knowledge tests, both published and unpublished; some items were constructed by the writer. Each knowledge test question was pasted on a separate index card and

then categorized as to type; in most instances, each question was also sub-categorized several times. Then all questions of each type and sub-type were put together. From the groupings, questions for the examinations were selected. Some questions were used in their original form. Others were edited either slightly or considerably. Still others suggested ideas for additional questions or responses to questions. The sources of the published or unpublished test items used in either their original form or after editing are listed in Appendix B.

Examination Administration

Each examination was typed and mimeographed by the secretarial staff in the Physical Education Department at Memphis State University. On the day prior to the examination day, the instructor for the course was given an adequate number of test booklets, IBM answer cards, and IBM magnetic pencils for his or her class. The test was to be administered in one class period. All of the answers were to be recorded on the IBM answer cards so that they could be machine graded by the Computer Center at Memphis State University. After the examination was given, the test booklets, answer cards and magnetic pencils were returned immediately. All of the examinations for one activity were given in two consecutive days. The examinations were administered in this fashion to prevent any instructor from teaching for the test and to prevent some students from having knowledge about the nature of the test prior to their examination period.

The directions for taking the test are stated in Appendix A. Copies of the entire original tests for each activity are given in Appendix A.

Statistical Procedures

A knowledge test was developed originally for each of the five activities in this study. The data from the bowling examination was divided into results for the group taking bowling for half a term and the group taking it for a full term. Consequently, the statistical treatments were carried out on six sets of data instead of five, and six proficiency knowledge examinations were developed.

Means and standard deviations were calculated for each form of each test. These were calculated from the per cent of questions answered correctly rather than the number of questions answered correctly. T-scales were developed for each form of each test. These were also based on the per cent of questions answered correctly.

Statistical validity was calculated for each item of the tests. The Flanagan Method using the nine, twenty, twenty, and nine per cent weightings were used for determining the index of discrimination for each item. Items for the revised test had an index of discrimination of .20 or above. The difficulty rating was calculated on the basis of the total number of students answering the questions correctly. The items selected for the revised test had difficulty ratings between .10 and .90. Any response that did not attract at least two per cent of the subjects was considered non-functional.

Reliability coefficients were calculated for each of the original and final tests. One of the Kuder-Richardson formulas was used to find this coefficient.

Procedures for Performance Tests

Skill evaluations were made for each activity. Scores from actual games were used to assess skill in archery, bowling and golf since playing ability can be measured directly in these activities. Skill tests were used in badminton and tennis in an attempt to find a test or battery that would measure playing ability.

Archery

An archery skill test was given only during the Spring semester. The skill test chosen was taken from the A.A.H.P.E.R. skills test manual, Archery for Boys and Girls. (2) The test for girls was selected since all of the subjects in archery were women. The test was developed for girls ages twelve to eighteen. The students taking archery at Memphis State were for the most part eighteen to twenty years of age. Consequently, it appeared that this test could be adapted and used appropriately for this situation.

Test Selection

The measure used most frequently to assess the achievement of college women, the Junior Columbia Round, includes ends at 20, 30 and 40 yards. The test selected required the student to shoot only from 10 and 20 yards. The A.A.H.P.E.R. Projects Committee found "that the distance of 30 yards was too great for many girls of all ages since zero scores ran from 65 per cent at ages 12 and 13 to 35 per cent at ages 17 and 18." (2:15) Therefore, only the distances of 10 and 20 yards were included for the test. In addition to the findings of the Projects Committee, the archery instructors at Memphis State indicated that most

of their instructional time was spent shooting from twenty yards or less. These were the reasons this test was selected instead of the Junior Columbia Round.

Test Directions

The A.A.H.P.E.R. Test consisted of shooting four practice arrows from each distance and then two ends from each distance. The test manual states that the reliability coefficient for this test was "not less than .70." (2:9) The test was increased in length for this study to evaluate its reliability for this situation, since it was developed for junior and senior high school girls and no information was available for college women.

The test given for this study consisted of shooting (1) one practice end at ten yards, (2) four ends at ten yards for score, (3) one practice end at twenty yards, and (4) four ends at twenty yards for score. The targets were forty-eight inches in diameter and measured forty-eight inches from the ground to the center of the gold, as in the A.A.H.P.E.R. test. Scores were recorded after each end on score cards provided for this purpose.

Test Administration

The test was completed in two consecutive class meetings. The ends from ten yards were completed the first day and the ends from twenty yards the second day. No provisions were made for absent students to make-up the test. Consequently, the total number of students taking the skill portion of the test varies from that of the knowledge portion of the test.

Statistical Treatment

The means and standard deviations were calculated for each of the distances and for the distances combined. T-score scales were developed for each distance and the distances combined.

Reliability was calculated for (1) the arrows shot from ten yards, (2) the arrows shot from twenty yards and (3) the arrows shot from both distances combined. The Split-Halves Method and the Spearman-Brown Prophecy Formula were used.

No validity coeffieicnt was calculated because shooting in archery is a direct measure of shooting ability. Face validity was assumed for this test.

Badminton

Four badminton skill tests were chosen for experimental purposes to find a test or battery that would adequately measure badminton playing ability for this situation. All four tests were administered to both the Fall and Spring semester classes. Two tests were chosen from the literature, the French and Stalter Clear Test and Short Serve Test. (31) Two tests were developed for this study, the Bounce Test and the Footwork Test.

Test Selection

The selection of these four tests was based on their apparent ability to evaluate four characteristics important in assessing degrees of badminton playing ability:

1. The ability of a player to hit the shuttle with power and accuracy.

2. The ability of a player to hit the shuttle with "touch," that is softly and accurately,
3. The ability of a player to react quickly and move the racket head rapidly, and
4. The ability of the player to cover the court.

The Clear Test (31)

The clear test was chosen primarily because it indicates the ability of the player to hit with power. This test has the drawback that the shuttle must be set-up to the subject. The other type of test that indicates this same quality is the wall volley test. This type of test could not be used because there was no suitable wall space available. Consequently, the clear test was chosen to measure this element.

Test Directions.--A badminton net was stretched across the court fourteen feet from the net and parallel to it so that the top of the net was eight feet above the floor. Lines were drawn for the target area as indicated in Figure 22. One line was drawn two feet nearer the net than the doubles service line and parallel to it. One line was drawn two feet farther from the net than the singles service line and parallel to it. Both lines were measured from the center of the lines, and were extended to the outer side lines. One inch wide plastic tape was used to mark the lines. Two markers were placed on the opposite side of the court. Each was eleven feet from the net and three feet from the center line. Measures were made from the center of the line.

The player being tested stood between the two markers on the court opposite the target area. The test administrator stood on the

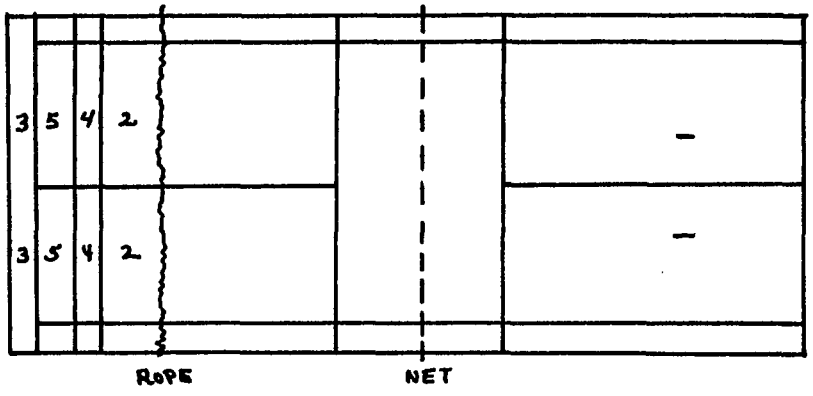


Fig. 22.--Court Diagram for Clear Test

same side of the net as the target area and served the shuttle to the player being tested. The player moved in any direction he chose after the shuttle was served to him. He had been instructed that only the shuttles he played counted as trials. The object of the test was to clear each serve over the added net and into the target area to score as many points as possible.

The target areas had the values indicated in Figure 22. The area nearest the net counted two, the next area four, the next area five, and the last area three. No score was given for any clear that did not go over the high net or which did not land in the target area. Hits landing on lines were given the value of the higher scoring area. The score for the test was the total points scored on twenty consecutive trials. Consideration was not given to "carried" shots because of the difficulty interpreting this rule.

The serves for the clear test were hit by one of five test administrators. All the test administrators were instructed and

observed before the test. Four of the five were active tournament competitors, and all were well qualified to administer the test from the point of view of playing ability.

The Short Serve Test (31)

The short serve test was chosen primarily as a measure of the ability of the player to hit the shuttle with "touch," rather than as a measure of serving ability. It has been criticized as a measure of serving ability for beginners because it is not the serve generally used by the player of this skill level. Many test administrators have found that many beginners fail to score on this test. Still it appeared to be the best test in the literature to indicate the ability of the player to hit the shuttle softly and accurately.

Test Directions.--A 3/8 inch manila rope was strung twenty inches directly above the net and parallel to it. A target was placed on the right service court marked as indicated in Figure 23. The intersection of the short service line and the center line was used as a mid-point to describe the four arcs. The radius of the first arc was twenty-two inches, the second was thirty inches, the third was thirty-eight inches and the fourth was forty-six inches. The measures included the width of the lines.

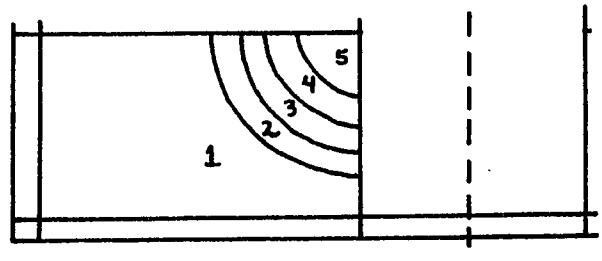


Fig. 23.--Court Diagram for Short Serve Test

The player being tested stood anywhere in the right service court diagonally opposite the target area. The object of the test was to serve the shuttle between the top of the net and the rope and into the target area. The target area included the entire right doubles service court. Any shuttle landing on a line received the higher value. Serves failing to travel between the net and rope or failing to fall within the target area scored no points. The score for the test was the total points scored on twenty consecutive trials.

The Bounce Test

The Bounce Test was developed as a possible alternative to using the short serve test. It was developed to see if it could measure "touch" more adequately than the short serve test. The Bounce Test, however, included several elements foreign to the Short Serve Test. Success on this test depended to a great extent on the ability of the player to (1) react rapidly, (2) move the racket head rapidly from place to place, and (3) judge rapidly the correct angle for the racket face.

Test Directions.--Each player had a racket and one shuttle. He was allowed one side of a court in which to take the test. The object of the test was to hit the shuttle as many times as possible in fifteen seconds. On the signal, Ready--Go, the player began bouncing the shuttle on the face of the racket. If the player missed the shuttle, he picked it up and continued to hit until the time was called.

The score was the total number of times the shuttle was contacted in the fifteen seconds. The hit which began the test and any

hits used to re-start the shuttle after it was missed were not counted. The entire shuttle had to leave the surface of the racket face in order to count as a hit. Each player received six fifteen second trials. This test was given to half of a class at a time with one test administrator keeping the time and giving the signals to begin and stop each trial. Score was kept for each subject by a partner.

The Footwork Test

The Footwork Test was devised to test the ability of the player to change directions and move primarily forward and backward. This pattern was adopted rather than some previously reported in the literature because it appeared to more closely approximate the actual footwork patterns desirable in a game situation.

This pattern emphasized (1) returning to a home base position after each direction change, (2) moving forward and backward rather than side to side, and (3) moving to the far backhand corner as if to hit a forehand shot. The home base element was introduced because the player who returns immediately to a home base position after each shot is usually in a better position to return the next shot. The forward and backward movement was emphasized rather than a side to side movement because this is the primary direction travelled in badminton due to the length and width of the court. The third element was put into the test because it is generally better for a player to take a shot from the backhand corner with his forehand. This is due to the mechanically inefficient position from which a backhand shot is usually hit, especially by beginners and particularly by women beginners.

Test Directions.--The Footwork Test consisted of following the pattern illustrated in Figure 24. The player began with both feet in the center box. On the signal, Ready--Go, the player ran (1) to the front right box and back to the center box, (2) to the front left box and back to the center box, (3) to the back right box and back to the center box, and (4) to the back left box and back to the center box. A trial consisted of completing this pattern twice. The player had to touch some part of each box, including the lines, for the trial to count and the player had to move from the center box to the left back box as if he intended to hit a forehand shot from that corner. Generally, this meant that the player had to face the center of the court and move backward to this box. If the player missed touching a box or forgot the pattern, the trial was repeated. The corner boxes were one foot in from the singles side lines; the front boxes were one foot in front of the short service line and the back boxes were one foot into the court from the doubles service line. Each corner box was one foot square. The center box was three feet wide and one and one half feet long. The distance from its side, facing the net, to the short service line was six feet. The center of the home base box was over the center line.

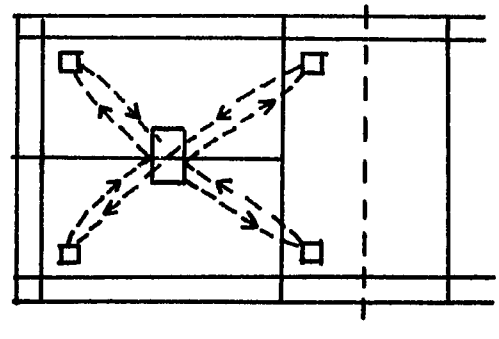


Fig. 24.--Court Diagram for Footwork Test

Each player received two trials and the score for the test was the total of the two trials. The score for a trial was the time it took the player to move from the center box on the Ready--Go signal until the player completed the pattern twice, ending by touching the center box. The score was recorded to tenths of a second.

The test administrator gave the directions and kept time. This test was administered either by the writer or a badminton class instructor.

Test Administration

All of the shuttles used in the testing situation were Carlton nylon blue band shuttles. This type of shuttle was used because this is the shuttle used in all the classes.

The badminton tests were administered to the classes meeting in one hour sessions during two consecutive class meetings. They were administered to the classes which met an hour and a half in one class meeting.

All scoring was done with a partner system. One partner took the test item while the other scored it. The Bounce Test was given to half of the class at a time in mass testing fashion. Two stations were set up for each of the other test items. Students rotated clockwise through the stations until they had completed all of the items.

Statistical Treatment

The statistical procedures in general were calculated for three sets of data: (1) the data from the Fall semester, (2) the data from

the Spring semester and (3) the data from the Fall and Spring semesters combined.

Means, standard deviations and standard errors of the means were calculated for each test for each set of data. A "t" of significant difference was calculated comparing the means of the Fall and Spring test administrations for each test. It was recognized that differences between the populations in the Fall and Spring semesters could occur. It was felt that whether or not the populations differed it was necessary to combine the scores from both semesters in order to get the broadest sampling of subjects and, consequently, get the truest picture of what skills a student should possess in order to be considered proficient in this activity.

In addition, means, standard deviations and standard errors of the means were calculated for the men and women students separately. A "t" of significant difference was also calculated comparing the means of the men's and women's scores for each test. If these indicated a significant difference between men and women students, the Physical Education Department at Memphis State University might choose to set separate standards of proficiency in skill performance for men and women students.

Consequently, T-scales were developed for the semesters combined for three groups: (1) men students, (2) women students and (3) men and women students combined, thus presenting scales for either course of action the Department might choose.

Reliability coefficients were calculated for each test for each set of data. The Split-Halves Method and Spearman-Brown Prophecy Formula were used to establish these co-efficients.

Validity coefficients were calculated for each test for each set of data. The criterion measure of playing ability used for badminton was tournament rankings. Each instructor ran a round robin or challenge singles tournament for each class. The ranking came from the results of these tournaments in each class, so that from every class there was a student ranked number one, one ranked number two, etc. The Pearson-Product Moment formula was used to calculate the validity coefficients.

Intercorrelations were calculated between the tests for the data combining the semesters. Doolittle multiple correlations were calculated for the combined Fall and Spring semester's data in order to find the tests that would make the most valid battery. The combined Fall and Spring semesters data were used, again, in order to obtain the broadest sample.

Bowling

There were three groups used to gather data in bowling: (1) women students taking bowling one-half a semester, (2) women students taking bowling the full semester and (3) men students taking bowling the full semester. The performance measure for bowling was made during both the Fall and Spring semesters.

Test Selection

Six lines were rolled by each student as a measure of bowling achievement. The direct measure was used since bowling is an individual activity. The related literature indicated that six lines would be sufficient to insure a reliable measure.

Test Administration

Two scores were taken for each of the six lines, the total game score and the pin fall count on the first ball for each of the ten frames. Any additional balls rolled in completing the tenth frame did not count in the first ball total. The first total was recorded because it was thought that it might yield a more reliable measure than game score. If it did and also showed a high degree of relationship to game score, it could be used instead of game score or with game score as indicative of achievement.

The two scores for each game were recorded by the student on a score card provided for that purpose. The six lines were rolled during two consecutive class meetings.

Statistical Treatment

The mean and standard deviation for total game score and first ball total were calculated for each group for each semester and the semesters combined. A "t" of significant difference was calculated between semesters for each group for total game score and for first ball total. It was recognized that differences between the populations in the Fall and Spring semesters could occur. It was felt that whether or not the populations differed it was necessary to combine the scores from both semesters in order to get the broadest sampling of subjects and, consequently, get the truest picture of what skills a student should possess in order to be considered proficient in this activity.

A correlation coefficient was calculated for each group for each semester and/or semesters combined comparing total game score to first ball average to find the relationship between the two.

No validity coefficient was calculated since the game score was a direct measure of achievement. Face validity was assumed for this measure.

Reliability coefficients were calculated for (1) each group for each semester, and (2) each group with both semesters combined. For each of these game score and first ball score was figured separately. The Split-Halves Method and Spearman-Brown Prophecy Formula were used.

Golf

Skill achievement in golf was measured directly by having each student play eighteen holes in class. The same golf course was used for all classes. It was thought that playing in class would give a more objective measure than playing out of class. However, the score cards received from the classes indicated that playing in class was not objective enough a measure to be used for the purpose of this study. There were numerous indications that the scoring was not accurate. Consequently, the golf performance measure was dropped from further consideration.

Tennis

Two elements, basically, were to be measured in this study to indicate tennis playing ability, the ground strokes and the serve. These strokes were chosen because the instructors indicated they spent almost all their instructional time on them.

Test Selection

Four tests were selected originally, for experimental purposes, to find an objective measure of tennis playing ability. Two tests were taken directly from the literature: (1) the Broer-Miller Forehand and Backhand Test (17) and (2) the Hewitt Serve Test (39). Two tests from the literature were adapted for the situation and purposes of this study: (1) the Wisconsin Wall Serve Test (79) and (2) the Timmer's Ball-Boy Forehand and Backhand Test (91).

Test Administration

The measures of tennis playing ability were administered to both the Fall and Spring tennis classes. However, unlike badminton, all of the tests were not administered in the same way to both groups. It was decided that the Fall semester data would be used as a pilot study because of the differences in the Fall and Spring test administrations. Consequently, the Fall and Spring semesters data were not combined as they were in badminton.

The partner method of scoring was used for all tests. One partner took the test while the other scored. The class was divided into groups so that each student began at the station indicated on his score card and then moved clockwise until he had completed all the test items. There were two stations for each of the ground stroke tests and one station for each of the serve tests. New Bancroft Tretorn tennis balls were used for all tests. This was the type of ball used for instruction in all tennis classes.

Test Directions

The Broer-Miller Test (17)

The Broer-Miller test was administered to both the Fall and Spring classes according to the directions given by its authors.

Test Directions.--A regulation tennis court was used. A 3/8 inch manila rope was stretched four feet directly above the net and parallel to it. The court was marked as illustrated in Figure 25. Four lines were drawn parallel to the net to make the target area. One was drawn ten feet nearer the net than the service line; one was drawn nine feet behind the service line; one was drawn five feet behind the baseline and one was drawn ten feet behind the baseline. These lines were drawn from doubles side line to doubles side line or its equivalent. The service line was extended to the doubles side lines. These lines plus the baseline divided the target area into seven areas. These areas had the point values, moving from the net to the fence, of two, four, six, eight, six, four, and two.

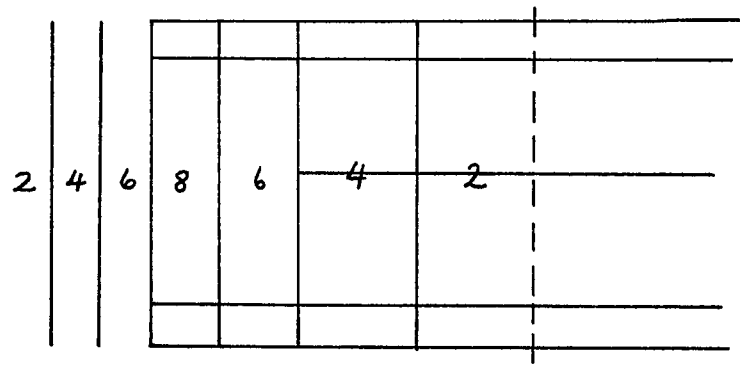


Fig. 25.--Court diagram for Broer-Miller Test

The player taking the test stood behind the baseline across the net from the target area. The object of the test was for the player to bounce the ball to himself and hit it across the net into the scoring

area. The player wanted to score as many points per hit as possible. The player received fourteen hits from the forehand side and fourteen hits from the backhand side. If the player swung at a ball and missed it, it counted as one of the fourteen trials.

The player had to hit the ball between the net and the rope in order to score the values shown in Figure 25. If the player hit the ball over the rope, but into the target area, he received one half the value of that area for that hit. A ball landing on a line received the higher of the two values. The scorer placed the number value of each area on the score card for each trial. If the ball had gone over the rope, he then circled the number. The hit was later scored as having half the value of the area. The score for the test was the total of the fourteen trials on the forehand and fourteen trials on the backhand.

The Hewitt Serve Test (39)

The Hewitt Serve Test was administered to the Fall semester classes, but not to the Spring semester classes. It was dropped from the testing because (1) the data for the Fall semester indicated that its validity and reliability were very low in this situation; its validity coefficients were .32 and .28 and its reliability coefficients were .65 and .44 and (2) the writer observed during the administration of the test that objectivity was very difficult to obtain because there were too many places to watch at once. It was administered to the Fall class according to the directions given by its author, but scored by the author's directions and by an experimental method.

Test Directions.--A regulation tennis court was used. A 3/8 inch manila rope was stretched directly above the net and parallel to it seven feet above the court. A target area for the accuracy portion of the test and a target area for the velocity portion of the test were marked off on the court as illustrated in Figure 26. Four boxes are marked off in the back center corner of the right service court. Each was three feet long and one and a half feet wide. The line closest and parallel to the net was extended to the singles side line. These lines marked off the target area for the accuracy portion of the test. The point values for each area are shown in Figure 26. Two lines were drawn beyond the baseline and parallel to it to complete the target area for the velocity portion of the test. One line was ten feet and the other twenty feet from the baseline. These lines, the baseline, and the fence marked the areas for the velocity measure. The point values for each are shown in Figure 26.

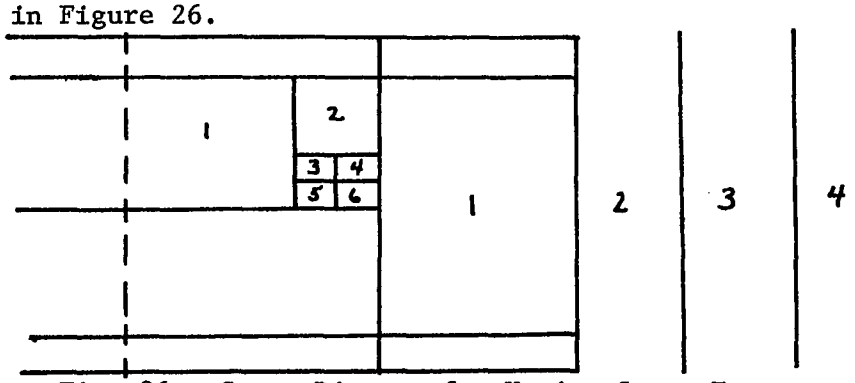


Fig. 26.--Court Diagram for Hewitt Serve Test

The player taking the test stood behind the baseline of the court opposite the target area and to the right of the center mark. The object of the test was to serve ten balls between the net and the restraining rope into the right service court. The player wanted to score as many points on accuracy as possible. Besides the points received

for accuracy, the player also received points for velocity depending on where his serve hit in the velocity target on its first bounce. Serves which did not land in the right service court were scored zero. In Hewitt's scoring method, serves which did not travel between the net and the rope scored zero. This method was used, but, in addition, the serves were also scored disregarding the limitation imposed by the restraining rope. The score for the test was the total points scored on both accuracy and velocity for the ten trials.

The score keeper had to determine, for each trial, (1) if the ball went between the net and the rope, (2) where the ball hit on the first bounce, and (3) where it hit on the second bounce. This proved to be difficult.

The Wisconsin Serve Test (79)

The Wisconsin Serve Test was accidently administered from a shorter distance than the directions specified during the Fall semester. The directions said that it should be given with the player standing behind a line forty-two and one half feet from the wall. The test was given during the Fall semester with the player standing behind a line twenty-seven and one half feet from the wall. This error was discovered after the Fall test administration, and the test was given as originally specified during the Spring semester.

It was necessary to make one adjustment in the target area for both administrations. The test calls for a wall eleven feet high. The one available for use by the tennis classes at Memphis State University

was only eight feet tall; however, above this eight foot wall there was a fence three feet in height. The wall was marked as the test directions specified, but the fence was scored as one area of the target instead of being divided into three areas.

Test Directions.--A line was drawn forty-two and one half feet from and parallel to the wall. The wall was marked in one-foot intervals with horizontal lines the length of the singles court baseline. The player taking the test stood behind the restraining line and served the ball against the wall. Two measures were made for each serve. An accuracy score was determined by where the serve hit on the wall. The values of this target area are given in Figure 27. The area scoring five was the fence in this test administration; in the original scoring plan it would have been divided into scoring areas of four, two, and one.

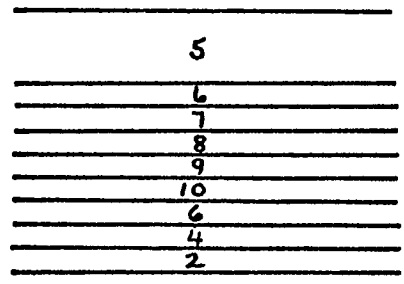


Fig. 27.--Wall Target for Wisconsin Serve Test

There was no limit on the width of the target; theoretically, the horizontal lines extended indefinitely. Each player hit ten serves against the wall. If the ball went over the target or hit the court before hitting the wall, the ball was reserved and did not count as a trial.

A velocity score was determined by measuring the time it took for the ball to travel from the face of the racket to the wall. This was measured in hundredths of a second on a stop watch. The time measure was converted to a point value, according to Table 7, and added to the accuracy measure.

TABLE 7

WISCONSIN SERVE TEST VELOCITY CONVERSION TABLE

Time	Points	Time	Points	Time	Points
.40	30	.725	17	1.10	6
.425	29	.75	16	1.15	5
.45	28	.775	15	1.20	4
.475	27	.80	14	1.25	3
.50	26	.825	13	1.30	2
.525	25	.85	12	1.35	1
.55	24	.875	11	1.36+	0
.575	23	.90	10		
.60	22	.95	9		
.625	21	1.00	8		
.65	20	1.05	7		
.675	19				
.70	18				

The scoring system for this test was changed slightly for reasons of simplicity. Edwards (79) experimented with four different scoring methods. The one chosen for this test administration was the one she

found to be the most reliable: adding the converted score for velocity to the accuracy score for each serve. It was time consuming to change each time measure for each trial to a converted score, add in the accuracy score for that trial and then total the ten trials. Consequently, in scoring this test, the time scores were totaled for the ten trials. The converted scores, given by Edwards, were multiplied by ten. The total time for ten trials was converted to the nearest conversion score. For example, a total time score of 5.30 would be a converted score of 250. This gave the total points for velocity for the ten trials. The ten accuracy scores were totaled and then the total velocity and total accuracy scores were summed to yield the total score for the test.

The test administrator measured the velocity of the serve on the stop watch and called it out to the score keeper. Only three different test administrators were used in all the testing sessions. This procedure was followed in order to increase the objectivity of the time measure. Prior to the test administration, a study was made of the objectivity in scoring this item. Three untrained test administrators timed twenty students taking this test. Each student was timed on two trials. The correlation coefficients between the scores recorded by the three timers were .94, .92 and .88. This investigation indicated that objectivity in scoring this item would not be a problem, but, as a precaution, only three administrators were used to give the test.

The Timmer's Forehand and Backhand Test (91)

The Timmer's Ball-Boy test was originally developed for varsity players. It was thought that with some adaptations it could successfully

be used with beginners. Ball-Boy machines were available, and a revision of this test appeared to be the only other ground stroke measure possible since there was not a wall of sufficient height on which to administer any revision of the Dyer wallboard test.

This test was adapted for beginners by the following means:

1. The original test called for the Ball-Boy machine to sit on the baseline and to be set on "fast" throw. The test was revised to make it less difficult by moving the machine to the service line and setting it on "soft" throw.

2. Scores were recorded for the test by two methods during the Fall test administration. The original test directions scored only the ball that went between the net and a rope fifty-one inches directly above and parallel to the net. This was one method used in the Fall. The other method disregarded the rope above the net and scored all balls landing in the target area. A compromise was made for the Spring semester. The rope was raised to nine feet above the court and only the balls going between it and the net were scored. The fifty-one inch height of the rope was too low for this situation, but the idea of the rope was kept in order to discount the lob and lob-like hits. Nine feet was chosen because many coaches agree that a well hit ground stroke travels within six feet of the top of the net.

3. Timmer did not state clearly the number of trials given, but the original test directions specified that the students should hit all the odd numbered balls down the alley and all the even balls cross court. This procedure was eliminated because it was thought too difficult for beginners.

4. Timmer stated that the Ball-Boy machine was placed on the baseline eight feet in from the singles side line. She did not make it clear whether the machine threw the balls down the side line or cross court. This test procedure placed the machine on the intersection of the service and singles sidelines and positioned it to throw the balls cross court. The cross court ball allowed the player taking the test an extra fraction of a second to prepare to hit, but also made him move farther from the homebase position in order to hit the ball. The fact that the player had to move to hit the ball was one of its most attractive features since this is more game-like than standing in one place to hit.

5. The target area and other court markings from the original test were used in this revision. Twenty trials were given for the forehand and twenty for the backhand.

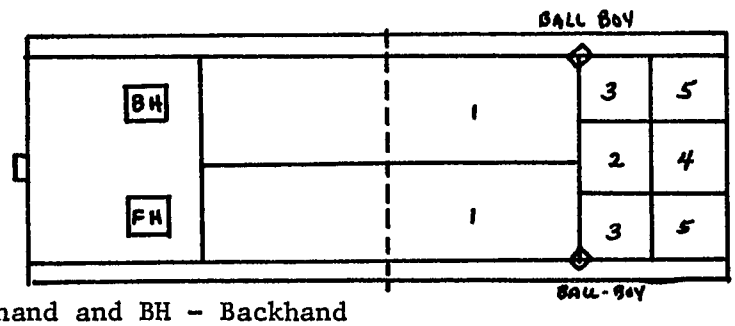
Test Directions.--A regulation tennis court was marked-off as illustrated in Figure 28. The target area was marked on one side of the court and comprised the entire singles court. One line was drawn between the baseline and service line and parallel to them; it was eight feet from the baseline. Two lines were drawn perpendicular to the baseline and service line; one nine feet in from each side line. This divided the target area into seven sections. The service courts comprised one section and the back court was divided into six sections. Each section was given the point value indicated in Figure 28.

The opposite side of the court was marked for two boxes, one which the player was directed to use as homebase position, and one into which

the Ball-Boy machine was to throw the ball. The homebase position was a three-foot square. The side of the square toward the net rested on the baseline. The square was centered between the side lines. The area into which the machine was to throw the ball was five feet square. The side of the square facing the net was five feet from a service line. The side parallel to the side line was five feet from the singles side line. The position of these boxes is illustrated in Figure 28.

The player taking the test stood in the homebase box to begin the test and returned to it after making each shot. The Ball-Boy machine was adjusted to throw the ball into the five-foot square. It projected one ball approximately every five seconds. The object of the test was for the player to hit the ball thrown by the machine so that it travelled between the net and the rope and landed in the target area. The player was to try to score as many points as possible. Each player received twenty trials on his forehand and twenty trials on his backhand. The score for the test was the total points scored in the forty trials.

One test administrator was used for this test. He reminded the students about the scoring and kept the Ball-Boy machine functioning properly.



FH - Forehand and BH - Backhand

Fig. 28.--Court Diagram for the Timmer Test

Statistical Procedures

Means, standard deviations and standard errors of the means were calculated for each test both semesters. Additional calculations were made for each part of each test, forehand and backhand scores on the ground stroke tests and accuracy and velocity scores on the serve test. This information was calculated for men and women students separately and for all students combined. A "t" of significant difference was calculated between the men's and women's scores. T-score scales were developed for each test during the Spring semester for men and women students separately and for all students combined.

Reliability was calculated for each test for both Fall and Spring test administrations. The Split-Halves Method and Spearman Brown Prophecy Formula were used. Separate calculations were made for the forehand and backhand scores on the ground stroke tests and the accuracy and velocity scores on the serve tests.

Validity coefficients were calculated for each test. The criterion measure used for playing ability was tournament rankings. Each instructor ran either a round robin or a challenge singles tournament in each class. The rankings came from the results of these class tournaments. There was one student from each class who received the ranking of one, two, etc. The tournaments were not combined so that there would be only one student in the population ranked one, two, etc.

Intercorrelations between the tests were calculated for each semester. Doolittle multiple correlations were calculated for the Spring semester tests in order to identify the best battery for evaluating skill in tennis.

CHAPTER V

DATA ANALYSIS

Knowledge and performance measures were administered to students in five activities of the Required Physical Education Program at Memphis State University: Archery and Bowling, Badminton, Bowling, Golf, and Tennis. The knowledge examinations were administered in the Spring semester, 1970. Performance measures in Archery and Golf were administered this same semester. Performance measures in Badminton, Bowling and Tennis were administered during the Fall semester, 1969, and Spring semester, 1970. These tests were given to all students enrolled in these activities during the respective semesters. There were only women students enrolled in the combination Archery and Bowling classes. The Badminton and Tennis classes were coeducational. There were separate classes for men and women students in Bowling and Golf. All tests were given near the end of the instructional period. Students received one semester hour of credit for these activity classes which met three hours a week.

The knowledge and performance tests were analyzed to determine the knowledge test questions and performance test or battery most suitable for use in determining if a student should be exempted from a course or should be allowed to enroll in an advanced level course.

T-scales were developed for the tests recommended for use in the proficiency testing program. The cut-off point for determining a student's proficiency on a test for exemption or advanced standing is

a decision to be made by the Department of Physical Education at Memphis State University. In examining the procedures followed by other departments, no prevalent practice was found. The Memphis State University regulations concerning exemption state that the student must make the equivalent score on the examination to earn a C grade in the course. This could be interpreted to be a T-score of approximately 50. There is no policy at present for admitting students to advanced level courses. Generally, the instructors of these courses have indicated that they would prefer to have students of above average skill and knowledge. This would necessitate setting a higher cut-off point for admittance to advanced level courses. A T-score of 60 as a cut-off point would admit students of ability approximately equivalent to the ability of the top one-sixth of the students in beginning classes.

Knowledge Examinations

All items on the knowledge examinations were best answer or correct answer multiple choice type questions. The answers to the questions were recorded by the students on IBM cards. The answer cards were machine graded at the Computer Center at Memphis State University.

The knowledge examinations were administered to the Spring semester classes in each activity. Table 8 shows the number of students taking each of the examinations. The Bowling Examination was given to two different groups: the students taking one-half a semester of bowling combined with one-half semester of archery and the students taking a full semester of bowling.

TABLE 8

NUMBER OF SUBJECTS TAKING KNOWLEDGE TESTS

Activity	Number of Students
Archery	196
Badminton	302
Bowling (1/2 semester)	205
Bowling (full semester)	240
Golf	187
Tennis	249

The design for analyzing the knowledge examinations and items on the examinations included the following steps:

1. Calculating the means and standard deviations for each examination both in the original and final forms.

2. Calculating the statistical validity of each item.

3. Selecting from the statistically valid questions the number and percentage of questions in each content area to insure empirical validity for the final form of the examinations.

4. Calculating the reliability of the original examinations and the final forms of the examinations.

5. Establishing T-scale norms for each examination.

Means and Standard Deviations

The means and standard deviations were determined for each examination. These figures were based on the per cent of questions answered correctly by each student rather than the number of questions answered correctly by each student. The reason for this was that the

tests were all computer graded, and the computer automatically converted all the scores to per cents. The means for the original tests ranged from 51 to 62 per cent and the means for the final tests ranged from 54 to 65 per cent. The standard deviations for the original tests ranged from 8.1 to 10.8 per cent. The standard deviations for the final forms of the examinations ranged from 12.0 to 15.4 per cent. These figures indicate that the final forms of the examinations are probably slightly easier than the originals and that the spread of scores on the final forms of the examinations is greater. The means and standard deviations for each examination are listed in Table 9.

Statistical Validity

Statistical validity is defined by Barrow and McGee as "the internal ability of the test to discriminate between those who 'know' and those who 'do not know.' The process is known as item analysis." (1: 509) It includes establishing, for each question, (1) the difficulty of the item or difficulty rating, (2) the ability of the item to distinguish between those students who know and those who do not know or the index of discrimination, and (3) the frequency with which each response was chosen or the functioning of responses.

Difficulty Rating.--The difficulty of each item was determined by counting the number of students who answered the question correctly and dividing this total by the number of students who took the examination. The result is a percentage score indicating the per cent of students who answered the question correctly.

TABLE 9

MEANS AND STANDARD DEVIATIONS FOR KNOWLEDGE EXAMINATIONS

Activity	No. of Subjects	No. of Items	Original Examinations *Mean	Original Examinations *Standard Deviation	No. of Items	Revised Examinations *Mean	Revised Examinations *Standard Deviation
Archery	196	70	54	8.1	45	61	12.9
Badminton	297	70	58	10.0	50	59	12.0
Bowling (½ term)	215	100	57	10.4	50	63	15.4
Bowling	240	100	62	8.4	50	65	13.5
Golf	187	70	51	9.5	50	54	12.6
Tennis	249	70	60	10.8	50	61	13.6

* Means and Standard Deviations are given in the per cent of questions answered correctly.

Measurement and evaluation texts in Physical Education generally agree that if fewer than ten per cent of the students answer the question correctly, it is too difficult, and if more than ninety per cent answer an item correctly, it is too easy. This study accepted these standards in selecting questions for the final forms of the proficiency knowledge examinations. The difficulty rating for each question of each test is given in Appendix B.

Index of Discrimination.--The index of discrimination for each item on the knowledge examinations was determined by the Flanagan Method. (1:509-511) This method operates on the theory that using only the answer sheets representing the highest and lowest scores is as efficient as using all the answer sheets in order to discriminate between those who knew and those who did not know. Only the top and bottom 29 per cent of the papers are analyzed; the middle 42 per cent are discarded for this analysis. Within these upper and lower groups, the top and bottom 9 per cent of the papers are given a double weighting to put further emphasis on the extreme scores. A comparison between the per cent of subjects in the upper groups and the lower groups answering the question correctly determines the index of discrimination. This study used the Index of Discrimination Table given by Flanagan (8:16-23) to determine the actual index of discrimination from the per cent scores for the upper and lower groups.

Most measurement and evaluation texts in Physical Education suggest that to use an item with an index of discrimination below .15 is unacceptable and that one between .15 and .20 is questionable. The index of discrimination standard used for selecting items for the final

forms of the proficiency knowledge examinations in this study was .20 or above. The index of discrimination for each question is given in Appendix B.

Functioning of Responses.--Most measurement and evaluation texts in Physical Education agree that each response for a question should be attractive enough for at least two or three per cent of the subjects to select it. If a response does not meet this criterion, it should be revised. Changing one non-functioning response in an item, however, also changes the difficulty and discriminatory powers of the question. Consequently, none of the non-functioning responses were altered after the analysis of the examinations in this study. The degree to which the responses functioned was not considered usually in selecting the questions for the final form of the examinations. When one question had to be chosen from two or more which met the standards for difficulty and discrimination, the function criteria was considered. The responses that did not function at the 2 per cent level are indicated in Appendix B.

Empirical Validity

"Empirical validity is achieved if the content of the test is in agreement with the unit of instruction." (1:509) To determine what the content balance of each examination should be, each instructor teaching the activity courses involved in this study was asked to fill out a form indicating the percentage of time he or she spent on each aspect of the activity. The results of the information were used to make the original examination for each activity. The questions selected for the final forms of the knowledge proficiency examinations

maintained the balance of the original examinations as closely as possible. Table 10 indicates that the content of each examination was changed only slightly from the original to the final form. The questions selected for the final form of the knowledge examinations are listed in Appendix B.

Each of the examinations in its final form contained fifty questions, except the archery examination. There were only forty-five questions on the archery examination which met the standards for statistical validity. This did not, however, affect the content balance of the final form of the examination significantly as is evident in Table 10.

Reliability

The reliability of each of the knowledge examinations was calculated with one of the Kuder-Richardson Formulas. (1:521) The reliabilities were determined for both the original and final forms of the examinations. The reliabilities for the original tests ranged from .64 to .80. The reliabilities for the final forms of the examinations were higher for each activity and ranged from .84 to .91. Reliability of a knowledge test is effected primarily by its length and internal consistency. Usually the longer the test, the more reliable it will be, but in this situation as each of the tests was reduced from 100 or 70 questions to 50 questions, the reliability increased. Consequently, the internal consistency of the tests must have increased considerably when only the questions meeting the statistical standards were included. The reliabilities for each test are given in Table 11.

TABLE 10

CONTENT BALANCE OF ORIGINAL AND FINAL FORMS OF KNOWLEDGE TESTS

Content Area	Archery		Badminton		Bowling (½ term)	
	Original	Final	Original	Final	Original	Final
History	0	0	1	0	2	2
Values	0	0	0	0	1	2
Equipment	6	4	3	4	5	4
Etiquette	1	2	3	4	5	6
Rules & Score	9	9	17	16	11	12
Safety	6	3	0	0	3	2
Techniques	71	73	57	56	50	50
Terminology	7	9	6	6	6	6
Strategy	0	0	13	14	17	16
	100%	100%	100%	100%	100%	100%

Content Area	Bowling		Golf		Tennis	
	Original	Final	Original	Final	Original	Final
History	2	2	1	2	1	2
Values	1	2	0	0	0	0
Equipment	5	4	1	2	3	2
Etiquette	5	6	5	4	3	2
Rules & Score	11	10	10	10	11	12
Safety	3	4	1	2	0	0
Techniques	50	50	66	64	66	66
Terminology	6	4	6	6	6	6
Strategy	17	18	10	10	10	10
	100%	100%	100%	100%	100%	100%

TABLE 11

RELIABILITY COEFFICIENTS FOR KNOWLEDGE TESTS

Activity	Original Test	Final Test
Archery	.63	.87
Badminton	.76	.91
Bowling (1/2 term)	.80	.91
Bowling	.64	.88
Golf	.73	.85
Tennis	.80	.88

T-Scale Norms

T-scales were developed for each of the final forms of the examinations. They were developed only for the final forms because, in each case, the final forms had the greater spread of score, indicated by greater standard deviation, and had the higher reliabilities, indicating greater internal consistency.

T-scales for the final form of each test are given in Appendix C. The T-scores are based on the per cent of questions answered correctly rather than the number of questions answered correctly.

Performance Tests

The analysis of the data for the various activities differed considerably because of the variety in the types of performance measures utilized. Consequently, the analysis of the data for the performance tests was made by activities. There were, however, some procedures followed throughout all of the analyses:

1. Raw score formulas were used in making all calculations. Calculations were carried out to four places and then, in most instances, rounded to two places.

2. The Pearson Product Moment Formula was used in calculating all coefficients, except the multiple correlation coefficients.

3. Fisher's "t" test of significant difference between means was used in calculating the differences between means. (105)

4. The Split-Halves method was used in calculating all reliability coefficients. The results of this method were then stepped-up by using the Spearman Brown Prophecy Formula.

5. The standards given by Barrow and McGee for validity and reliability coefficients were accepted in assessing the coefficients obtained in this study. (1:42) They are listed in Table 12.

TABLE 12

VALIDITY AND RELIABILITY STANDARDS
FOR SKILL TESTS

Coefficient	Validity	Reliability
.95-.99	excellent	excellent
.90-.94	excellent	very good
.85-.89	excellent	acceptable
.80-.84	very good	acceptable
.70-.79	acceptable	poor
.60-.69	questionable	questionable

Archery

The archery test was administered only to the Spring semester classes. One hundred and fifty-five women students completed the test.

The data were based on the total score for four ends from the ten yard line and four ends from the twenty yard line.

Means and Standard Deviations

The means and standard deviations were calculated for the scores from each distance and the distances combined. These and the ranges in the scores are given in Table 13.

TABLE 13

MEANS AND STANDARD DEVIATIONS FOR ARCHERY SKILL TESTS
N = 150

Distance	Mean	Standard Deviation	Range
10 yards	130.77	29.72	70-202
20 yards	70.12	29.01	0-152
10 + 20 yards	200.88	51.47	79-335

There was a sharp drop in scores from ten to twenty yards, but not a similar drop in the standard deviation for the two distances. The range of ability among the students did not change even though their scores dropped sharply.

Reliability

A reliability coefficient was calculated for the scores from each of the distances and for the two distances combined. The total score for the first and third ends for each distance was correlated against the total score for the second and fourth ends. The Split-Halves

coefficients and the Spearman-Brown coefficients are listed in Table 14.

TABLE 14

RELIABILITY COEFFICIENTS FOR ARCHERY SKILL TEST

Distances	Split-Halves	Spearman-Brown
10 yards	.63	.78
20 yards	.69	.82
10 + 20 yards	.79	.88

The reliability of the test from ten yards was poor according to the standards previously set, and the test from twenty yards was on the low end of the acceptance range. The coefficients of the two tests together was on the high end of the range considered acceptable. This indicated that the most reliable measure of achievement in archery was the test combining scores from both distances.

Validity

No validity coefficient was calculated for archery because shooting was considered a direct measure of ability. Face validity was, therefore, assumed.

T-Scale Norms

A T-scale was developed for scores from the distances combined. The scales were developed from the combined scores because these

showed considerably greater reliability than the test from either distance separately. This scale is given in Appendix D.

Badminton

The badminton skill tests were administered in both the Fall and Spring semesters. Statistical treatments were completed on the data from each semester and the data for the two semesters combined. The tests given were the French Clear Test, the French Short Serve Test, the Bounce Test and the Footwork Test. The Clear and Serve Tests data were based on the total score for twenty trials. The Bounce Test data were based on the total score for six fifteen-second trials. The footwork data were based on the total time for two trials.

The number of students in each group is listed in Table 15. The inconsistency in the N for women during the Fall was due to one student failing to complete all items on the test.

TABLE 15

NUMBER OF SUBJECTS IN BADMINTON SKILL TESTS

Semester	Men	Women	Total
Fall	15	89-90	104-105
Spring	54	245	299
Fall + Spring	69	334-335	403-404

Means and Standard Deviations

The means, standard deviations and standard errors of the means were calculated for each test. These figures are listed in Table 16

along with the number of students taking each test and the range of scores for each test. Fisher's "t" test of significant difference was used to compare the means made in the Fall and Spring semesters. The "t's" calculated are listed in Table 16 also.

Each test had a significant difference between the means of the Fall and Spring administrations. There are many possible reasons for the difference. The Fall semester is broken by a number of holidays, including Thanksgiving and Christmas. The Fall classes are composed of almost all Sophomores or Upperclassmen because of the Freshmen Orientation requirement. The number of students participating in the Spring semester was about three times the number in the Fall semester. These factors may have contributed to the differences in the scores. The means for the Serve and Bounce tests were lower in the Spring, while the means for the Clear and Footwork tests were better in the Spring.

In addition to the above calculations, the means, standard deviations, and standard errors of the means were calculated for men and women students separately. These figures are listed in Table 17 along with the number of students taking each test and the range of the scores for each test. Fisher's "t" test of significant difference was used to compare the scores made by men and women students. These coefficients are listed also in Table 17.

There definitely was a significant difference between the performance of men and women students on all tests. The men students scored better on each test. Consequently, the Physical Education Department at Memphis State might wish to set separate standards for skill achievement for men and women students. This decision will have

TABLE 16

MEANS AND STANDARD DEVIATIONS FOR
BADMINTON SKILL TESTS

Clear Test

Semester	N	Range	Mean	S.D.	S.E.	t
Fall	105	0-93	51.99	26.90	2.63	2.30*
Spring	299	0-96	56.53	21.94	1.27	
Combined	404	0-96	55.35	23.38	1.16	

Serve Test

Semester	N	Range	Mean	S.D.	S.E.	t
Fall	104	3-92	42.27	16.91	1.66	3.07*
Spring	299	0-96	37.20	18.37	1.06	
Combined	403	0-96	38.51	18.12	.90	

Bounce Test

Semester	N	Range	Mean	S.D.	S.E.	t
Fall	104	53-222	124.68	28.83	2.83	9.44*
Spring	299	30-198	104.59	26.47	1.70	
Combined	403	30-222	109.77	30.56	1.52	

* A "t" above 1.966 indicates a significant difference at the .05 level.

TABLE 16 (Continued)

Footwork Test

Semester	N	Range	Mean	S.D.	S.E.	t
Fall	105	55.8-29.5	41.72	4.92	0.48	2.49*
Spring	299	55.0-28.0	39.55	4.66	0.27	
Combined	404	55.8-28.0	40.08	4.81	0.24	

* A "t" above 1.966 indicates a significant difference at the .05 level.

TABLE 17

MEANS AND STANDARD DEVIATIONS FOR MEN AND WOMEN STUDENTS IN BADMINTON SKILL TESTS

	Men					t	Women				
Test	N	Range	Mean	S.D.	S.E.		N	Range	Mean	S.D.	S.E.
Clear	69	26-96	73.09	13.59	1.64	12.54*	335	0-91	51.70	23.31	1.27
Serve	69	10-85	47.16	15.87	1.91	6.13*	334	0-96	36.72	18.06	0.99
Bounce	69	85-222	139.83	29.55	3.56	16.17*	334	30-181	103.56	26.90	1.47
Footwork	69	28.0-51.0	34.22	4.21	0.51	8.32*	334	32.2-55.8	41.30	3.96	0.22

* A "t" above 1.966 indicates a significant difference between the means at the .05 level.

to be made by the Department according to its philosophy concerning grading the skill of men and women students in coeducational classes.

Reliability

Reliability coefficients were calculated for each test. The Split-Halves and Spearman-Brown coefficients are listed in Table 18. A test of significant difference between coefficients of correlation was used to compare the reliability coefficients for the two semesters. These are also given in Table 18.

TABLE 18

RELIABILITY COEFFICIENTS FOR BADMINTON SKILL TESTS

Test	Fall		Spring			Combined	
	S-H	S-B	S-H	S-H	t	S-H	S-B
Clear	.86	.93	.78	.88	*2.44	.81	.90
Serve	.58	.73	.69	.82	*2.00	.66	.80
Bounce	.85	.92	.89	.94	1.31	.89	.94
Footwork	.91	.95	.88	.94	.78	.90	.95

* A "t" of 1.96 or above indicates a significant difference at the .05 level.

The coefficients for the clear and serve tests varied from semester to semester, while the coefficients for the bounce and footwork tests were more constant. All of the tests had acceptable reliability coefficients. The serve test, however, was only on the border line. The coefficients for the others ranged from very good to excellent. Any of the tests, then, could be used in the battery from the stand point of

reliability. But, because the serve test coefficient dropped .10 from the one nearest it, it is suggested that some combination of the other three tests be used. This decision is supported further by the findings of the validity analysis.

Validity

Validity coefficients were calculated for all the tests. The criterion measure used to establish validity was tournament rankings. The students in each class were ranked according to the results of either a class round robin or challenge singles tournament. The validity coefficients obtained are listed in Table 19.

TABLE 19

VALIDITY COEFFICIENTS FOR BADMINTON SKILL TESTS

Test	Fall	Spring	"t"	Combined
Clear	.72	.53	*2.79	.60
Serve	.37	.30	.70	.31
Bounce	.46	.50	.44	.44
Footwork	.59	.48	1.39	.52

* A "t" of 1.96 or above indicates a significant difference at the .05 level.

The validity coefficients had to be at least .70 to be acceptable, according to the standard previously set. No single test, when the semesters were combined, had an acceptable validity, but the Fall Clear test had an acceptable validity.

A test of the significant differences between coefficients of correlation was run to compare the coefficients for the two semesters. (9) The results are listed in Table 19. The only significant difference was found to be in the Clear Tests. There was no apparent reason for this.

Intercorrelations between the test items for the two semesters combined were calculated. They are listed in Table 20. They ranged from .03 to .37 and are all fairly low.

TABLE 20

INTERCORRELATIONS FOR BADMINTON SKILL TESTS

	Serve	Bounce	Footwork
Clear	.14	.03	.28
Serve		.23	.15
Bounce			.37

Doolittle multiple correlations were calculated for four combinations of items. The coefficients for the various batteries are listed in Table 21.

The Serve Test was dropped from consideration after the first multiple correlation because its validity coefficient was much lower than those of the other three tests. The Clear Test was used in each correlation because its validity coefficient was the highest of the four tests. The multiple correlations indicated that any of the first three combinations achieved an acceptable validity standard. Combination one,

TABLE 21

MULTIPLE CORRELATIONS FOR BADMINTON SKILL TESTS

Tests	Coefficients
1. Clear, Serve, Bounce, Footwork	.7710
2. Clear, Bounce, Footwork	.7657
3. Clear, Bounce	.7345
4. Clear, Footwork	.6976

however, would be impractical for use because (1) the reliability coefficient for the serve test was only bordering on acceptability and (2) it would take much more time and equipment to include one more item to obtain less than .01 greater validity. Combinations 2 or 3 could be used. The choice would depend on the time, space, and administrative personnel available. According to the technique used here, each test in the selected battery would have equal weighting.

T-Scale Norms

T-scales were developed for each test for the data from the semesters combined. These data were used in order to get the widest sample of subjects even though some means and validity and reliability coefficients were significantly different when the semesters were compared. It was felt that proficiency standards founded on data from classes taking the activity course should be based on the achievement of as many subjects as possible.

Scores were combined for men and women students in one set of scales and separated in another set of scales. Because the men students scored significantly better on all the tests there is the possibility that the Physical Education Department might wish to set separate standards of proficiency for men and women students. On the other hand, they may wish to make the standards the same for both. This decision will have to be based on the philosophy of the Department. Scales are presented for each. These are given in Appendix D.

To obtain a composite skill test score for the student, the score of each test from the selected battery must be converted to its equivalent T-score; then the T-scores must be added, and the sum divided by the number of tests in the battery.

Bowling

The bowling test was administered during both the Fall and Spring semesters. Three groups were tested in bowling: (1) women students enrolled for half a term, (2) women students enrolled for a full-term, and (3) men students enrolled for a full-term. The analysis is based on the total score for six games. Two scores were taken from each game, total game score and first ball total. The number of students in each group is listed in Table 22.

Means and Standard Deviations

Means and standard deviations were calculated for each set of data. These are given in Table 23. Fisher's "t" test of significant difference was used to find the significance of the difference between the means for the two semesters. These are listed in Table 23 also.

TABLE 22

NUMBER OF STUDENTS IN EACH BOWLING GROUP

Semester	Women Students ½ Term	Women Students Full Term	Men Students
Fall	155	77	56
Spring	208	99	113
Total	363	176	169

The means were higher during the Spring semester for both groups of women students and lower for the group of men students. There was a significant difference between the means for all the groups, except the first ball total means for the women students enrolled in the full semester courses. There was the greatest difference in the means for the men students. There was no apparent reason for the difference between semesters or for the women's scores going up in the Spring semester and the men's scores going down. Although most of the means between semesters were significant, it was still felt that the standards for the proficiency tests should be based on the scores of the two semesters combined. This would give the greatest sample of student ability.

Correlations were calculated to determine the relationship of total game scores to first ball total for each group. These are given in Table 24.

TABLE 23

MEANS AND STANDARD DEVIATIONS FOR BOWLING SKILL TEST

Total Game Score

Semester	Women (½ term) Mean	S.D.	"t"	Women (1 term) Mean	S.D.	"t"	Men Mean	S. D.	"t"
Fall	588.14	90.06		710.66	87.24		834.27	120.26	
			3.69*			3.11*			9.82*
Spring	601.63	88.03		724.39	94.28		790.93	102.96	
Combined	595.87	89.15		718.39	91.52		805.29	110.88	

First Ball Total

Semester	Women (½ term) Mean	S.D.	"t"	Women (1 term) Mean	S.D.	"t"	Men Mean	S.D.	"t"
Fall	354.77	64.15		422.05	44.51		461.63	38.25	
			3.67*			1.87*			5.61*
Spring	365.94	51.14		427.75	41.86		445.12	36.99	
Combined	360.98	57.31		425.26	43.13		450.58	38.21	

* Indicates a "t" showing a significant difference between means. A "t" above 1.972 indicates a significant difference at the .05 level.

TABLE 24

RELATIONSHIP OF GAME SCORE TO FIRST BALL TOTAL FOR BOWLING

Group	Fall	Spring	Combined
Women (1/2 term)	.71	.86	.78
Women (1 term)	.88	.81	.84
Men	.88	.83	.85

The coefficients for students enrolled for the full semester of bowling were fairly high, and the coefficient for the women enrolled for the half term in the Fall was somewhat lower. There was not, however, enough difference in the reliability coefficients for total game score and first ball total to include first ball total as a part of skill evaluation in bowling or to use it instead of total game score. The data for the three groups were not combined because the groups represented three separate courses.

Reliability

Reliability coefficients were calculated for all groups by the semester and with the semesters combined. In each case, coefficients were calculated for total game score and first ball totals separately. The Split-Halves and Spearman-Brown coefficients are listed in Table 25. The same test of significant difference between coefficients of correlation as in the badminton study was used to compare the reliability

coefficients for the two semesters in bowling. These are given in Table 25.

The tests of significant difference indicated that only two sets of coefficients were significantly different between the semesters. There was no apparent explanation for these differences.

The reliability coefficients for total game scores were on the borderline of acceptability when the data for the two semesters were combined and the coefficients for first ball total were only slightly better. This indicated that, in order to get a more reliable measure of bowling ability, more than six games were going to be necessary. The Spearman-Brown Prophecy Formula was used to predict how many games would have to be bowled in order to obtain a measure above marginal acceptability. It indicated that bowling nine games would yield coefficients ranging from .85 to .89, which would be acceptable, and rolling twelve games would yield coefficients from .88 to .91. The choice between these two would depend, in most cases, on the amount of time available for testing. Nine games should give a reliable score for all groups.

Validity

No validity coefficients were calculated for bowling because the bowling score is a direct measure of ability. Face validity was, therefore, assumed.

T-Scale Norms

T-scales were developed for each group for the total game score data. The data from the semesters combined were used in order to get

TABLE 25

RELIABILITY COEFFICIENTS FOR BOWLING SKILL TEST

Total Game Score

Group	Fall		Spring			Combined	
	S-H	S-B	S-H	S-B	t	S-H	S-B
Women (½ term)	.68	.81	.63	.78	.75	.65	.79
Women (1 term)	.59	.74	.72	.84	1.75	.67	.80
Men	.64	.78	.71	.83	.84	.68	.81

First Ball Total

Group	Fall		Spring			Combined	
	S-H	S-B	S-H	S-B	t	S-H	S-B
Women (½ term)	.77	.87	.59	.74	3.57*	.66	.80
Women (1 term)	.74	.85	.70	.82	.65	.72	.84
Men	.69	.82	.86	.93	3.00*	.72	.84

* A "t" of 1.96 or above indicates a significant difference at the .05 level.

the broadest sample of scores, even though most of the means were significantly different from the Fall to the Spring semesters. Only the data for total game score were used because (1) there was a high relationship between this data and the data for first ball total, (2) the reliability coefficients for total game score and first ball average were approximately the same, and (3) total game score is the direct measure of achievement in bowling.

Separate scales were developed for each group because each were taught as separate activity classes. Consequently, it would seem logical to set separate proficiency standards for students wishing to be exempt or given advanced placement in any of the courses. These scales are presented in Appendix D.

Tennis

Three of the tennis tests were administered during both semesters, but one, the Hewitt Serve Test, was dropped after the Fall semester. The Broer-Miller Forehand and Backhand Test, the Wisconsin Serve Test and the Timmer Ball Boy Test were given both semesters. The data from the Fall semester were used in making decisions about the tests and adaptations of the tests to be used in the Spring semester. The Fall administration was considered to be a pilot study, and the data for the two semesters were treated separately. The analysis is based on fourteen trials in the forehand and fourteen trials in the backhand for the Broer-Miller Test, ten trials on the Hewitt Serve Test, ten trials on the Wisconsin Serve Test, and twenty trials from the forehand and twenty trials from the backhand for the Timmer Tennis Test.

The number of students participating in each study is listed in Table 26. The variations in the N for the first semester were caused by some students failing to finish all of the tests because of absences.

TABLE 26

NUMBER OF SUBJECTS IN TENNIS SKILL TESTS

Test	Fall			Spring		
	Men	Women	Total	Men	Women	Total
Broer-Miller	48	141	189	63	177	240
Timmer	42	116	158	63	177	240
Hewitt	48	136	184			
Wisconsin	45	123	168	63	177	240

Pilot Study

The Hewitt Serve Test and the Timmer Ball-Boy Test were scored by two methods during the Fall semester. Each was scored counting only the shots that went between the net and the restraining rope. This was the way the directions for each test stated they should be scored. For purposes of clarity, the tests scored by this method will be designated Hewitt I and Timmer I. The tests were also scored disregarding the restraining rope. Scoring by this method will be indicated by Hewitt II and Timmer II. All trials for all subjects were scored by both methods.

Means and Standard Deviations

Means, standard deviations and standard errors of the mean were calculated for each test and for each of its parts. These are given in Table 27.

There was not much difference in the means calculated by the two scoring methods for the Hewitt Test, but there was considerable difference in the means of Timmer I and Timmer II. The large standard deviation compared to the mean for Timmer I indicated there were a large number of 0 scores on the test. There were no zero scores for Timmer II. This indicated, then, that the method used in scoring Timmer II was better in this respect.

Means, standard deviation and standard errors of the means were also calculated for men and women students separately. These are listed in Table 28 along with the number of students taking each test and the ranges of scores. Tests of significant difference were made between the means of the men and women students' scores. They are given in Table 28 also. The men students scored higher on each test. There was a significant difference between the two groups on each test.

Reliability

Reliability coefficients were calculated for each test and for the components of each test. The Split-Halves and Spearman-Brown coefficients are given in Table 29. They ranged from .44 to .97 for the complete tests and from .38 to .98 for the forehand-backhand or velocity-accuracy parts of the tests. All the tests, except the Hewitt Serve, had acceptable reliability coefficients. The coefficients for the

TABLE 27

MEANS AND STANDARD DEVIATIONS
FOR TENNIS SKILL PILOT STUDY

Test	N	Range	Mean	S.D.	S.E.
Broer-Miller	189	10-184	76.17	37.25	2.71
Forehand		2-96	43.21	19.05	1.39
Backhand		0-88	33.07	21.12	1.53
Timmer I	157	0-117	23.70	24.59	1.96
Forehand		0-61	12.54	12.62	0.91
Backhand		0-70	10.46	13.63	1.08
Timmer II	157	7-117	52.72	22.48	1.80
Forehand		1-63	27.59	11.74	0.85
Backhand		0-70	24.04	13.84	1.10
Hewitt I	184	0-42	13.10	8.23	0.61
Accuracy		0-30	7.58	5.02	0.37
Velocity		0-18	5.80	3.58	0.26
Hewitt II	184	2-40	16.81	7.18	0.53
Accuracy		1-30	9.94	4.63	0.34
Velocity		0-18	6.87	3.12	0.23
Wisconsin	168	30-409	292.74	65.00	5.03
Accuracy		46-99	73.14	7.49	0.58
Velocity		24-329	219.61	60.51	4.67

TABLE 28

MEANS AND STANDARD DEVIATIONS FOR MEN AND WOMEN STUDENTS IN THE TENNIS SKILL PILOT STUDY

	Men					Women					
	N	Range	Mean	S.D.	S.E.	N	Range	Mean	S.D.	S.E.	t
Broer-Miller	48	56-184	120.50	31.32	4.53	141	10-152	61.03	25.10	2.11	23.06*
Forehand		29-96	62.94	17.51	2.53		2-82	36.50	14.33	1.21	
Backhand		19-88	57.56	17.84	2.57		0-70	24.72	14.74	1.24	
Timmers I	42	0-117	48.05	27.49	4.24	115	0-84	14.81	16.04	1.50	13.88*
Forehand		0-61	24.18	13.04	1.86		0-46	8.53	9.66	0.81	
Backhand		0-70	23.38	17.29	2.67		0-45	5.78	8.00	0.74	
Timmers II	42	31-117	73.47	20.04	3.09	115	7-95	45.07	18.12	1.70	12.98*
Forehand		13-63	35.33	11.31	1.62		1-56	24.92	10.69	0.90	
Backhand		10-70	37.02	13.77	2.12		0-45	19.30	10.46	0.97	
Hewitt I	48	2-36	18.33	7.52	1.08	136	0-42	11.26	7.68	0.66	5.36*
Accuracy		1-20	10.25	4.35	0.63		0-30	6.63	4.91	0.42	
Velocity		1-18	8.09	3.72	0.54		0-15	4.62	3.06	0.26	
Hewitt II	48	2-36	19.08	7.15	1.03	136	2-42	16.01	7.05	0.60	2.41*
Accuracy		1-20	10.67	4.20	0.61		2-30	9.68	4.76	0.41	
Velocity		1-18	8.42	3.52	0.51		0-16	6.32	2.78	0.24	
Wisconsin	45	257-409	363.82	30.64	4.62	123	67-360	266.74	52.94	4.79	31.65*
Accuracy		62-99	75.98	7.17	1.07		46-89	72.10	7.36	0.66	
Velocity		216-329	287.84	28.51	4.25		24-288	194.64	48.72	4.39	

* A "t" of 1.972 or above indicates a significant difference at the .05 level.

TABLE 29

RELIABILITY COEFFICIENTS FOR TENNIS SKILL PILOT STUDY

Test	N	Split-Halves	Spearman-Brown
Broer-Miller	189	.8945	.94
Forehand		.7617	.86
Backhand		.8421	.91
Timmers I	157	.8697	.92
Forehand		.7403	.85
Backhand		.8260	.90
Timmers II	157	.6850	.80
Forehand		.4415	.61
Backhand		.6239	.77
Hewitt I	184	.4958	.65
Accuracy		.4224	.59
Velocity		.5063	.67
Hewitt II	184	.2861	.44
Accuracy		.2077	.38
Velocity		.3681	.52
Wisconsin	168	.9536	.97
Accuracy		.3409	.51
Velocity		.9595	.98

Broer-Miller and Timmer I were very good. The reliability for the Wisconsin was very low compared to the velocity component. It was thought, however, that this test would lose considerable validity if students taking it knew that it was based solely on velocity. Consequently, both elements of the test were retained for further study. The Hewitt Test was much lower in reliability and validity than the others. It was decided, therefore, to drop it from the Spring testing. Another consideration in this decision was the difficulties that had been encountered in administering it.

Validity

Validity coefficients were calculated for each test. Coefficients were also calculated for the component parts of each test. The criterion measure used to establish validity was tournament rankings. The students in each class were ranked according to the results of a class round robin or challenge singles tournament. The validity coefficients are listed in Table 30.

The coefficients for the tests ranged from .28 to .66. The coefficients for the parts of the tests ranged from .17 to .61. None of the tests alone was a valid measure of tennis playing ability. The Hewitt Test coefficients were so much lower than the next closest coefficient that the possibility of dropping this test was considered. The second method of scoring the Timmer Test showed it had an advantage over the original scoring method for this skill level group.

Intercorrelations were run between tests to determine their relationships to one another. These are given in Table 31.

TABLE 30

VALIDITY COEFFICIENTS FOR TENNIS SKILL PILOT STUDY

Test	N	Coefficient
Broer-Miller	189	.45
Forehand		.46
Backhand		.39
Timmer I	157	.53
Forehand		.37
Backhand		.47
Timmer II	157	.66
Forehand		.35
Backhand		.61
Hewitt I	184	.32
Accuracy		.27
Velocity		.36
Hewitt II	184	.28
Accuracy		.17
Velocity		.37
Wisconsin	168	.55
Accuracy		.27
Velocity		.41

The relationships between the two scoring methods used with the Hewitt and Timmer tests were high and the relationship between the two ground stroke tests was high as would be expected. The unexpected was the low relationship between the two serve tests. The coefficients were fairly low between the ground stroke tests and serve tests.

T-Scale Norms

T-Score scales were not developed for these sets of data since this was a pilot procedure.

TABLE 31

INTERCORRELATIONS BETWEEN TENNIS TESTS FOR PILOT STUDY

Test	Timmer I	Timmer II	Hewitt I	Hewitt II	Wisconsin
Broer-Miller	.65	.65	.48	.34	.32
Timmer I		.77	.52	.34	.25
Timmer II			.48	.37	.23
Hewitt I				.79	.31
Hewitt II					.22

Spring Test Administration

The Spring test administration for tennis included three tests: the Broer-Miller Test, the Wisconsin Serve Test and the Timmer Test. The latter two were not administered in the same manner as in the pilot study. The Wisconsin Test was administered by its original directions. In the Fall, it accidently had been administered from a twenty-seven and one half-foot restraining line instead of a forty-two and one half-foot line. The Timmer Test had been administered in the Fall using two scoring methods. One required the ball to travel between the top of the net and a rope fifty-one inches above the net. The second disregarded the rope. The validity and reliability coefficients were higher for the second scoring method. The mean and standard deviation of the first method indicated that many students failed to score on the test under this method. A compromise between the two methods was used in the Spring. The restraining rope was retained, but raised to nine feet above the court. This, it was thought, would keep the lob and lob-like shots from scoring and would score the good drive shots.

The number of students taking the tests in the Spring was 249. There were 186 women students and 63 men students.

Means and Standard Deviations

The means, standard deviations and standard errors of the means were calculated for all tests and their parts. These calculations along with the range in scores are given in Table 32.

The high standard deviation in relation to the mean for the Timmers Test was the result of several extremely high scores. There were two students who failed to score on the test.

TABLE 32

MEANS AND STANDARD DEVIATIONS FOR TENNIS SKILL TEST

	Range	Mean	S.D.	S.E.
Broer-Miller	9-179	77.18	32.24	2.08
Forehand	4-98	42.89	16.90	1.09
Backhand	0-87	34.29	18.80	1.21
Timmers	0-155	25.22	21.37	1.38
Forehand	0-88	15.42	12.51	0.81
Backhand	0-75	9.80	10.55	0.68
Wisconsin	66-345	192.46	61.64	3.91
Accuracy	43-142	70.65	9.27	0.60
Velocity	5-260	121.81	50.74	3.22

The means, standard deviations and standard errors of the means were calculated for men and women students separately. These are given in Table 33. Tests of significant difference were calculated to compare

the means of the scores obtained by men and women students. These are listed in Table 33 also.

There definitely was a significant difference between the performance of men and women students on all tests. The men students scored better on each test. Consequently, the Physical Education Department at Memphis State might wish to set separate standards for skill achievement for men and women students. This decision will have to be made by the Department according to its philosophy concerning grading the skill of men and women students in coeducational classes.

Reliability

Reliability coefficients were calculated for each test. The Split-Halves and Spearman-Brown coefficients are listed in Table 34.

The reliability coefficients for each of the total tests ranged from very good to excellent. The reliability of the accuracy part of the Wisconsin serve test was of concern. However, it was still felt that dropping this portion of the test would appreciably affect the validity of the test, so both portions were retained. From the standpoint of reliability, any of the tests could be used with confidence in the proficiency battery.

Validity

Validity coefficients were calculated for each test and each of its parts. They are listed in Table 35.

The coefficients for Broer-Miller and Timmer were very close. The "t" test of significant difference between correlation coefficients

TABLE 33

MEANS AND STANDARD DEVIATIONS FOR MEN AND WOMEN STUDENTS IN TENNIS SKILL TESTS

	Men				Women				
Test	Range	Mean	S.D.	S.E.	Range	Mean	S.D.	S.E.	t
Broer-Miller	45-179	107.37	30.75	3.87	9-149	66.50	25.28	1.90	17.01*
Forehand	23-98	55.46	10.46	2.33	4-82	38.44	13.85	1.04	
Backhand	16-87	51.90	16.36	2.06	0-77	28.06	15.36	1.15	
Timmers	7-155	43.30	25.61	3.23	0-91	18.82	15.22	1.14	11.72*
Forehand	3-80	24.98	13.74	1.73	0-67	12.03	10.10	0.76	
Backhand	2-75	18.32	13.54	1.71	0-36	6.79	7.19	0.54	
Wisconsin	-345	270.30	40.02	2.54	66-195	164.99	20.20	1.28	55.89*
Accuracy	43-87	71.38	8.62	1.09	44-142	70.39	9.51	.71	
Velocity	90-260	198.92	40.26	2.56	5-130	94.60	7.00	.44	

* A "t" of 1.972 or above indicates a significant difference at the .05 level.

for correlated data was applied to find if the difference between the coefficients was significant. (9)

TABLE 34

RELIABILITY COEFFICIENTS FOR TENNIS SKILL TESTS

Test	S-H	S-B
Broer-Miller	.84	.91
Forehand	.71	.83
Backhand	.77	.87
Timmer	.83	.91
Forehand	.72	.84
Backhand	.73	.84
Wisconsin	.91	.95
Accuracy	.13	.23
Velocity	.94	.97

A "t" of above 1.645 at the .05 level was needed to indicate a significant difference between the coefficients of the two tests. (7: 406) The "t" was .6522 and, therefore, the coefficients were not significantly different.

TABLE 35

VALIDITY COEFFICIENTS FOR TENNIS SKILL TESTS

Test	Coefficient
Broer-Miller	.57
Forehand	.46
Backhand	.57

TABLE 35 (Continued)

Test	Coefficient
Timmers	.54
Forehand	.51
Backhand	.49
Wisconsin	.62
Accuracy	.18
Velocity	.66

It is interesting that the coefficients for the backhand part of the Broer-Miller Test and the whole test differ only .0021, while the difference for the forehand and the total test was .1147. Almost the reverse was true in the Fall test.

The validity coefficient for the Wisconsin Test was higher for this administration than the Fall administration in which the shorter line had been used. This version of the test was, therefore, a better measure from the standpoint of validity. The velocity measure of the Wisconsin Test was, again, much higher than the accuracy measure, but it was still thought that eliminating the accuracy factor from the test would lower the validity of the test if the students knew the test was based solely on velocity. It was decided that the total Wisconsin Test should be used in calculating the multiple correlations.

Intercorrelations were calculated between the tests. These are listed in Table 36.

All of the intercorrelations for the tennis tests were fairly high. It is interesting that the relationship between the two ground

stroke tests and the serve test was identical. It is also interesting that the two ground stroke tests had approximately the same relationship to each other as each had to the serve test. This would seem to indicate that the two ground stroke tests really measure, to some degree, different aspects of the playing ability.

TABLE 36

INTERCORRELATIONS FOR TENNIS SKILL TESTS

Test	Timmer	Wisconsin
Broer-Miller	.59	.58
Timmer		.58

Doolittle multiple correlations were calculated for three combinations of items. The coefficients for the various batteries are listed in Table 37.

TABLE 37

MULTIPLE CORRELATIONS FOR TENNIS SKILL TESTS

Test	Coefficient
Broer-Miller, Timmer, Wisconsin	.69
Broer-Miller, Wisconsin	.67
Wisconsin, Timmer	.66

None of the combinations of items yielded an acceptable validity coefficient of .70 or above, although the combination of the three items was very close.

The decision was made to investigate further the method of arriving at the validity coefficients for the various tests. All of the results of the round robin or challenge tournaments had been put together so that there were as many students with each rank as there were classes, generally. The question seemed to be what effect did this have on the validity coefficients. If the various classes varied in skill level, then the student ranked one in a poorly skilled class could have ranked maybe only tenth in a more highly skilled class. To investigate the possibilities of this situation, means and validity coefficients were calculated for each class separately for the three skill tests. These are given in Table 38 along with the number of students in each class.

The means for the classes varied considerably on the three tests: Broer-Miller, 67.09 to 105.44; Timmer, 17.54 to 38.72 and Wisconsin, 156.09 to 241.06. It is interesting that class number three had the highest mean on all three tests and that most of the classes ranked approximately the same on all the tests--classes 2 and 5 were notable exceptions to this.

The validity coefficients varied considerably between the classes also. Broer-Miller coefficients ranged from .43 to .84; Timmer coefficients ranged from .49 to .86. The Broer-Miller test had five coefficients in the .40's and .50's, only one in the .60's and five in the .70's and .80's, which was a rather unusual distribution. The Timmer

TABLE 38

MEANS AND VALIDITY COEFFICIENTS FOR TENNIS SKILL TESTS BY CLASSES

		Mean			Validity		
Class	N	Broer-Miller	Timmer	Wisconsin	Broer-Miller	Timmer	Wisconsin
1	19	75.21	27.80	182.42	.67	.62	.61
2	22	67.09	33.91	170.91	.58	.54	.66
3	18	105.44	38.72	241.06	.43	.63	.78
4	28	79.00	23.75	178.96	.45	.38	.61
5	26	70.12	17.54	229.85	.84	.61	.73
6	18	67.11	17.83	164.56	.80	.73	.75
7	17	91.06	31.06	212.24	.76	.82	.86
8	22	72.23	23.32	175.64	.75	.68	.73
9	21	89.10	27.00	198.33	.70	.59	.85
10	25	68.76	19.28	184.40	.52	.58	.66
11	11	72.27	18.36	156.09	.54	.53	.49

Test had one extremely low and one extremely high coefficient, and the Wisconsin Test had one extremely low coefficient. There did not appear to be a relationship between achievement on the test and validity of the item. When the validity coefficients from the classes were averaged together for each test they resulted in average coefficients approximately .07 higher than those calculated by the first method. The comparisons are given in Table 39.

TABLE 39

COMPARISON OF TENNIS SKILL ORIGINAL AND AVERAGE VALIDITY COEFFICIENTS

Test	Original Coefficient	Average Coefficient
Broer-Miller	.57	.64
Timmer	.54	.61
Wisconsin	.62	.70

This investigation tends to indicate that the validity coefficients calculated by the original method were probably low and that the resulting multiple correlations were also probably low. The average coefficients were used in calculating multiple correlation coefficients. These are given in Table 40.

Using these validity coefficients, all of the combinations of tests gave valid batteries, Because of the time factor, it would probably be impractical to give both of the ground stroke tests. The

TABLE 40

MULTIPLE CORRELATIONS FOR TENNIS SKILL TESTS FROM AVERAGED COEFFICIENTS

Tests	Coefficient
Broer-Miller, Timmer, Wisconsin	.78
Broer-Miller, Wisconsin	.76
Timmer, Wisconsin	.74

choice between them would depend on the facilities and equipment available. Although the Timmer Test takes more equipment than the Broer-Miller Test, it has the advantage of being more game-like than the Broer-Miller Test and, consequently, appears to be more interesting and challenging to students. This is particularly true of students who score from average to well on it. Such students would be expected to take the proficiency tests resulting from this study.

T-Scale Norms

T-scales were developed for each test for men and women students separately and combined. There is the possibility that the Physical Education Department at Memphis State University may wish to set separate skill standards for men and women students in these coeducational classes because the men students scored significantly higher on each test. They may, on the other hand, decide to use the same standards for both groups. This decision will have to be based on the departmental philosophy dealing with the skill achievement in coeducational classes. There is no clearly

defined policy at present. Scales are presented in Appendix D for each set of data.

To obtain the composite skill test score for the student, the score of each test from the selected battery must be converted to its equivalent T-score; then, the T-scores must be summed and the total divided by the number of tests in the battery.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Knowledge and performance measures were administered to students in five activities of the Required Physical Education Program at Memphis State University: Archery and Bowling, Badminton, Bowling, Golf and Tennis. The knowledge examinations were administered in the Spring semester, 1970. Performance measures in Archery and Golf were administered this same semester. Performance measures in Badminton, Bowling and Tennis were administered during the Fall semester, 1969 and the Spring semester, 1970. These tests were given to all students enrolled in these activities during the respective semesters. There were only women students enrolled in the combination Archery and Bowling classes. The Badminton and Tennis classes were coeducational. There were separate classes for men and women students in Bowling and Golf. All tests were given near the end of the instructional period for that activity. Students received one semester hour of credit for these activity classes which met three hours a week.

The knowledge and performance tests were analyzed to determine the knowledge questions and performance tests or battery most suitable for use in determining if a student should be exempted from a course or should be allowed to enroll in an advanced level course.

T-scales were developed for the tests recommended for use in the proficiency testing program at Memphis State University. Establishing the cut-off point for determining whether or not a student has reached the proficiency level for exemption or advanced standing is the responsibility of the Physical Education Department at Memphis State University. No prevalent practice was found among other departments having similar programs. There is no clearly defined policy at Memphis State University regarding the cut-off point at the present time.

Conclusions

The following conclusions were drawn from the findings of this study:

1. Empirically and statistically valid and reliable knowledge tests were constructed for each of the five selected activities. A separate test was developed for each activity in the Archery and Bowling combination course. Each of the tests was composed of fifty multiple choice questions except for the Archery test which had forty-five. These tests followed the content and emphasis of the courses as they are taught at Memphis State University.

2. The measure of archery skill used in the study was found to have an acceptable reliability. Face validity was assumed for the test since it was a direct measure of skill achievement. The test consisted of shooting four ends from both ten and twenty yards.

3. The four badminton tests used in this study, the Clear Test, the Short Serve Test, the Bounce Test, and the Footwork Test, were found to be reliable. None of the tests alone was a valid measure of badminton

playing ability. Four combinations of these tests were found to be valid measures of badminton playing ability: (1) the Clear, Serve, Bounce and Footwork tests, (2) the Clear, Bounce and Footwork tests, (3) the Clear and Bounce tests, and (4) the Clear and Footwork tests. One of the final three batteries is recommended for use because the reliability and validity coefficients for the serve test were considerably lower than for the other three tests, and because its presence in the battery contributed less than .01 to the validity of the battery. The scores for the men and women students in these coeducational classes were significantly different, thus raising the question of whether or not separate standards for proficiency should be set for each sex.

4. The findings for bowling performance indicated that more than six games were necessary for a score which was above the borderline of acceptability. Using the Spearman-Brown Prophecy Formula on the data from this study, nine or twelve games would give more than borderline results. Face validity was assumed for this test since it was a direct measure of skill achievement.

5. A cursory examination of the scores from the golf skill evaluation indicated that these scores were not accurate enough to be used in a study setting standards for other students to meet.

6. The preliminary tennis results indicated there were three of the four tests under scrutiny which were suitable for further study. The Broer-Miller Test, the Timmer Test and the Wisconsin Test were retained in the study. The Hewitt Serve Test was dropped because of its low validity and reliability coefficients and because of the difficulties

encountered in its administration. The three tests used in the second test administration were found to be reliable measures. No test alone was found to be a valid measure of tennis playing ability, nor were any of the combinations of tests when the original method of establishing validity coefficients was used. This method of finding validity was investigated further, and it was found that when the classes were evaluated as separate units and then these coefficients averaged, the total validity coefficients for each test was raised about .07. Using these coefficients, all of the combinations of tests were found to be valid measures of playing ability.

7. T-scales were developed for all of the knowledge tests and for the recommended skill measures. The skill test scores in the badminton and tennis batteries must be converted to their equivalent T-score, summed, and divided by the number of tests in the battery in order to obtain a skill test score for a student. The performance score either may be combined with the knowledge test T-score in some weighting to determine the proficiency standard or a standard of passing may be set for each. This is the responsibility of the Physical Education Department at Memphis State University.

Recommendations

The following recommendations are made as a result of the findings of this study:

1. The revised knowledge tests constructed for this study can be used to evaluate the knowledge of students who have had courses similar in content emphasis to the ones in this study. The tests can

be used to establish whether or not a student should be declared proficient in knowledge for similar courses.

2. The skill test for archery can be used to establish skill proficiency in this activity.

3. The skill test battery for badminton should include either (1) the Clear, Bounce and Footwork tests, (2) the Clear and Bounce tests, or (3) the Clear and Footwork tests. The choice between these should be determined mainly by the facilities, equipment and time available for testing. The scores from the selected battery should be converted to their equivalent T-score, summed, and divided by the number of tests in the battery.

4. The scores for more than six lines should be used to give a reliable measure in determining the proficiency of a student in bowling. Nine or twelve is recommended.

5. Any of the three combinations of tennis tests may be used to assess proficiency in tennis skill. It would seem advisable to use only one of the ground stroke tests with the serve test, however. Either of the ground stroke tests may be used. It is recommended that the Timmer Test be used if the equipment is available because it is more game-like and more interesting to students. The scores from the selected battery should be converted to their equivalent T-scores, summed and divided by the number of tests in the battery to give the performance score for a student.

6. The performance test T-score may be combined with the knowledge test T-score to give a composite score in establishing proficiency,

or the scores from each type of measure may have a set standard in order to determine proficiency.

7. Other departments may use the knowledge tests constructed for this study if their courses are similar in content and emphasis. The performance measures used in this study may be used with similar groups. The norms established may be used only if the data from the group being tested are very similar to the data in this study with regard to means and standard deviations.

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APPENDIX A

ARCHERY EXAMINATION

DIRECTIONS: All of the questions are multiple choice. Select the best answer from those given for each question. Indicate the correct answer by blackening the proper space on the answer card. Be sure to mark heavily in the space provided. If you mark the wrong box, be sure to completely erase the incorrect answer. Do not mark on the test booklet. Do not waste time on difficult questions. Go to the other items and reconsider omitted items if you have time, but please finish all items if at all possible. Unless otherwise stated, assume the player is right handed in answering all questions.

1. What determines the length arrow an archer should use?
   A. The weight of the bow.
   *B. The length of the archer's arms.
   C. The distance from the target.
   D. The length of the bow.

2. How do you determine which end of the bow should be up when shooting?
   A. The trademark on the bow identifies the upper limb.
   B. The looped end of a single-loop string should be on top.
   *C. The upper limb is longer and has more bend.
   D. It does not make any difference, the bow shoots well either way.

3. Which piece of equipment does the term laminated describe?
   *A. The bow.
   B. The arrow.
   C. The target.
   D. The target stand.

4. How should arrows be removed from the target?
   *A. Place back of one hand against target with fingers surrounding arrow and with the other hand grasp the arrow close to the target.
   B. Grasp arrow with both hands and pull gently.
   C. Push against target with palm of one hand and pull arrow gently with other.
   D. Push against target with one hand and place the other around the fletching for protection as you pull gently.

5. What should an archer do when finished shooting an end?
   A. Retrieve his arrows.
   B. Remain quietly on the shooting line until everyone is finished.
   C. Step behind the shooting line and talk to the other archers.
   *D. Step at least three feet behind the shooting line and remain quiet.

6. What score is given an arrow which cuts the red and the blue?
   A. 5
   B. The value of the color in which the greater part of the arrow is.
   *C. 7.
   D. 3.

7. How is the score recorded when a shooter has 1 gold, 2 reds, and 3 whites in an end?
   A. 1,1,1,7,7,9.
   B. 9,5,5,1,1,1.
   *C. 9,7,7,1,1,1.
   D. None of the above.

8. What would be the score of one bounce-off, one bull's eye, one blue, two blacks, and one petticoat?
   A. 25.
   *B. 27.
   C. 28.
   D. 29.

9. What happens to a misfire?
   A. It may not be shot again under any circumstances.
   B. It may be retrieved after shooting has ceased and shot again.
   *C. It may be shot again if the archer can reach it with his bow.
   D. It is scored as 7.

10. What is the proper scoring procedure?
   A. Everyone draws and scores his own arrows.
   *B. One person draws all the arrows while a different person scores them.
   C. Everyone draws his own arrows except the scorekeeper.
   D. Everyone draws his own arrows including the scorekeeper.

11. What should be done with a "hanging-arrow"?
   A. It should be left alone and fixed when the end is over.
   B. It should be pulled and placed under the target.
   C. It should be shot over again.
   *D. It should be straightened and placed in the appropriate color.

12. What should an archer do upon hearing two blasts of a whistle?
   A. Retrieve her arrows.
   B. Know that there is an emergency.
   C. Start shooting.
   *D. Stop shooting and unnock her arrow.

13. When should archers advance beyond the shooting line?
   A. When all of the arrows have been released.
   B. When the round has been completed.
   C. When the archer's end is completed.
   *D. When the signal is given to retrieve arrows.

14. Why should an arrow never be nocked before the signal is given to shoot?
    *A. It violates archery safety rules.
    B. It violates archery courtesy rules.
    C. It gives an unfair advantage to that shooter.
    D. Someone may be in front of the shooting line.

15. What should an archer look for after each end?
    A. Broken nocks.
    B. Splintered arrows.
    C. Missing piles.
    *D. All of the above.

16. What does bracing the bow involve?
    A. The act of hanging it up unstrung after use.
    B. Keeping it on the quiver rest and out of the grass.
    C. Drawing the bow several times before shooting.
    *D. Stringing the bow.

17. Where should the point of aim be when shooting long distances?
    *A. On or above the target.
    B. On or below the target.
    C. In front of the target.
    D. At the bull's eye.

18. Why is it usually more difficult to shoot accurately at long ranges than at short ones?
    A. Arrows must be released higher so a point of aim is harder to find.
    B. Gravity has more effect so arrow flight is harder to control.
    C. The release must be perfect so as not to smother the bow's force.
    *D. Slight directional errors are magnified as distance increases.

19. How should your aim be adjusted as you move farther away from the target?
    A. Lowered.
    *B. Raised.
    C. Stay the same.
    D. Moved to the left.

20. Where do you sight in aiming?
    A. Over the cock feather.
    *B. Over the pile.
    C. Down the shaft.
    D. Over the crest.

21. How should the archer sight?
    *A. With the right eye.
    B. With the left eye.
    C. With both eyes.
    D. With either eye, it really does not matter.

22. What does the point of aim method of shooting involve?
    *A. Aiming at a specific object placed on the ground for this purpose.
    B. Aiming by picking a point on or above the ground at which to aim.
    C. Aiming by using a bow sight.
    D. Aiming directly at the yellow to see where the arrows are "grouped."

23. A shooter who is using a point of aim marker on the ground finds her arrows going over the target at 11 o'clock. What adjustment should be made?
    *A. Move her marker nearer the shooting line and slightly to the right.
    B. Move her marker nearer the target and slightly to the right.
    C. Move her marker nearer the shooting line and check the position of her bow hand and arm.
    D. Move her marker nearer the target and slightly to the left.

24. Why do most shooters aim below the target at ranges of 30 yards or less?
    A. Because at shorter distances gravity does not have time to take effect.
    *B. Because the shooter looks <u>down</u> over the tip of the arrow instead of sighting along the shaft.
    C. Because the arrow is "caught" by the target as it rises in flight.
    D. Because at shorter ranges the arrow speed is so great that gravity does not affect the arrow.

25. Which does <u>not</u> apply in correctly bracing a bow by the push-pull method?
    A. Bow is placed against inside arch of right foot.
    B. Left hand presses upper limb of bow down and pushed string toward upper nock.
    C. Right hand pulls bow toward archer by grasping the bow handle.
    *D. Right leg steps between bowstring and belly of the bow.

26. Why do hunters use instinctive shooting rather than bowsights?
    A. They cannot judge the distance accurately enough.
    *B. They do not have time to set a bowsight.
    C. They have to get so close to have "killing power" that a bow sight is useless.
    D. The bow is too heavy to hold at anchor point so the length of the draw and angle of release must be done by "feel."

27. How would a free style archer adjust his sight if his arrows were low and left?
    A. Higher and toward the bow.
    B. Higher and away from the bow.
    C. Lower and towards the bow.
    *D. Lower and away from the bow.

28. A shooter using a bowsight finds her arrows going just over the top of the target. What adjustment should she make?
    *A. Pin should be raised (moved up toward the upper limb of the bow).
    B. Pin should be lowered (moved down toward the ground).
    C. Shorten her anchor point slightly; she is probably overdrawing.
    D. Check her head position; she is probably looking up or peeking.

29. Where is the string placed on the fingers in drawing the bow?
    A. Near base of fingers.
    B. On the crease of the second joint.
    C. Between the first and second joint.
    *D. Near the tips of the fingers.

30. Why is <u>holding</u> an important part of shooting?
    *A. It gives the bow arm a chance to become steady.
    B. It will help reduce fatigue.
    C. It helps the muscles increase in tension.
    D. It gives the shooter time to "get set."

31. An archer's arrows are grouped at 4 o'clock. Why is this an important accomplishment?
    A. Consistency is very important in archery.
    *B. Grouping shows that the shooter has established consistent form in shooting.
    C. Only a small adjustment needs to be made with her bowsight for her to group her arrows in the gold.
    D. Grouping shows that the shooter is releasing each arrow the same way.

32. Which best describes the position of the bow arm during the draw?
    *A. The elbow is slightly bent.
    B. The elbow is locked.
    C. The elbow is bent at a right angle.
    D. The elbow is tilted slightly upward.

33. Which fingers are on the bow string during the draw?
    A. All the fingers.
    B. The first finger and thumb.
    *C. The first three fingers.
    D. The first two fingers.

34. Is the stance important in archery? Why or why not?
    A. No, if the hips and shoulders are aligned, the arrow is apt to fly more true.
    B. No, if the line of pull is parallel to the bow arm, the arrow will fly to the target.
    C. Yes, the line across the toes determines the direction the arrow will take.
    *D. Yes, the hips and shoulders are more apt to be aligned if the stance is right.

35. Which of the following is most important in gripping the bow?
    A. Hold the bow securely in the fingers.
    B. Hold the bow against the full length of the heel of the hand and let the fingers curl naturally around the bow.
    *C. Hold bow against heel of the thumb, grip very little with the fingers.
    D. Hold bow so knuckle of forefinger is as wide and level as possible.

36. A shooter is having difficulty because her arrows fall off her bow hand. Which of these is the most likely cause?
    A. She probably has not tipped her bow slightly as she should.
    B. Her arrows probably fit the bow string too loosely.
    C. She probably does not have her fingers close to the arrow as she draws.
    *D. She probably draws the string back toward her right ear.

37. What is the location of the anchor point?
    A. At the tip of the nose.
    B. High on the cheek bone.
    C. Beside the ear.
    *D. Under the jaw bone.

38. Which statement best applies to the anchor point?
    *A. It must be consistent.
    B. It is constantly changing.
    C. It determines the distance the arrow travels.
    D. It varies with the individual.

39. Which of the following would be most likely to cause an arrow to go high?
    *A. Anchoring while the mouth is open.
    B. A head-on wind.
    C. Creeping.
    D. Bow sight placed too high.

40. When should an archer remove her hand from the anchor point?
    A. When the arrow is released.
    *B. When the arrow hits the target.
    C. When the arrow is on its way.
    D. When the draw is completed.

41. Why should the fistmele be 6" or more?
*A. So the string will not slap the wrist.
B. So the bow will have its full power.
C. So the bow will shoot smoothly.
D. So the flight of the arrow will not be affected.

42. How is the bow held when nocking the arrow?
*A. Parallel to the ground.
B. Perpendicular to the ground.
C. In shooting position.
D. In the opposite hand.

43. What generally causes the arrow to fall off the arrow rest?
*A. Holding arrow too tightly with the right hand.
B. Tipping bow to the left.
C. Not holding arrow with left index finger.
D. Cross-wind.

44. How is the cock feather distinguished from the other feathers?
*A. It is at a right angle to the nock.
B. It is parallel to the nock.
C. It is colored white.
D. It is a different shape.

45. Which direction does the cock feather point when the arrow is nocked?
A. Toward the ground.
B. To the right and left.
*C. Toward the sky.
D. It depends on the wind.

46. Which best describes the proper way to address the target?
A. Stand on shooting line, facing the target.
*B. Stand astride the shooting line, looking toward target.
C. Stand with feet together, shoulder toward target.
D. Stand astride the shooting line, turning the body to face target.

47. Under which condition is the elbow apt to be bruised?
A. Shooter lets her elbow bend as she releases the arrow.
*B. Shooter uses all possible forces to support bow at full draw position.
C. The bow is understrung.
D. The shooter overdraws.

48. A shooter scores only random hits in the target. She has few high scoring arrows; many hits are in the black and white. She shows no consistent directional errors. What is most apt to be her source of difficulty?
    A. She varies her shooting stance each time she shoots.
    B. She has not marked her point of aim carefully enough.
    *C. She has a poor release as her main problem.
    D. She fails to concentrate long enough on point of aim before release.

49. How should the arrows be released?
    A. By pushing the arrow.
    *B. By relaxing the fingers.
    C. By jerking the right hand off the string.
    D. By relaxing the shoulder muscles.

50. What is important to do after loosing the arrow?
    A. Watch the flight of the arrow.
    *B. Hold the shooting position for one to three seconds.
    C. Nock another arrow immediately.
    D. Relax the position before the next shot.

51. What does the term "quiver" describe?
    A. A shaking of the bow as the string is released.
    B. A jerky release.
    C. The result of an incorrect anchor.
    *D. A device to hold the arrows.

52. What is a round?
    A. Six arrows.
    B. Six ends.
    *C. Any designated number of ends.
    D. 15 ends.

53. What is the crest?
    *A. Distinctive markings on the arrow.
    B. Collective name for the feathers.
    C. Part of the arrow between the nock and the feathers.
    D. Pointed end of the arrow.

54. To what does bow "weight" refer?
    *A. The number of pounds required to draw the string a specific distance.
    B. The number of pounds a bow weighs after it is strung.
    C. The number of pounds a bow weighs before it is strung.
    D. The number of pounds of pressure one must exert to string a bow.

55. What is the petticoat?
    A. The black line around the edge of the target.
    *B. The non-scoring portion of the target.
    C. The white ring on the target.
    D. The gold circle on the target.

Below are a number of questions listing some common errors in archery. For each question decide the direction an arrow will go if the archer makes this error.

If high mark box	A
If low mark box	B
If to the right mark box	C
If to the left mark box	D

56. Third finger not on the string. (A)

57. Flinching the bow arm. (D)

58. Squeezing the arrow. (D)

59. Hunching the left shoulder. (C)

60. Dropping the bow arm on release. (B)

61. Plucking the string on release. (C)

62. Arrow nocked low. (A)

63. Tilting the bow to the left. (D)

64. Failure to anchor under chin. (A)

65. Creeping. (B)

66. Elbow of drawing arm lowered on release. (B)

67. Aiming with the left eye. (D)

68. Not bringing the arrow back to full draw. (B)

69. Releasing while string is away from face. (D)

70. Failure to anchor under jaw. (A)

* or (A)--asterisk or letter in parenthesis indicates correct answer.

BADMINTON EXAMINATION

DIRECTIONS: All of the questions are multiple choice. Select the best answer from those given for each question. Indicate the correct answer by blackening the proper space on the answer card. Be sure to mark heavily in the space provided. If you mark the wrong box, be sure to completely erase the incorrect answer. Do not mark on the test booklet.

Do not waste time on difficult questions. Go to the other items and reconsider omitted items if you have time, but please finish all items if at all possible.

Unless otherwise stated, assume the player is right-handed in answering all questions.

1. Where did badminton originate?
   A. China.
   B. France.
   *C. India.
   D. U.S.A.

2. How can you differentiate between an indoor and outdoor shuttlecock?
   A. Indoor shuttles have blue bands around the base.
   B. All outdoor shuttles have rubber bases.
   *C. Outdoor shuttles are heavier.
   D. Indoor shuttles have white feathers; outdoor shuttles do not.

3. Which statement about equipment is true?
   A. Rackets do not need to be kept in presses unless strung with gut.
   *B. Nylon strings are more durable than gut.
   C. All steel shafted rackets are of top quality.
   D. The correct height to set up a badminton net is 7 1/2 feet.

4. How should you recover a bird which has fallen in the alley of an adjacent court where play is in progress?
   A. Reach in quickly with racket to roll it out.
   B. Run on to court quickly and dodge out of way.
   *C. Wait on your own court until play is finished.
   D. Get a new bird.

5. Who should call fouls, line violations and out-of-bounds shots?
   *A. Call your own fouls and line decisions.
   B. Call your opponents fouls and line decisions.
   C. Replay rallies when fouls and line shots occur.
   D. Always have an official to call fouls and line decisions.

6. What does it mean when a team is on the "offensive"?
   A. The term is serving.
   B. The team has the higher score.
   C. The team is the more skilled.
   *D. The team has hit the shuttle downward.

7. What is a "let"?
   *A. The re-playing of any rally.
   B. The act of one side conceding a point.
   C. A served shuttle touching the net and landing in the correct service court.
   D. A shuttle, during a rally, touching the net and landing in the opponent's court.

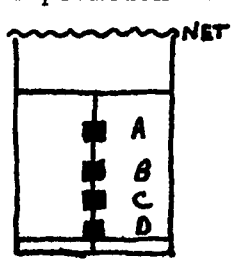
8. What is "down"?
   A. A point.
   *B. The player serving loses service.
   C. The opponents win right to serve.
   D. The point is played over.

9. What is "setting"?
   A. An indistinct hit.
   B. A team's term of service.
   C. A player's term of service.
   *D. Extending a tie game.

10. Which would be most advantageous for a good game of badminton?
   A. Good drop, above average clear, average drive, poor smash.
   *B. Good clear, above average drop, average smash, poor drive.
   C. Good smash, above average drive, average clear, poor drop.
   D. Good drive, above average smash, average drop, poor clear.

11. Which is a simple strategy for badminton?
   A. Use trick shots.
   *B. Place the shuttle where the opponent is not.
   C. Hit the shuttle high and hard.
   D. Hit the shuttle down the center.

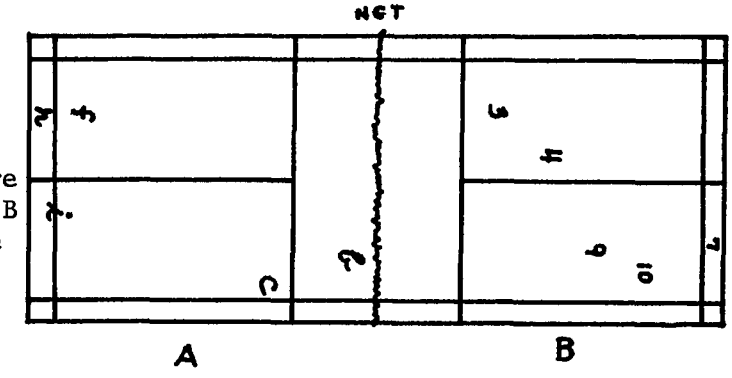
12. Which square in the diagram shows the correct location of home or base position for a singles player?



(B)

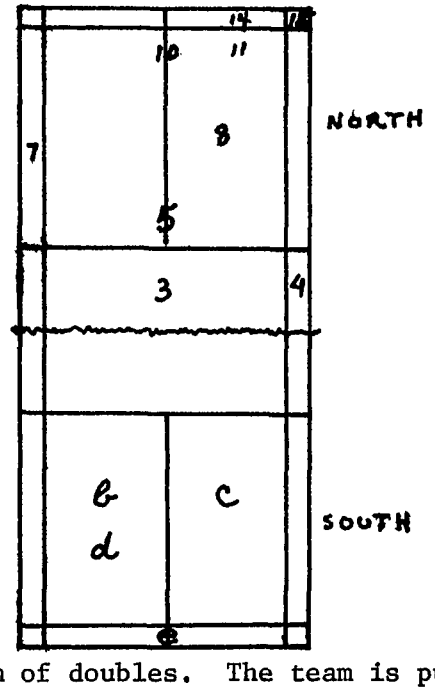
The diagram below shows different court positions. Answer the following as to which strokes should be used in the situations described for singles play.

13. Player A, standing at f, clears to 7. What is the best return for B to make?
    *A. Drop shot to b.
    B. Clear to h.
    C. Smash to c.
    D. Clear to i.



14. A is serving; the score is 4-3. Where should B be standing to receive the serve?
    A. 3
    *B. 4
    C. 9
    D. 10

The diagram below shows different court positions. Answer the following as to which strokes should be used in certain situations in a doubles game.



15. North is playing Up-and-Back at 5 and 10. South receives a drive at d. What is South's best return stroke?
    A. Clear to 11.
    B. Smash to 4.
    C. Clear to 14.
    *D. Drive to 7.

16. South is playing Side-by-Side at b and c. North is also playing Side-by-Side. North hits a clear to e. What is South's best return?
    A. b smash to 8.
    *B. b drop to 3.
    C. c clear to 15.
    D. c smash to 5.

17. A team is playing the rotation system of doubles. The team is put on the defensive. What positions should these players now take?
    A. Stay in the same place.
    *B. Side-by-Side.
    C. Player in right court goes up.
    D. Player in left court goes up.

18. Which system of doubles play is most frequently used for mixed doubles?
    A. Diagonal.
    B. Parallel.
    C. Rotation.
    *D. Up and back.

19. Which of the following best describes the ready position?
    A. Side to net, knees slightly bent, racket extended in front of body.
    *B. Facing net, weight balanced, racket extended in front of body.
    C. Side to net, weight balanced, racket extended to side.
    D. Facing net, knees slightly bent, racket extended to side of body.

20. How can a player best position for shots requiring quick movements to the left or right?
    A. Take a couple of small sliding steps in that direction.
    B. Reach as far as possible, keeping the feet stationary.
    *C. Pivot, then run if necessary.
    D. Run quickly in that direction.

21. What is the advantage in holding the racket in the "hand shaking" grip for the forehand?
    A. It is the most comfortable way to hold the racket.
    *B. It allows one to have the most wrist snap.
    C. It allows one to hold the racket tightly.
    D. It allows one to rapidly shift from forehand to backhand grips.

22. Which combination of strokes requires the same execution until just before contact is made with the bird?
    A. Clear, service, net shots.
    B. Smash, clear, drive.
    C. Drop shot, drive, smash.
    *D. Drop shot, smash, clear.

23. What portion of the body provides most of the power in a badminton stroke?
    A. Hand.
    *B. Wrist.
    C. Arm.
    D. Shoulder.

24. Which of these shots is contacted at the greatest distance in front of the body of the player?
    A. Clear.
    B. Overhead drop.
    *C. Smash.
    D. Backhand Clear.

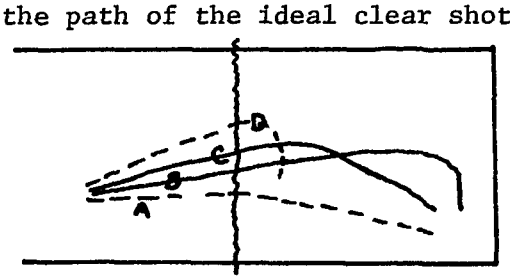
25. Why is it desirable to hit overhead shots at the peak of the player's reach?
    A. The bird is traveling faster and thus rebounds off the racket at a greater speed.
    B. The wrist can be snapped most efficiently at this point, thus increasing the velocity of the bird.
    *C. The lever arm is longest at this point, thus providing maximum force behind the shot.
    D. The bird is closest to the net at this point, thus having less distance to travel back to the net.

26. From what point should the swing of the racket head begin for the overhead strokes?
    (A)

27. Where should the hand be when gripping the racket?
    A. About two inches up from the leatherbase.
    *B. At the butt end of the racket.
    C. Anywhere on the handle that feels comfortable.
    D. In the middle of the grip.

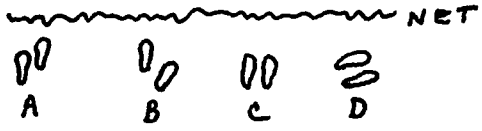
28. Which statement best describes the Eastern forehand grip?
    *A. The top plate of the handle comes in the middle of the "V" made by the thumb and forefinger.
    B. The thumb exerts the most pressure in maintaining the grip.
    C. The racket face is parallel to the ground when the player grasps the racket.
    D. The forefinger extends up the handle of the racket.

29. What is the path of the ideal clear shot?
    (B)



30. Which statement describes the correct execution of the forehand clear?
    *A. At the finish of the backswing, the elbow and wrist bend so that the racket head drops below the shoulders.
    B. The shuttle is contacted slightly behind the head.
    C. The elbow is bent at the time of impact of racket and shuttle.
    D. In the backswing, the body is turned so that the shoulders are parallel with the net.

31. Which diagram shows the correct stance for the forehand clear?
(B)



32. In the diagram below, the flight pattern is that of what stroke?
A. Smash.
B. Short serve.
*C. Drop shot.
D. Drive.

33. What is the greatest difference in the techniques of hitting a clear and a smash?
A. The amount of wrist snap.
*B. The distance in front of the player at which the bird is contacted.
C. The grip.
D. The transfer of body weight from one foot to another.

34. What is the greatest difference in the technique of hitting the clear and drop shots?
*A. The amount of wrist snap.
B. The distance in front of the player at which the bird is contacted.
C. The grip.
D. The transfer of body weight from one foot to another.

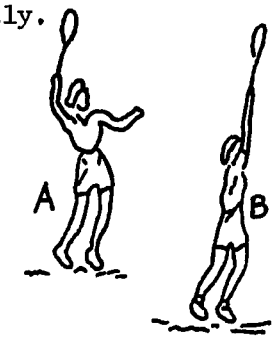
35. How high should the shuttle be contacted on the clear?
(D)

36. If the player at the right were attempting a clear, at which point should she contact the bird?
(B)

A B C D

37. If the player at the right were attempting a smash from midcourt, at which point should she contact the bird?
(C)

38. Which of the two arm positions is the better position for smashing? Why?
   *A. A; the bird can be hit more forcefully.
   B. A; the racket can be swung into position more quickly and the player is ready to smash sooner.
   C. B; the bird flight can be angled downward more sharply.
   D. B; the bird can be placed more accurately.



39. What should you avoid in executing a smash?
   A. Having the left foot forward.
   B. Emphasizing wrist action.
   C. Hitting the shuttle in front of the body.
   *D. Hitting the shuttle with a bent arm.

40. Which best describes the flight of a good smash?
   A. High arc that drops near opponent's end line.
   B. Straight line parallel to the floor.
   C. Flight directly downward toward the opponent's end line.
   *D. Flight directly downward into the opponent's fore court.

41. Which does not describe proper execution of the smash?
   A. The backswing should resemble that of the overhead clear.
   B. The shuttle is contacted at the height of the player's reach.
   *C. The shuttle is contacted at a point above the right foot.
   D. Speed is imparted to the shuttle by snapping the wrist.

42. What is the chief difference in execution of a smash and a drop shot if each is played from high overhead?
   A. Length of preliminary swing.
   *B. Follow through.
   C. Direction of racket face.
   D. Speed of preliminary swing.

43. What is an important factor in performing a drop shot?
   *A. Start the shot by moving as if returning a clear shot to deceive opponent.
   B. Use no wrist action.
   C. Hold racket up and let shuttle rebound off racket.
   D. Omit backswing.

44. A player wants to hit a drop shot with less arc in its flight. What might he change about his stroke?
   A. Contact the bird slightly back of his right shoulder.
   B. Bend his elbow at contact.
   C. Swing easier.
   *D. Change the angle of the racket face at contact.

45. Where should the overhead drop shot be contacted? A B C D
(B)

46. What is the most important feature of a net shot or a hairpin stroke?
*A. Meet bird as high as possible.
B. Keep wrist firm.
C. Hold the racket tightly.
D. Use little backswing.

47. What is the most important aspect of a backhand swing?
A. Level backswing.
B. Shift of weight on contact.
C. Follow through.
*D. Side to net.

48. Where should the backhand be contacted for the most effective shot?
(A)

49. Why is the thumb placed up the back of the racket for the backhand grip?
A. For leverage
*B. For added force.
C. For adding wrist action.
D. For control.

50. What is characteristic of the forehand drive?
A. Swing should be at waist level.
B. Contact point is near the back foot.
C. Shuttle should land in rear of opponent's court.
*D. Shuttle skims rapidly over top of net.

51. Which statement describes the execution of the underhand clear?
A. The weight, during the backswing is on the forward foot.
B. The elbow is bent at the time the shuttle is hit.
C. The shuttle is contacted at waist level.
*D. The follow through of the racket is in line with the shuttle's path.

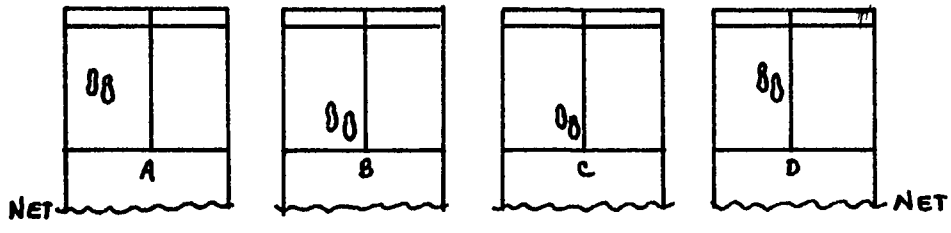
52. At what height should the bird be contacted on the serve for maximum efficiency?
    A. Waist.
    *B. Hips.
    C. Upper legs.
    D. Knees.

53. What is the difference in the technique of hitting a long and short doubles serve?
    A. More backswing in the long serve.
    *B. More wrist snap in the long serve.
    C. More shift of body weight in the long serve.
    D. More speed in the arm movement in the long serve.

54. What might a player do to flatten out his short serve and still have it travel the necessary distance?
    A. Swing easier.
    B. Hit more under the bird.
    *C. Swing more horizontally.
    D. All of the above.

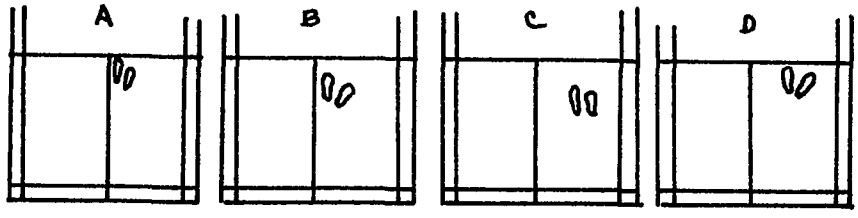
55. Which statement does <u>not</u> describe proper execution of the long serve?
    A. The server attempts to make the backswing resemble the backswing of the short serve.
    B. The weight is transferred from the back to the forward foot as the racket is swung forward.
    C. The wrist leads the racket until just before the moment of impact of racket and shuttle.
    *D. The desired flight of the shuttle is low over the net.

56. Which of the diagrams below shows the correct location of the server's feet in a singles game?
    (D)



57. Why is the long service considered best for singles play?
    A. Because it gives the server time to get ready for follow-up play.
    B. Because the receiver's return is more apt to be a set-up for a smash.
    C. Because the receiver is limited to the clear in choice of returns.
    *D. Because the receiver must move backward to get into position for a return stroke.

58. Which of the diagrams below shows the correct serving position in a doubles game? The team is using Up-and-Back coverage.
(B)



59. In a singles game, A serves a bird which would have gone out-of-bounds. B returns it. What should A do?
A. Play point over.
B. Give B the service.
*C. Play the bird when it is returned.
D. Claim a point.

60. Which of the following is <u>not</u> a service fault?
A. Racket face is above the hand.
*B. Server completely misses the shuttle.
C. Server feints as if to hit the shuttle but does not strike it.
D. Server contacts shuttle above the waist.

61. Which of the following is a foul when playing a net shot?
A. Racket follows through over the net.
B. Bird contacts frame of racket.
C. Player steps on sideline when contacting bird for return shot.
*D. Racket touches net on return shot.

62. What choices does the winner of the toss have?
A. Must serve and can choose side of court.
B. Choose to serve or receive.
*C. Choose to serve or receive or choose side of court.
D. Choose serve or side of court.

63. For what is the inner back boundary line used?
A. Singles service court only.
B. Both singles and doubles service court.
*C. Doubles service court only.
D. Singles playing area.

64. Which applies when the shuttlecock touches the net on a serve?
A. Call a "let" serve.
B. Replay the serve.
*C. Continue play.
D. Terminate period of service.

65. The score is 5-4 in a singles game. From which court should the next bird be served?
*A. Left court.
B. Right court.
C. Either court, it does not matter.
D. Impossible to determine.

66. The score is 10-all in a ladies' singles match. To what number of points may the game be set?
*A. 2.
B. 3.
C. 4.
D. 5.

67. How many points are played in a game of Women's singles?
*A. 11.
B. 15.
C. 21.
D. May be any of the above.

68. In doubles, Team "A's" score is 13 and Team "B's" score is 12. Team "B" scores one more point. What can Team "B" do?
A. Set the game at two points.
B. Set the game at three points.
C. Set the game at five points.
*D. Cannot set the game.

69. In the first rally of the game, the server serves a fault. What is the procedure?
A. Her partner serves.
*B. The opponent in the right court serves.
C. The opponent in the left court serves.
D. She reserves.

70. Player A's serve lands on the center line of Player B's service court. What is the decision?
A. Point B.
B. Repeat the serve.
*C. Point A.
D. Side-out.

* or (A)--asterisk or letter in parenthesis indicates correct answer.

BOWLING EXAMINATION

DIRECTIONS: All of the questions are multiple choice. Select the best answer from those given for each question. Indicate the correct answer by blackening the proper space on the answer card. Be sure to mark heavily in the space provided. If you mark the wrong box, be sure to completely erase the incorrect answer. Do not mark on the test booklet.

Do not waste time on difficult questions. Go to the other items and reconsider omitted items if you have time, but please finish all items if at all possible.

Unless otherwise stated, assume the bowler is right-handed in answering all questions.

1. From what did American ten pin bowling originate?
   A. Sixpins.
   B. Sevenpins.
   C. Eightpins.
   *D. Ninepins.

2. What is the name of the organization that establishes rules and regulations for bowling?
   *A. National Bowling Congress.
   B. American Bowling Congress.
   C. National-International Bowling.
   D. United States Bowling Committee.

3. What factors should be taken into consideration when choosing a ball?
   A. Weight.
   B. Finger hole size.
   C. Span of holes.
   *D. All of above.

4. What is the range in the weight of regulation balls?
   A. 9-16 pounds.
   *B. 10-16 pounds.
   C. 9-15 pounds.
   D. 10-15 pounds.

5. Which of the following are uniform in all bowling alleys?
   A. Length of the lane.
   B. Approach.
   C. Position of the range finder.
   *D. All of the above.

6. How can you determine that a bowler bowls with her right hand by observing her bowling shoes?
   A. The toe of the left shoe will be worn.
   *B. The sole of the left shoe will be leather.
   C. The sole of the left shoe will be rubber.
   D. The sole of the left shoe will have a leather tip.

7. How should one select a ball with the proper finger span?
   A. The bowler should have to "pinch" the ball slightly to hold it.
   B. The fingers should have to stretch slightly to reach across the span.
   C. The palm of the hand should rest against the ball when the ball is held.
   *D. The grip should allow a pencil to be inserted between ball and palm.

8. When bowlers on adjacent alleys are both ready to bowl, what procedure should be followed?
   *A. Bowler on the right should be allowed to roll first.
   B. Bowler on the left should be allowed to roll first.
   C. Both bowlers should be allowed to bowl at the same time.
   D. Whichever bowler was in position first should be allowed to bowl.

9. Which of the following is an example of proper etiquette?
   A. Walking into an adjacent approach to determine which pins are still standing.
   B. Alternately using two balls so that someone else will be able to use them.
   *C. Confining "body English" to your own alley.
   D. Offering advice to other bowlers concerning their game.

10. Where should you be standing while waiting for the return of your ball?
   A. At the foul line.
   B. On the approach.
   *C. At the scorer's table.
   D. Near the ball return rack.

11. Where should a bowler, when he finishes bowling, leave a ball belonging to the bowling establishment?
   A. On the ball return rack on his alley.
   B. At the ball storage rack nearest his lane.
   *C. At the ball storage rack with other balls of the same color.
   D. At any of the above.

12. When may the bowler on the left have priority if two bowlers start their approach at the same time?
   A. If he has just bowled a strike.
   B. If he is bowling his first ball.
   *C. If he is bowling his second ball.
   D. If he is bowling his last frame.

13. How is an error recorded on a score sheet?
    A. 0.
    *B. -.
    C. /.
    D. c.

14. What is the bowler's score if all the balls are knocked down on the first ball?
    A. Ten points.
    *B. Ten points plus the score of the next two balls.
    C. Ten points plus the score of the next ball.
    D. A bonus of ten points.

15. The bowler knocks down all but the 7 pin with her first ball. The second ball rolls into the gutter before reaching the pin deck, but comes back to knock down the 7 pin. How is this frame scored?
    *A. The player is credited with 9 pins.
    B. The player is credited with a spare.
    C. The 7 pin is respotted and the player rolls the second ball again.
    D. The pins are all respotted and the player rerolls the frame.

16. How is a spare scored?
    A. 10 plus the score of the first ball in the frame in which the spare was made.
    *B. 10 plus the pins knocked down by the next ball.
    C. 10 plus 10.
    D. 10 plus the pins knocked down in the next frame.

17. At the end of the seventh frame the score is 100. What is the score at the end of the game?

Frame	1st Ball	2nd Ball
8	6	3
9	5	5
10	8	2

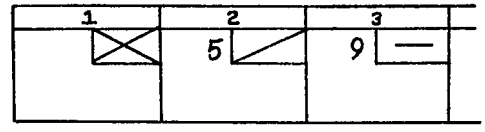
    A. 137.
    B. 129.
    C. 139.
    *D. Incomplete.

18. The score in the seventh frame is 123. What is the final score in the game?

Frame	1st Ball	2nd Ball
8	5	5
9	10	0
10	10	
	10	

A. 173.
B. 203.
*C. Incomplete.
D. Correct score not given.

19. What is the score for the third frame in this line?
A. 39.
*B. 48
C. 56.
D. 65.



20. What is the maximum number of points that can be scored in one game?
A. 100.
B. 200.
*C. 300.
D. 400.

21. What is the penalty for committing a foul on the first ball?
A. No credit, pins are reset, next player bowls.
*B. No credit, pins are reset, second ball rolled.
C. Credit, pins are reset, next player bowls.
D. Credit, pins are reset, second ball rolled.

22. Which of the following is <u>not</u> a foul in bowling?
A. The bowler's foot slides over the foul line as the ball leaves the bowler's hand.
*B. The bowler slides over the foul line with the ball, but does not deliver it.
C. The bowler's hand touches the wall beyond the foul line as the bowler attempts to maintain balance after delivering the ball.
D. The bowler's hand comes in contact with the alley just beyond the foul line after the ball is released.

23. What is a sleeper?
*A. A pin standing directly behind another pin.
B. A mechanical apparatus for resetting pins.
C. The space between pins 1-2.
D. Three consecutive strikes.

24. What is a turkey?
    A. 3 spares in a row.
    B. 2 spares in a row.
    *C. 3 strikes in a row.
    D. 2 strikes in a row.

25. When does an error occur in bowling?
    *A. When a bowler slides across the foul line during the delivery.
    B. When a bowler bowls out of turn.
    C. When a bowler releases the ball too far behind the foul line.
    D. When a bowler fails to make a spare or strike.

26. When the ball strikes the head pin full in the face, which leave might a bowler expect?
    *A. A split.
    B. A strike.
    C. A washout.
    D. A chop.

27. What is a mark?
    A. Three consecutive strikes.
    B. Three strikes in the 10th frame.
    *C. A strike or a spare.
    D. A strike and a spare in consecutive frames.

28. What name is often given to a bowler?
    A. Roller.
    B. Leager.
    C. Striker.
    *D. Kegler.

29. A bowler is bowling her first ball. What is the decision if the pins are hit with such force that one pin spins while lying on the alley and knocks down three more pins?
    A. All the pins are respotted and the bowler rolls her first ball again.
    B. The additional three pins knocked down are respotted and the bowler rolls her second ball.
    C. All pins are respotted and the bowler rolls her 2nd ball.
    *D. All the pins knocked down count and the bowler rolls her second ball.

30. What is the most probable cause for a bowler dropping the ball on the approach?
    A. Lack of controlled backswing.
    *B. Lack of sufficient strength for weight of the ball.
    C. Lack of a follow through.
    D. Lack of a pendulum swing.

31. How should one pick up a ball from the rack?
    *A. Grasp the ball with the hands on the outside of the ball.
    B. Roll the other balls away and place the hands on the inside of the ball.
    C. Insert the fingers, lift the ball and support it with the free hand.
    D. Place only the thumb in the ball, spread the fingers over the ball and place the free hand under the ball for support.

32. Which of the following is considered acceptable practice when bowling?
    *A. Taking refreshments into the area behind the pit.
    B. Trying out the approach in your regular shoes before the game begins.
    C. Trying out the approach in your sock feet.
    D. Putting chalk on the soles of your shoes to protect the approach.

33. What is the advantage of using a heavy rather than a light ball?
    A. It is less likely to roll into the gutter.
    B. It aids the bowler's rhythm in the approach.
    C. It aids the bowler's balance on the release.
    *D. It causes more pin action.

34. What should be the point of aim for a right-handed bowler in head pin bowling?
    A. Directly toward the head pin.
    *B. The 1 - 3 pocket.
    C. The 1 - 2 pocket.
    D. The number 2 pin.

35. What is an advantage of spot bowling?
    A. The point of aim is located at the pins.
    B. The bowler can devote full attention to his approach.
    *C. The point of aim is located about one-third of the distance from the pins.
    D. It immediately improves scores.

36. If the ball is released in line with the space between the first two dots on the range finder, which alley dart is used as a point of aim?
    A. The first dart.
    B. Space between the first and second dart.
    *C. The second dart.
    D. The space between the second and third dart.

37. What should the bowler do if he is spot bowling and his first ball is consistently going to the right of the head pin?
    A. Move slightly to the left.
    *B. Move slightly to the right.
    C. Move considerably to the right.
    D. Move considerably to the left.

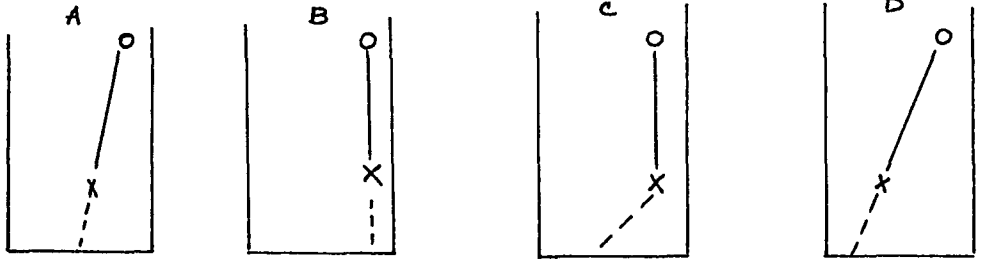
38. What pins should the ball hit to make a strike?
    A. 1-3-5-8-9.
    B. 1-3-5-8.
    *C. 1-3-5.
    D. 1-3.

39. When spare leaves are grouped in the center of the alley, where should the hook ball bowler start the approach?
    A. From the far left.
    B. From the far right.
    C. From the center.
    *D. From the strike ball position.

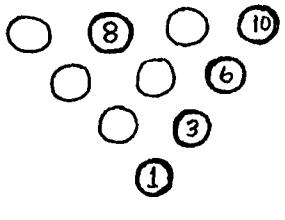
40. What is the best procedure for converting a sleeper leave?
    A. To hit the front pin from either side.
    *B. To hit the front pin head on.
    C. To hit the kingpin.
    D. To hit the head pin.

41. What should you do if you have a seven-ten split?
    A. Not try for either one.
    B. Try for both.
    *C. Roll for the 7 pin.
    D. Roll for the 10 pin.

42. Select the diagram which shows how a bowler should pick up the remaining pin. The broken line represents the bowler's approach; the X is where the ball is released; and the straight line is the ball. (A)

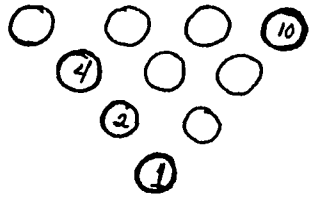


43. How does one pick up the spare leave diagrammed below at the left?



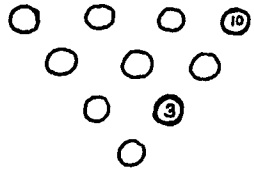
    A. Hit #1 full and drive it back to hit #8.
    *B. Hit the left side of #1 so #3 and #6 knock down #10 and the ball hits #8.
    C. Hit between #1 and #3 so 1 hits 8, and 3 hits 6 and 10.
    D. Hit #1 almost full but slightly to the right so #3 and the ball hit #8, and #3 hits 6, then 6 hits 10.

44. For each of the diagrams, decide if the leave shown is a split and choose the best way of picking it up.



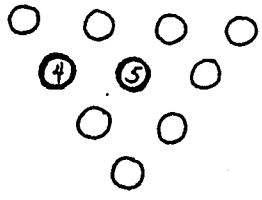
A. No split; hit almost full on #1 so either the ball or the pin knocks down #10.
*B. No split; hit between #1 and #2 so #1 knocks down #10.
C. Yes, split; hit the left side of #1 pin.
D. Yes, split; hit #1 thin on right so ball deflects to get #10.

45.



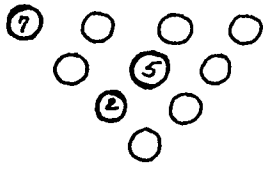
A. No split; hit the left side of the #3 pin.
B. No split; hit the #3 pin almost full.
*C. Yes, split; roll ball between the two pins.
D. Yes, split; hit the left side of the #3 pin.

46.



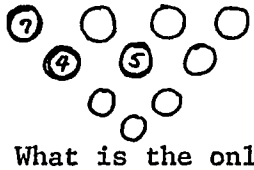
A. No split; hit thin on right side of #5 or thin on the left side of #4.
B. No split; hit between the pins.
C. Yes, split; hit thin on right of #5 or thin on the left of #4.
*D. Yes, split; hit between the pins.

47.



A. No split; hit #2 thin on the right.
B. No split; roll the ball between #2 and #7.
*C. Yes, split; hit #2 thin on the right.
D. Yes, split; roll between #2 and #7.

48.



*A. No split; roll ball between 4 and 5.
B. No split; hit thin on the left side of #4.
C. Yes, split; roll ball between #4 and #4.
D. Yes, split; hit thin on the left side of #4.

49. What is the only factor that should change when you roll the second ball of the frame?
A. The length of the pushaway.
B. The method of aim.
*C. The starting position on the approach.
D. The speed of the ball.

50. Which of the following statements is <u>not</u> true about bowling today?
A. It can be enjoyed by peoples of almost all ages and body builds.
*B. It is most popular among people over 50.
C. It is relatively inexpensive as sports go.
D. It is not a strenuous game.

51. What is the most important factor related to improving your score?
A. Correcting your release.
B. Correcting your form.
*C. Converting your spares.
D. Changing your point of aim.

52. How long should a bowler focus his eyes on the point of aim?
    A. Until the approach is completed.
    B. Until the ball is released.
    *C. Until the ball crosses or hits the target.
    D. Until the last pin falls.

53. Upon what and how long should one concentrate when aiming for a strike by looking at the pins?
    *A. On the 1-3 pocket until the ball hits the pins.
    B. On the 1-3 pocket until the ball is released, then watch the ball.
    C. On the pins during the approach but watch the release of the ball.
    D. On the pins until the ball rolled at least half-way down the alley, then watch the ball.

54. What is the result of using too heavy a ten pin ball?
    A. The right shoulder drops appreciably during delivery.
    *B. The ball may be prematurely released.
    C. The ball may be lofted on the alley bed.
    D. The ball is frequently swung in a side arm fashion.

55. Where should the ball be held when you take your stance in preparation for the approach?
    *A. In front of the body about chest height.
    B. In front of the body just below the waist.
    C. At the side of the body with the arm hanging relaxed.
    D. In front of the body in the right hand.

56. Why will holding the ball in the proper position during the stance help some bowlers?
    A. It adds to the velocity of the ball.
    B. It prevents releasing the ball too soon.
    *C. It helps prevent a side arm swing.
    D. It increases the back swing.

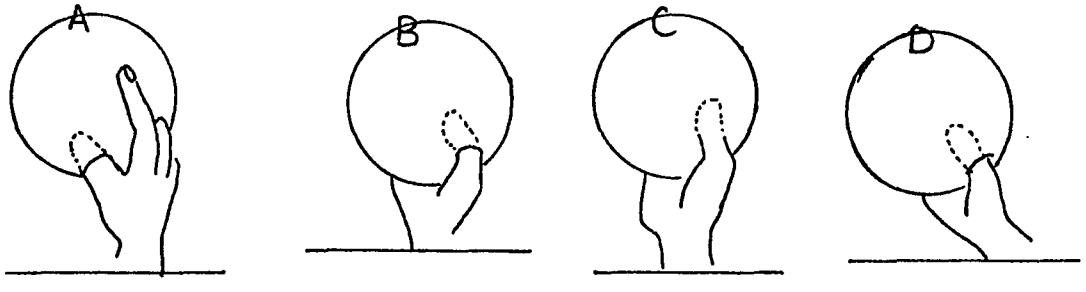
57. Which principle best relates to the starting position?
    A. First ball delivery; distance from foul line is constant, position from side to side varies.
    B. First ball delivery; distance from foul line varies, position from side to side is constant.
    *C. First or second ball delivery; distance from foul line is constant, position from side to side varies.
    D. First or second ball delivery, distance from foul line varies, position from side to side is constant.

58. How should one assume a stance in preparation for taking the approach for the first ball?
    A. Stand with the heels on the back edge of the approach area.
    B. Stand with the toes on the center mark of the approach.
    C. Stand 6 to 8 inches to the left of the center mark.
    *D. Stand 6 to 8 inches to the right of the center mark.

59. A bowler, who usually stands 15 feet behind the foul line, occasionally stands 14 feet (1/2 step closer) from the foul line. When is it advisable to do this?
    A. Never on the first ball; usually on the second.
    B. Sometimes, depending on the way her ball is breaking that day.
    C. Occasionally, depending on the spare leave.
    *D. Never after she has established an effective approach pattern.

60. How much of the approach area should be used?
    A. About 1/2.
    B. About 3/4.
    *C. As much as possible.
    D. As little as possible.

61. In which of the diagrams below is the ball being held correctly as the bowler looks down on it before she starts her approach? The straight line represents the bowler's shoulders. (C)



62. The distance each bowler stands behind the foul line depends upon
    A. The markings on the approach.
    B. The speed at which he approaches the line.
    *C. The number and size of the steps he uses.
    D. The smoothness of his delivery and approach.

63. Which of the following statements indicates the best speed for a ball? Why?
    A. The faster the better because the pins will scatter farther.
    B. A moderately slow ball because the bowler can be more accurate.
    C. A moderately fast ball because the front pins will have time to fall and roll back.
    *D. A speed that feels comfortable to the bowler because the ball will be more accurate.

64. Which of the following methods of delivery is most effective in terms of rhythm, grace and accuracy?
    *A. Ball with moderate speed is rolled smoothly onto the alley just <u>beyond</u> the foul line.

65. What advantage can the four-step approach be considered to have over the three-step approach?
   *A. Body balance and forward motion are more effective.
   B. The coordination is easier to learn.
   C. The coordination is more similar to the five-step approach which most bowlers use eventually.
   D. Longer steps can be taken giving the bowler more time to build up momentum in the arm swing.

66. What is characteristic of the steps in the bowling approach?
   A. They are the same length, but each one is successively faster.
   B. The first two steps are slow and short, the last two faster and longer.
   C. The first step is short and slow, the last three are similar in length, but each is slightly faster.
   *D. They are progressively longer and progressively faster.

67. How is the pushaway best described?
   A. The right shoulder drops as the ball is pushed forward.
   B. The ball is lowered gently into the swing.
   *C. The ball is pushed forward toward the target as the bowling arm is extended.
   D. It takes the ball forward as far as or farther than the length of the first step.

68. What adjustment should be made to increase the speed of the ball?
   A. Shorten and quicken the steps in the approach.
   B. Release the ball and forceably flick the wrist.
   C. Lengthen and quicken the steps in the approach.
   *D. Increase the backswing.

69. What happens when the bowler takes a backswing which is too short?
   A. The ball rolls too fast.
   *B. The ball rolls too slowly.
   C. The ball rolls to the right.
   D. The ball skids instead of rolls.

70. Which statement best describes the height of the backswing?
   A. It should be slightly below the waist.
   B. It should be at waist level.
   *C. It should be slightly above the waist.
   D. It should be well above the waist.

71. When should the height of the backswing be reached in the four-step approach?
   A. On the first step.
   B. On the second step.
   *C. On the third step.
   D. On the fourth step.

72. What should be the action on step two in the four-step approach?
    A. The arm swings forward, the ball is released and the follow through is made.
    B. A step is taken on the right foot.
    C. A step is taken on the right foot, and the ball is at the height of the backswing.
    *D. A step is taken on the left foot and the arm is fully extended, with the ball being swung back.

73. When do you start the pushaway?
    *A. Simultaneously with the first step.
    B. Simultaneously with the second step.
    C. Before you begin the first step.
    D. After you begin the first step.

74. Which statement best explains the second step?
    A. It is in direct line with the headpin.
    *B. It is slightly longer than the first.
    C. It is slightly shorter than the first.
    D. It is slightly slower than the first.

75. Why do you slide on the last step of the approach?
    *A. To insure a smooth delivery.
    B. To maintain body poise.
    C. To insure a greater degree of accuracy.
    D. To increase the distance traveled.

76. What is the number of steps taken by the average bowler?
    A. 3 steps.
    *B. 4 steps.
    C. 5 steps.
    D. 6 steps.

77. What should the bowler do in order to release the ball near the floor so that it will not be dropped?
    A. Bend forward at the waist.
    *B. Bend the left knee.
    C. Bend the knees and bend forward at the waist.
    D. Drop the right shoulder and bend slightly forward at the waist.

78. Which statement best describes the consistent bowler?
    A. He delivers his ball slowly and deliberately.
    B. He adjusts his body to the speed of the ball.
    *C. He delivers his ball the same way each time.
    D. He delivers his ball with good speed.

79. What in all probability will be the result if the ball is not released soon enough on the delivery?
    A. The ball will hook to the left.
    B. The ball will bounce down the alley.
    C. The ball will have a reverse spin.
    *D. The ball will be lofted.

80. When the thumb moves beyond the 10 o'clock position on release, what will the ball do?
    A. Slide too much.
    *B. Hook too much.
    C. Back up too much.
    D. Wander too much.

81. How is the arm swing in bowling best described for any type of delivery?
    A. Slight side-arm swing backward and forward.
    *B. Pendular swing backward and forward.
    C. Pendular backswing followed by bending of the elbow on the forward swing.
    D. Side-arm backswing and pendular forward swing.

82. Which statement best describes the proper ball release?
    *A. Thumb comes out first.
    B. The fingers come out first.
    C. The thumb and fingers come out together.
    D. The thumb and fingers come out naturally.

83. Where should the ball be released?
    A. On the bowler's side of the foul line.
    B. On the foul line.
    *C. Beyond the foul line.
    D. It depends on the bowler's starting position.

84. What should the shoulder position be when the ball is released at the end of the approach?
    A. Left shoulder pointing toward the pins.
    B. Right shoulder pointing toward the pins.
    *C. Both shoulders parallel to the foul line.
    D. Left shoulder high for balance, right shoulder low to release the ball close to the alley.

85. What should the foot position be when the ball is released at the end of the approach?
    *A. Left toe pointed straight at the right pins, right foot diagonally backward for balance.
    B. Left foot turned sideward to the foul line (to avoid fouling), right foot diagonally back for balance.
    C. Both feet pointed toward the pins in a stride position.
    D. Left toe pointed diagonally toward the right gutter, right foot swung across the body to the rear for balance.

86. What causes the ball to break to the right just before reaching the pins?
    A. Delivering the ball from left of the center.
    B. Turning the palm so the thumb points to the left gutter.
    C. Releasing the ball too soon.
    *D. Turning the palm so the thumb points toward the right gutter.

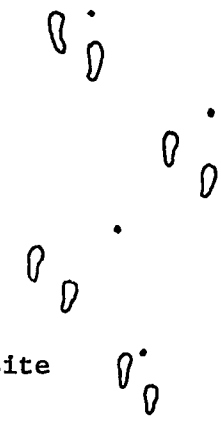
87. Which of the following errors may cause the ball to go into the left gutter?
    A. Pulling the thumb out of the ball before the fingers are removed.
    B. Standing too far back from the foul line.
    C. Turning the thumb to the right on the release.
    *D. Swinging the bowling arm across the body.

88. If your ball goes consistently to the left gutter short of the pins, what should you do to correct the error?
    A. Select a lighter ball.
    B. Shift starting position further to the right.
    *C. Concentrate on keeping shoulders level without tenseness.
    D. Rotate trunk slightly to the right.

89. Which of the following will cause a ball to <u>curve</u> to the left?
    A. The bowling arm is carried across in front of the body.
    *B. The thumb of the bowling hand is turned to the left as ball is released.
    C. The bowler pushes or forces the ball; i.e., throws too hard.
    D. The bowler fails to complete the follow-through.

90. Which statement best describes the last step?
    A. It is a drag step.
    *B. It is a slide step.
    C. It is a hop step.
    D. It is a long step.

91. Which of the following is the most accurate description of the ball release for a strike?
    A. Even with the left toe, but in front of the right foot.
    *B. Ahead of the left foot, but in front of the right foot.
    C. Ahead of the left foot, but outside the right foot.
    D. Even with and opposite the left toe.



92. After the finish of the follow-through, where should the right hand usually be?
    A. About knee level.
    B. About waist level.
    C. About eye level.
    *D. About shoulder level.

93. What is the best position for a bowler at the completion of the approach and after the ball is released?
    A. The body weight should be balanced on both feet.
    B. The bowler should lean back slightly and catch balance on rear foot.
    *C. The body weight should be balanced over the left leg and foot.
    D. The bowler should bend both knees and squat to lower the center of gravity.

94. Why is the follow-through important?
    A. It helps increase speed.
    *B. It helps develop accuracy.
    C. It helps maintain balance.
    D. It helps develop rhythm.

95. What are the essential points in the delivery of a straight ball?
    A. Shoulders give easily with arm swing, ball released with wrist flick.
    *B. Shoulders square, thumb leads through straight arm swing and delivery.
    C. Shoulders square, fast arm swing and held follow through.
    D. Shoulders sufficiently tense to ensure stopping of arm swing with delivery.

96. Why is the curve ball often <u>not</u> recommended?
    A. Is ineffective as a stride producer.
    *B. Presents problems of control.
    C. Requires greater speed.
    D. Has tendency to vary more on different lanes.

97. Which will cause a backup ball?
    A. A shake hands grip.
    B. A ball dropped at the foul line.
    *C. A twist of the wrist in a clockwise direction.
    D. A twist of the wrist in a counter clockwise direction.

98. What advantage does a hook ball have over a straight ball?
    A. Easier to control.
    B. Has more speed.
    *C. Scatters pins more effectively.
    D. None.

99. What is the recommended position for the thumb in a hook ball in relation to a clock face?
    A. 1:00.
    B. 8:00.
    *C. 10:00.
    D. 12:00.

100. Which is <u>not</u> true of the hook ball?
   *A. The hook must always hit the exact center of the 1-3 pocket.
   B. The hook must hit the 5 pin in a normal strike position.
   C. The fingers lift counterclockwise to impart the hook spin.
   D. The wrist is rigid and the fingers closed.

* or (A)--asterisk or letter in parenthesis indicates correct answer.

GOLF EXAMINATION

DIRECTIONS: All of the questions are multiple choice. Select the best answer from those given for each question. Indicate the correct answer by blackening the proper space on the answer card. Be sure to mark heavily in the space provided. If you mark the wrong box, be sure to completely erase the incorrect answer. Do not mark on the test booklet. Do not waste time on difficult questions. Go to the other items and reconsider omitted items if you have time, but please finish all items if at all possible. Unless otherwise stated assume the player is right-handed in answering all questions.

1. Which is the governing body of golf?
   A. LPGA.
   *B. USGA.
   C. NGA.
   D. PGA.

2. Where is it best to stand when someone is teeing off?
   A. Behind them.
   B. In front of them.
   *C. In front and to the side of them.
   D. To the side and back of them.

3. What should you do if the ball comes to rest in the wrong fairway?
   A. Hurry and play the ball immediately.
   B. Lift the ball and drop it in the correct fairway.
   C. Tee-off again with a one stroke penalty.
   *D. Play the ball when it is safe to do so and without interfering with other players.

4. What should a player do after hitting out of a sand trap?
   A. Leave the trap by the same route she entered.
   B. Refill the hole made by the "explosion" shot.
   C. Leave the trap by the shortest route.
   *D. Refill all holes left by the club and feet.

5. In what two ways will the clubs in a matching set of golf clubs differ?
   A. Length and flexibility.
   B. Weight and flexibility.
   C. Weight and clubface loft.
   *D. Length and clubface loft.

6. When may a player tee-off?
   A. After the preceding party is on the green.
   B. After the starter gives signal to start.
   C. After the preceding party is taking the approach shot to the green.
   *D. After the preceding party has taken their second shot.

7. Players tee off in the following order on hole #6. Jane, Betty, Nancy, and Carolyn. The scores for the hole are Jane, 6; Betty, 4; Nancy, 7; and Carolyn, 6. In what order should they tee off on hole #7?
   A. Jane, Betty, Nancy and Carolyn.
   B. Betty, Jane, Nancy and Carolyn.
   *C. Betty, Jane, Carolyn and Nancy.
   D. Betty, Carolyn, Jane and Nancy.

8. From where on the teeing area should the ball be hit?
   A. Only within the tee markers.
   B. Anywhere in front of the markers.
   C. Anywhere within and one club length behind the tee markers.
   *D. Anywhere within and two club lengths behind the tee markers.

9. What should Jane do if she accidently hit her ball while taking a practice swing?
   *A. Play the ball from where it landed, counting the practice swing as a stroke.
   B. Play the ball from where it landed with no penalty.
   C. Replace the ball with one stroke penalty.
   D. Replace the ball with no penalty.

10. What should John do if his ball goes out-of-bounds on his tee shot?
   A. Find his ball and play it where it went out, with no penalty.
   B. Tee-off again with a penalty of one stroke, leaving the tee with two strokes.
   *C. Tee-off again with a penalty of two strokes, leaving the tee with three strokes.
   D. Tee-off again with no penalty, leaving the tee with one stroke.

11. What is the procedure to follow when your ball lands in a water hazard?
   A. Play another ball from the place of the last shot.
   B. Drop a ball and add a 1 stroke penalty.
   *C. Drop a ball and add a 2 stroke penalty.
   D. Drop a ball without penalty.

12. What is the basis for computing par for a hole?
   A. The yardage of the hole.
   B. The difficulty of the hole.
   *C. The yardage and difficulty of the hole.
   D. The average score of players on that hole.

13. What determines one's score for eighteen holes?
    A. Number of times the ball was missed.
    B. Number of times the ball was hit.
    *C. Number of times the ball was struck at.
    D. Number of times the ball was putted.

14. Which describes the firm wrist method of putting?
    A. Hips and shoulders remain steady.
    *B. Head and hips are steady and the arms swing from the shoulders.
    C. Ball is tapped and a short follow-through results.
    D. Ball is stroked with the hands and wrists.

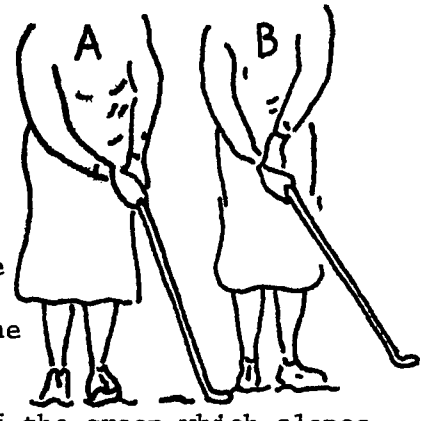
15. Which is the best suggestion for improving your putting?
    A. Practice, take more time to study each putt, take several practice swings before each putt.
    *B. Increase your practice, work on a smooth, effective stroke, know that you can become skillful in putting.
    C. Change to a different putter, copy the form of a professional, and take more time studying each putt.
    D. On long putts do not putt past the hole, point your left elbow toward the hole, and keep your head down.

16. In lining up a putt, you see that the green slopes away from you and slightly to the right. What is the best tactic for making the shot?
    A. Aim directly at the hole and hit the ball harder than usual to overcome the effect of gravity.
    *B. Aim to the left of the hole and let gravity operate.
    C. Aim at the hole but follow-through to the left.
    D. Aim to the right of the hole and let gravity operate.

17. Which of the following grips is the most widely used in putting?
    A. Overlapping.
    B. Interlocking.
    C. 10 finger grip.
    *D. Reverse overlapping.

18. How should the player stand in order to best sight the line of the putt?
    A. So that his eyes are to the right of the ball.
    *B. So that his eyes are directly over the ball.
    C. So that his toes point toward the hole.
    D. So that his eyes are to the left of the ball.

19. Which of the 2 pictures at the right shows the better putting technique and why?



*A. A, the ball has been stroked with the club head traveling close to the ground.
B. B, the left elbow points toward the hole.
C. B, the right hand dominates the stroke
D. B, the entire body remains stationary except the right hand which applies the force.

20. Your ball is resting just off the apron of the green which slopes toward the cup. What club would you use to hit the ball on to the green?
A. #2 iron.
B. #5 iron.
*C. #9 iron.
D. #7 iron.

21. A short hole, 125 yards long, has a raised green surrounded by traps. What club would you use from the tee and why?
A. #3 wood for less distance than a driver.
B. #1 wood for distance.
*C. #5 iron for distance.
D. #7 iron for more lift.

22. Which club is carried by all golfers?
A. #9 iron.
B. #5 iron.
*C. Putter.
D. Driver.

23. You are faced with this situation: on the first nine holes you played satisfactory golf for you. On the second nine you have hit several poor shots. Which suggestion would be best for you to follow?
A. Study and take more time for each shot and keep your head down.
B. Ask the best player in your foursome to watch your swing and tell you what is wrong.
C. Take more practice swings, keep your left arm straight and keep your head down.
*D. Accept the shots played, do not try to dissect your swing and trust that good shots might return.

24. Which of the following irons will give the greatest accuracy of placement and why?
A. #5 iron; distance and roll.
*B. #9 iron; more height and less roll.
C. #7 iron; less height and more roll.
D. #2 iron; least amount of height and roll.

25. What adjustment is made when a shorter distance with an iron is desired?
    A. A smaller (lower) numbered club is used.
    B. Ball is played in the middle of the stance.
    C. Swing is more upright so club is raised from ground slightly sooner.
    *D. Body rotation is decreased.

26. On what basis should a golfer select a club for a particular shot?
    A. Distance to go and whether or not winter rules are used.
    B. Loft necessary, uphill or downhill lie, location of hazards around green.
    *C. Lie of ball, hazards involved, individual ability.
    D. Individual ability and presence or absence of bunkers.

27. What is a sharp bend in the fairway called?
    A. An angle fairway.
    *B. A dog leg fairway.
    C. A curved fairway.
    D. A bogey fairway.

28. Which of the following best describes match play?
    *A. Hole-by-hole competition.
    B. Stroke competition.
    C. Players paired according to ability.
    D. Players paired according to draw.

29. Which is a correct statement?
    A. Birdie is 1 over par, eagle is 2 under par.
    B. Bogey is 1 under par, birdie is 2 under par, ace is 1 over par.
    C. Eagle is 1 under par, birdie is 2 under par, ace is 1 over par.
    *D. Birdie is 1 under par, eagle is 2 under par, bogey is 1 over par.

30. Which is an example of an obstacle on the fairway?
    A. Dog-leg.
    B. Rough.
    C. Divot.
    *D. Bunker.

31. Which would cause a player to hook the ball?
    A. Placing the left palm under the shaft of the club.
    *B. Striking the ball so it spins counterclockwise.
    C. Taking an open stance.
    D. Playing the ball opposite the left toe.

32. What is the result if a golfer tenses the muscles of the hands, wrists, and forearms?
    *A. Prevents the natural "Cocking" of the wrists.
    B. Insures a more powerful stroke.
    C. Helps the player get a "feel" of the swing.
    D. Insures a "grooved" swing.

33. What effect will a stance wider than the width of the player's shoulders have?
    A. Allows the player to put more into the stroke.
    B. Insures balance during the stroke.
    C. Insures more accurate drives.
    *D. Retards correct body action.

34. Which is the best suggestion for curing the fault of consistently hitting the ball on a straight line to right of your target?
    A. Check your stance and aiming and try to hit from "inside-out."
    *B. Check your stance and aiming and go back to practicing the short strokes and work up to the long shots.
    C. Take an open stance and aim for the left of the target, thereby allowing for the error.
    D. Try to pivot more on your backswing and keep your head down.

35. Which is the best suggestion for increasing the distance you can hit a golf ball?
    A. Pivoting more on your backswing and cocking the wrists more sharply.
    B. Starting the downswing with a forceful movement of the hips to the left and pulling the club through the contact area with the left arm and hand.
    C. Practicing the woods and long irons only and trying to increase the speed of the clubhead in each practice session.
    *D. Work from the short strokes to the long strokes in practice and allowing distance to come with the development of a stronger and better timed swing.

36. Which is the best suggestion for curing the error of topping the ball?
    A. Keep your left arm straight and your right elbow in to your side.
    B. Hold your head down until the end of the follow through, and swing from inside-out.
    C. Try to get under the ball and swing your right shoulder under your chin.
    *D. Watch the clubhead strike the ball and try to sweep the grass after striking the ball.

37. How should the body weight be distributed during the address position?
    A. Concentrated on the outside of the left foot.
    *B. Concentrated on the inside of both feet.
    C. Concentrated on the outside of the right foot.
    D. Concentrated on the outside of both feet.

38. Where, in relation to the feet, should most shots be played?
    A. Off the front of the left foot.
    B. Off the front of the right foot.
    C. Back from the center of the feet.
    *D. Forward from the center of the feet.

39. Which grip is recommended most for beginners?
    *A. Overlap.
    B. Interlock.
    C. Reverse overlap.
    D. Spread or ten finger.

40. Which shot is caused by swinging from the outside-in?
    A. Hook.
    B. Push.
    C. Pull.
    *D. Slice.

41. Which is the sequential movement order of the body on the forward swing?
    *A. Hips--shoulders--hands.
    B. Shoulders--hips--hands.
    C. Hands--shoulders--hips.
    D. Hips--hands--shoulders.

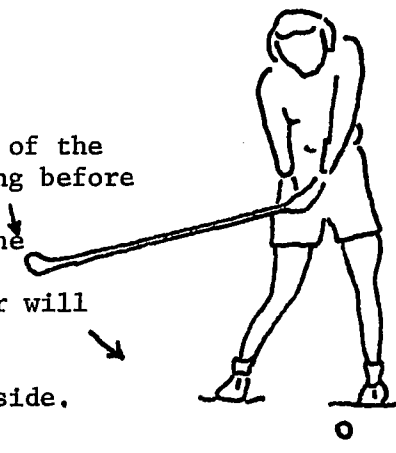
42. Which statement best describes a correct follow-through?
    A. The club is stopped when the hands reach shoulder height.
    B. The club is stopped when the handle points toward the hole.
    *C. It is determined by the momentum of the club head.
    D. It continues until the club is over the left shoulder.

43. What is the <u>primary</u> function of the backswing?
    A. To get the clubhead in motion.
    *B. To position the club to hit the ball.
    C. To establish the arc of the swing.
    D. To ensure a rhythmical swing.

44. What is the axis around which the club is swung?
    A. Head.
    B. Shoulders.
    C. Hips.
    *D. Spine.

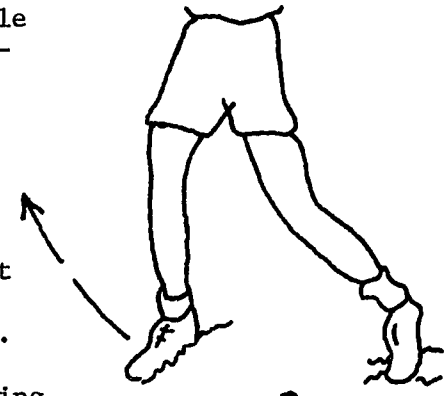
45. Which of the following starts the down-swing of the club?
    A. Uncocking of wrists.
    B. Hip rotation.
    C. Shoulder rotation.
    *D. Weight shift.

46. Is the diagram at the right a good diagram of the action that takes place during the downswing before impact? Why or why not?
    *A. Yes, wrist power can be unleashed at the moment of impact.
    B. No, right hand has been dropped; golfer will hit the ground.
    C. No, body action is ahead of the hands.
    D. No, golfer is pressing with the right side.

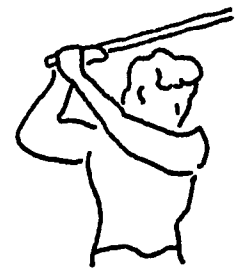


47. Is the picture left and below a good example of knee and ankle action on the backswing? Why?
   A. Yes, both knees remain "easy" or slightly bent.
   B. Yes, Left knee rolls inward toward the right leg.
   C. Yes, the body "sits to the ball" slightly during the swing.
   *D. No, right knee is moved sideward so that golfer's head may also move to the right.

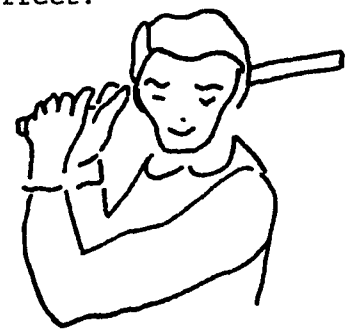
48. Is the picture at the right a good example of the knee and ankle action on the backswing?
   A. Yes, the weight has been taken primarily to the right foot but some pressure remains on the left toe.
   *B. No, left leg action is apt to result in body lift.
   C. No, stance is so wide the body weight cannot be shifted correctly.
   D. No, the left heel is lifted too high.



49. What is apt to be the result of a downswing executed from the position shown at the left?
   *A. As the player pulls her arms down, she will pull across the back of the ball and slice it.
   B. Club has not been swung back far enough and hit will lack power.
   C. Shoulders have been lifted so ball will be topped.
   D. Shoulders have been rotated too far; ball will be shanked.



50. Is the diagram at the right correct or incorrect? Why?
   A. Correct, club shaft is parallel to the ground at the top of the backswing.
   B. Correct, arc of the swing can be controlled to hit through the ball.
   *C. Incorrect, arc of swing has been shortened so golfer will probably top the ball.
   D. Incorrect, shoulders have not been rotated to add power to the swing.

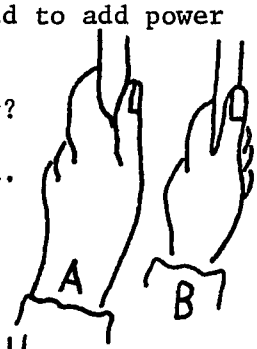


51. Does the diagram at the right show the right or wrong wrist action on the downswing? Why?
    A. Right, wrists have been straightened to bring club close to the ground before contact.
    B. Right, wrists have been uncocked to give club head additional speed before contact.
    C. Wrong, only the right wrist is being used.
    *D. Wrong, wrists have been uncocked too soon.

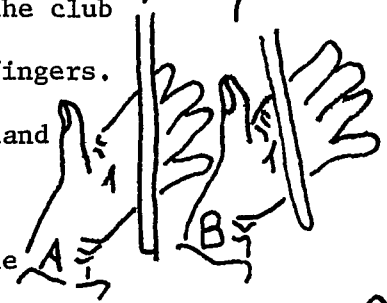
52. Why is the diagram at the left an <u>incorrect</u> demonstration of the golf pivot on the backswing?

    A. Left knee is bent forward so weight is actually on the left foot.
    B. Weight has been transferred completely to the right foot.
    C. Right knee is hyperextended.
    *D. Hips are not rotated to add power to the swing.

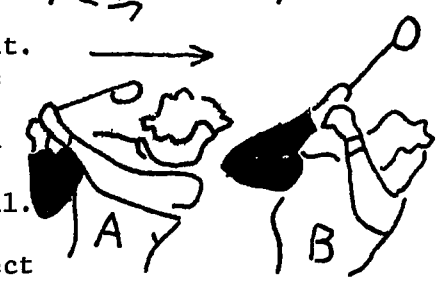
53. Which diagram shows the better left-hand grip and why?
    *A. A, the wrist power can be applied properly.
    B. A, 3 knuckles on the back of the hand are visible.
    C. B, the grip is more secure.
    D. B, the V of thumb and forefinger points to the chin.



54. Which diagram shows the proper placement of the club shaft in the left hand and why?
    A. A, the shaft lies diagonally across the fingers.
    *B. A, club can be controlled by the fingers.
    C. B, entire muscular strength of the left hand can be employed.
    D. B, the grip on the club is more secure.



55. Which diagram shows the proper position of the right arm and why?
    A. A, ball will have a lower, longer flight.
    *B. A, line of swing can be controlled more accurately.
    C. B, club swings through a longer arc and results in a more powerful swing.
    D. B, the left arm has a more powerful pull.



56. What should the golfer do to secure a correct grip?
    A. Place his hands on the club so they are in the same plane as when they hang from the sides.
    B. Have the "feeling" of the clubhead.
    C. Have mainly a finger grip with the right hand.
    *D. All of the above.

57. Where should the ball be placed when driving from the tee?
    A. Off the right heel.
    *B. Off the left heel.
    C. Slightly to the right of center.
    D. In the center of the stance.

58. In which of the following instances might one employ a closed stance?
    A. Short pitch and run shots.
    B. Longer pitch and run shots.
    *C. Driving and long approach shots.
    D. Pitch shots.

59. Does the diagram at the left show a good swing pattern for a wood shot? Why or why not?

    *A. Yes, arc of swing is correct for the length of a wood.
    B. Yes, arc is low and will give low, long ball flight.
    C. No, swing is too flat; ball may be topped.
    D. No, club has been lifted from the ground too soon.

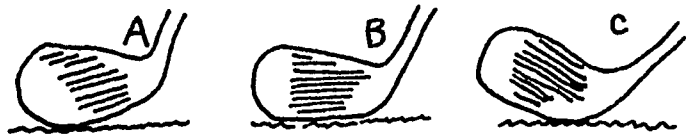
60. What would you do to get less distance with a certain iron?
    *A. Decrease the length of the backswing.
    B. Decrease the speed of the clubhead.
    C. Decrease the power of the swing.
    D. Decrease the length of the follow-through.

61. Which statement best describes the downswing with irons?
    *A. The ball is contacted first and then the turf for loft.
    B. The ball is hit on the upswing to insure loft.
    C. The turf is contacted first, then the ball for loft.
    D. The clubhead hits through the ball which means that the turf is never contacted.

62. Is the diagram at the left a good picture of the swing pattern of an iron shot? Why or why not?

    A. Yes, club is swung in an upright arc.
    B. Yes, golfer will hit down on back of ball and give backspin to the approach shot.
    *C. No, direction of follow-through is incorrect.
    D. No, swing has too much downward motion; divot will result.

63. Which diagram below shows the correct way to sole a #5 iron? Why?
   A. A, the ball will be hit by the widest part of the club face.
   *B. B, the head of the club is balanced to hit the ball at the center of the club face.
   C. C, the ball will be hit with the heaviest part of the club head.
   D. A for shots from bare spots; B for fairway shots; C for shots out of the rough because full effectiveness of the club can be realized.

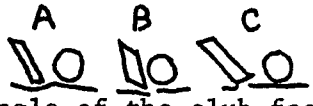


64. What is the best suggestion for executing short approach shots?
   A. Use a #9 iron or wedge, always try to pitch the ball, hit the ball with backspin.
   *B. Grip down on the leather of the club, choose a medium or lofted iron to suit the situation, take a narrow stance.
   C. Take a divot after striking the ball, use the wedge, take an open stance.
   D. Use a #5 iron or wedge depending on the shot desired, hit down on the ball, grip down on the leather of the club.

65. What is the basic difference between the pitch and pitch-and-run shots?
   *A. The amount of roll and time the ball is in the air.
   B. Club selection.
   C. The length of the swing.
   D. Stance and ball placement.

66. Where should the ball be placed in relation to the body on an approach shot?
   *A. Off the right heel.
   B. Off the left heel.
   C. Slightly to the right of center.
   D. In the center of the stance.

67. Which diagram below best represents the soling of a #8 iron? Why?



   *A. A, the angle of the club face will cause the ball to pitch upward at the correct angle.
   B. B, the ball will have a low line of flight and will go a greater distance and straight toward the target.
   C. C, the ball will have more loft and will "sit" on the green when it lands because it has less roll.
   D. A for regular shots; B for going under tree branches; C for lifting the ball out of the rough.

68. What is the effect of top spin on the ball when it drops to the ground?
    *A. Increased forward roll.
    B. No effect.
    C. Decreases the amount of roll.
    D. Makes the ball bounce forward.

69. What should a player do if greater force is desired?
    A. More wrist action.
    *B. A longer backswing.
    C. Firmer wrists at impact.
    D. A longer follow-through.

70. Which stance is used to correct the slice?
    *A. Open.
    B. Closed.
    C. Square.
    D. Full.

* or (A)--asterisk or letter in parentheses indicates correct answer.

TENNIS EXAMINATION

DIRECTIONS: All of the questions are multiple choice. Select the best answer from those given for each question. Indicate the correct answer by blackening the proper space on the answer card. Be sure to mark heavily in the space provided. If you mark the wrong box, be sure to completely erase the incorrect answer. Do not mark on the test booklet.

Do not waste time on difficult questions. Go to the other items and reconsider omitted items if you have time, but please finish all items if at all possible.

Unless otherwise stated, assume the player is right-handed in answering all questions.

1. What equipment is a must for good tennis?
   A. An expensive racket.
   *B. Good balls.
   C. Tight Strings.
   D. Rubico Courts.

2. Which of the following is least important to a beginning player in the selection of a racket?
   A. Type of strings.
   B. Size of grip.
   *C. Balance of the racket.
   D. Weight.

3. A ball rolls onto a neighboring court where play is going on. When should the ball be recovered?
   A. Not until the players on that court are ready to return the ball to you.
   B. The ball should be retrieved immediately so that it will not interfere with play on that court.
   C. Not until the players on that court have completed a game.
   *D. At the completion of the point in progression on that court.

4. What should the receiver do if he is unable to determine whether a ball is good or outside?
   A. Call a fault.
   B. Ask the server to make the decision.
   *C. Call the ball good.
   D. Ask the server to play the point over.

5. Who brought tennis to the United States?
   A. Walter Wingfield.
   B. Jack Kramer.
   *C. Mary Outerbridge.
   D. Billie Jean King.

6. When is a game completed?
   *A. When one side has won four points and the opponents have not more than two points.
   B. When one side has won four points and the opponents have won three.
   C. When a total of four points have been played.
   D. When the score is 40-15.

7. In which situation would a "let" be called?
   A. A ball in play hits the top of the net and falls within the court boundaries.
   *B. A serve hits the top of the net and falls into the correct service box.
   C. A ball hits into the net on the first service.
   D. A serve hits the top of the net and lands in the alley.

8. What is the decision when the server tosses the ball up and catches it instead of striking at it?
   A. A fault should be called.
   *B. The server may try again without penalty.
   C. The server may try again, but if the same action is repeated, a fault occurs.
   D. A let should be called.

9. Which of the following situations would <u>not</u> be a fault?
   *A. The player makes contact with the ball on his side of the net and then his racket continues over the net on his follow-through.
   B. The player makes contact with the ball while his racket is beyond the net but not touching the net.
   C. The ball hits the player, but still rebounds over the net and into the playing surface.
   D. The ball is touched by both partners' rackets in making a return.

10. During play, the server struck at a ball and missed it; the ball landed outside the baseline. What is the ruling?
   *A. Point for the serving side.
   B. Point for the receiving side.
   C. Let.
   D. Legal, the ball remains in play.

11. What is the score when the receiver wins the next point after deuce?
    A. Game for the receiver.
    B. 40-30.
    C. Advantage in.
    *D. Advantage out.

12. Which of the following scores is a completed set?
    A. 4-2.
    B. 6-5.
    C. 7-6.
    *D. 8-6.

13. Where should the service be made when the score is 40-love?
    A. From the right side of the court.
    *B. From the left side of the court.
    C. From either side, depending upon the side from which the game was started.
    D. From either side, depending upon the side from which the last service was made.

14. For which stroke is the Eastern grip <u>not</u> suitable?
    A. The forehand.
    *B. The backhand.
    C. The serve.
    D. The volley.

15. Which statement describes an error?
    A. Hitting the ball at the top of the bounce.
    B. Covering the ground in few steps.
    *C. Dropping the racket head during the backswing.
    D. Taking the shot with a side to the net.

16. Which describes the type of drive for which a player should strive?
    *A. Drive the ball just over the net so that it lands close to the baseline.
    B. Drive the ball over the net so that it lands between the service line and the baseline.
    C. Drive the ball just over the net so that it lands between the service line and the net.
    D. Drive the ball so that it clears the net by about six feet and lands on the baseline.

17. When should the backswing for a stroke be started?
    A. Just as the ball bounces on the court.
    *B. As soon as the ball leaves the opponent's racket.
    C. As soon as the ball is across the net.
    D. As soon as the ball begins to rise from the bounce.

18. Which stroke is hit with very little backswing and follow-through?
    A. Lob.
    B. Backswing.
    *C. Volley.
    D. Forehand.

19. At what height should the racket meet the tennis ball for the drive?
    A. Between the waist and shoulders.
    B. Shoulder height.
    C. Between the knees and hips.
    *D. Between the knees and waist.

20. Where should the player have her weight at the moment of impact in hitting ground strokes?
    A. On her rear foot.
    B. Evenly distributed on both feet.
    *C. On her forward foot.
    D. In front of her forward foot.

21. What is the first and most basic rule in tennis?
    A. Bend your knees.
    B. Stay on your toes.
    *C. Keep your eyes on the ball.
    D. Follow through on strokes.

22. What most frequently causes a player to miss the ball completely?
    A. Swinging too soon.
    *B. Failing to watch the ball.
    C. Dropping the racket head.
    D. Gripping incorrectly.

23. Which of the following best describes the waiting position?
    A. Stand with the left side toward the net, weight on the right foot.
    *B. Stand squarely facing the net, weight on the balls of the feet, knees relaxed.
    C. Stand squarely facing the net, weight equally distributed on both feet.
    D. Stand squarely facing the net, knees relaxed, weight shifting back and forth from toes to heels.

24. Which statement best describes the proper sequence of actions when running to hit a shot?
    A. (1) Run, (2) pivot, (3) bring racket back.
    B. (1) Pivot and run, (2) bring racket back.
    C. (1) Bring racket back, (2) run, (3) pivot.
    *D. (1) Pivot and bring racket back, (2) run.

25. Which statement describes correct form on the forehand drive?
    *A. The racket head is slightly above the wrist.
    B. The racket swings in a circular path.
    C. The racket face is closed as the ball is met.
    D. The wrist is snapped at the moment of contact.

26. If a player consistently sends balls too far to the left on the forehand drive, what is the most probable cause?
    A. No backswing.
    *B. Forward swing made too early.
    C. Body facing the net.
    D. Racket head drags behind wrist.

27. Where will a forehand hit off the back foot tend to go?
    *A. To the right.
    B. To the left.
    C. Straight across the net.
    D. In a high arc to the baseline.

28. Where will the ball go on the forehand drive if the handle of the racket is nearer the net than the head of the racket at the point of contact?
    A. Probably to the left of the intended target.
    *B. Probably to the right of the intended target.
    C. Probably into the net.
    D. Probably over the baseline out of bounds.

29. Where should the ball be contacted for the most effective forehand drive?
    A. Close to and a little to the rear of the body.
    *B. With a full arm extension and opposite the forward foot.
    C. With a full arm extension and a little in front of the forward foot.
    D. Close to the body and a little in front of the forward foot.

30. Where should the ball be contacted for the most effective backhand drive?
    A. Close to and a little to the rear of the body.
    B. With a full arm extension and opposite the forward foot.
    *C. With a full arm extension and a little in front of the forward foot.
    D. Close to the body and a little in front of the forward foot.

31. Where should the body weight be during the follow through of a forehand drive?
    A. Shifting from the rear to the forward foot.
    B. Equally distributed over both feet.
    C. Concentrated primarily over the right foot.
    *D. Concentrated primarily over the left foot.

32. Where should the body weight be during the follow through of a backhand drive?
    A. Shifting from the rear to the forward foot.
    B. Equally distributed over both feet.
    *C. Concentrated primarily over the right foot.
    D. Concentrated primarily over the left foot.

33. In what direction should a player face when executing a forehand drive?
    A. Toward the left side line.
    *B. Toward the right side line.
    C. Directly toward the net.
    D. It doesn't matter so long as she can make an effective return.

34. In what direction should a player face when executing a backhand drive?
    *A. Toward the left side line.
    B. Toward the right side line.
    C. Directly toward the net.
    D. It doesn't matter so long as she can make an effective return.

35. Which describes a good forehand drive?
    A. It is hit high so that it will bounce high.
    *B. It goes deep or near the base line.
    C. It has a great deal of speed.
    D. It drops just over the net.

36. What is the best advice for the most successful forehand drive?
    A. Keep your weight equally distributed on both feet throughout the stroke.
    B. Keep your grip and wrist loose at the point of impact.
    C. Keep your elbow bent and the arm close to the body.
    *D. Keep the swing of the racket almost parallel to the ground.

37. When the ball comes down the center of the court in doubles play, who should usually take the shot?
    *A. The player who can return it with a forehand shot.
    B. The player who can return it with a backhand shot.
    C. The better of the two players.
    D. The player who calles for the shot.

38. Where will the ball tend to go on the backhand if it is contacted too close to the body of the player?
    *A. In a high arch to the left of the intended target.
    B. In a high arch to the right of the intended target.
    C. Low to the left of the intended target.
    D. Low to the right of the intended target.

39. How far should the racket be brought back in the backswing for a backhand drive?
    A. Opposite the left foot.
    B. Opposite the right foot.
    C. Opposite the center of the body.
    *D. Opposite the net.

40. A player consistently sends balls too far to her left when hitting backhand drives. What is the most probably cause of this error?
    A. The lack of a backswing on the stroke.
    B. Her body facing the net.
    *C. The forward swing made too late.
    D. An insufficient amount of force on the swing.

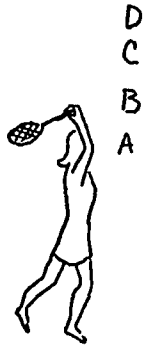
41. A student consistently sends balls too far to the right on the backhand drive. What is the most probable cause?
    A. No backswing on stroke.
    B. Forward swing made too late.
    C. Insufficient force.
    *D. Forward swing taken too early.

42. A player consistently has difficulty in clearing the net with her backhand drive. What error may she be making?
    A. Contacting the ball on the rise from the bounce.
    B. Contatcing the ball as it drops from the height of the bounce.
    *C. Stroking so that the backswing is higher than the follow through.
    D. Starting the backswing so late that the stroke is hurried.

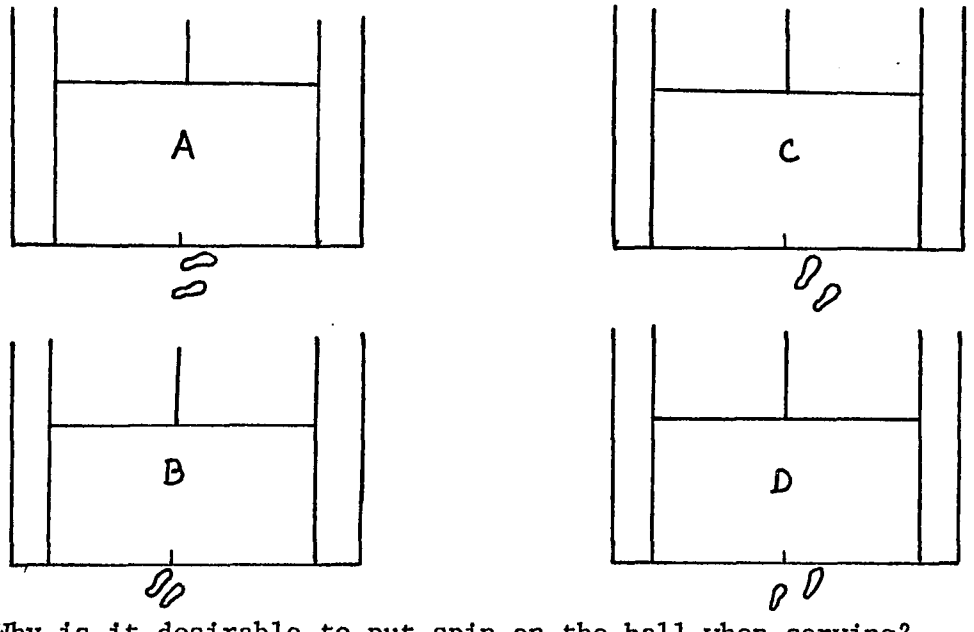
43. Why is the thumb placed up the back of the racket for the backhand grip?
    A. For added leverage.
    *B. For added support.
    C. For added wrist action.
    D. For added control.

44. From what position should the forward motion of the swing begin for the serve? (D)

45. How high should the ball be tossed for the serve? (C)



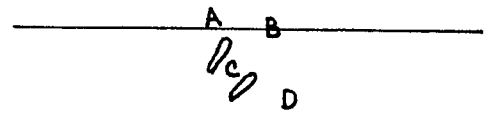
46. Which diagram shows the correct foot position for the serve? (C)



47. Why is it desirable to put spin on the ball when serving?
    A. It causes the ball to bounce in an unexpected manner, thus making it more difficult to return.
    B. It permits greater control of the ball.
    C. It permits a wider margin of error as the ball crosses the net and causes the ball to drop more rapidly within the service court.
    *D. All of these.

48. Which shot is most like the serve?
    A. Lob.
    B. Slice.
    *C. Smash.
    D. Chop.

49. A player is practicing the toss for the flat serve and allowing the ball to bounce after the toss. Where should a properly tossed ball bounce in relation to the player's feet? (B)



50. What usually causes the ball to go into the net on the serve?
    A. Turning the racket face upward.
    *B. Contacting the ball too far in front of the body.
    C. Contacting the ball behind the head.
    D. Tossing the ball too high.

51. What is the proper follow-through after contacting the ball in serving?
    A. There is no follow-through.
    *B. Down across the left side of the body.
    C. Straight down in front of the body.
    D. Down and to the right side of the body.

52. What will be the result if the service toss is too low?
    A. There will be a tendency to swing the racket out to the side of the body thus losing momentum.
    *B. The swing is hurried and cramped.
    C. The ball will be hit out of bounds.
    D. The ball will hit on the wood of the racket.

53. Why is it important in serving to toss the ball high enough to be hit with the arm fully extended?
    A. Enables the server to hit the ball either to the right or the left of the receiver.
    *B. Enables the server to use the entire body as a lever, thus getting more power behind the ball.
    C. Eliminates the possibility of hitting the ball into the net.
    D. Assures the server of greater accuracy.

54. What differentiates the lob from other ground strokes?
    *A. Angle of the racket face at contact.
    B. Grip.
    C. Stance.
    D. Backswing.

55. Which expression is related to the lob?
*A. Lift racket in followthrough.
B. Take a full backswing.
C. Close the racket face.
D. Stroke down and through.

56. Which of the following applies to the volley?
A. It requires a long, vigorous forward swing.
B. It is used primarily from the backcourt.
*C. It is used primarily in the forecourt.
D. It is most frequently hit with a backhand.

57. How does the volley differ from a drive?
A. The volley may only be used when a player is close to the net.
B. The voller has a longer followthrough than the drive.
C. The volley allows for more effective placement of shots.
*D. The volley has a shorter backswing than the drive.

58. Where should the ball be contacted in hitting a flat volley?
A. In front of the volleyer and below the level of the net.
B. To the side of the volleyer and above the level of the net.
C. To the side of the volleyer and as high as possible.
*D. In front of the vollerey and as high as possible.

59. How is a volley executed?
A. Striking the ball just after it hits the forecourt.
*B. Striking the ball before it hits the court.
C. Striking the ball high overhead on a high bounce.
D. Striking the ball as it rebounds from a forehand drive.

60. Which of the following should be emphasized more than usual when stroking a low-bouncing ball?
A. Shorten the backswing.
B. Shorten the followthrough.
*C. Bend the knees.
D. Drop the racket head.

61. With what are the terms rough and smooth generally associated?
A. The condition of the court.
B. The type of service.
*C. The decision for serve in toss.
D. The covering of the ball.

62. What is an "ace?"
A. A serve returned out of bounds.
B. A hard overhead smash untouched by the opponent.
C. A skillful player.
*D. A serve untouched by the opponent.

63. Where is "no man's land?"
    A. The forecourt area near the net.
    *B. The mid-court area, behind the service line.
    C. The backcourt area near the baseline.
    D. Behind the baseline.

64. What term refers to a point that must be replayed?
    *A. Let.
    B. Fault.
    C. Deuce.
    D. Net ball.

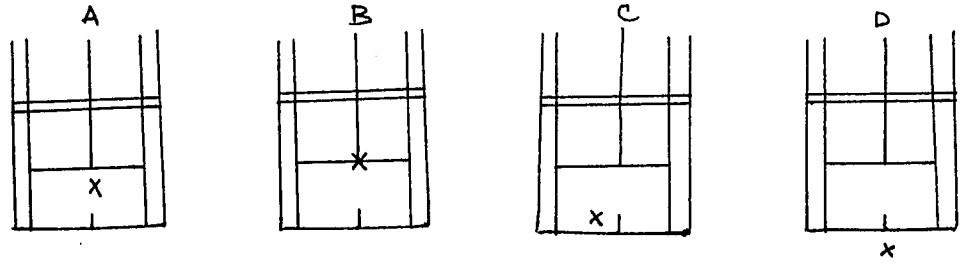
65. What is good strategy in tennis?
    *A. Force opponent out of position.
    B. Drive all balls to opponent's backhand side.
    C. Rattle opponent during play by shouting.
    D. Chop all balls.

66. Which stroke would you force your opponent to use that would probably produce the most points for you?
    A. Forehand.
    *B. Backhand.
    C. Lob.
    D. Volley.

67. What causes most points to be scored?
    A. Accurate placement shots.
    B. Powerful serves.
    C. Overpowering ground strokes.
    *D. Errors.

68. What is the primary purpose of serving a ball to the right court near the center line?
    A. To surprise the receiver.
    *B. To force the receiver to return the serve with a backhand stroke.
    C. To cut down the possible angle of return.
    D. To draw the receiver out of position for the next shot.

69. What is the best waiting position for rallying in singles? (D)



70. What is the net man's first responsibility in doubles?
    A. To go for the "kill."
    *B. To protect his alley.
    C. To dominate short angle shots.
    D. To pull opponents out of position.

* or (A)--asterick or letter in parenthesis indicates correct answer.

APPENDIX B

ARCHERY

Number of Tests: 196

Mean: 54

Standard Deviation: 8.1

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
1	96.4	.35	A, C, D		Equipment	McIntosh
2	22.4	.06	D		Equipment	Schumm
3	73.0	.36		*	Equipment	Wallace
4	43.4	.31	B, D	*	Equipment	Caldwell
5	81.1	.20	A, C	*	Etiquette	Wallace
6	88.8	.53	A, D	*	Rules & Scoring	McIntosh
7	82.7	.19			Rules & Scoring	McIntosh
8	50.0	.45		*	Rules & Scoring	Wallace
9	59.2	.30	D	*	Rules & Scoring	Wallace
10	61.7	.35		*	Rules & Scoring	Wallace
11	28.6	.05	B, C		Rules & Scoring	Schumm
12	45.4	.28		*	Safety	Schumm
13	98.0	.33	A, B, C		Safety	Caldwell
14	44.9	.12	B, C		Safety	Schumm
15	93.9	.35	A, C		Safety	Wallace
16	83.2	.47	A	*	Technique	Lewis
17	78.6	.39		*	Technique	Caldwell
18	40.8	.35	C	*	Technique	Ley
19	86.7	.20	C, D	*	Technique	Jarvis
20	46.4	.50		*	Technique	Lewis
21	16.3	.06			Technique	Lewis
22	65.8	.11			Technique	Lewis
23	34.7	.36		*	Technique	Ley

ARCHERY (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
24	20.9	.16			Technique	Ley
25	83.2	.22	B	*	Technique	Caldwell
26	64.3	.25		*	Technique	Ley
27	62.8	.42		*	Technique	Wallace
28	10.2	.20			Technique	Ley
29	59.7	.12	A		Technique	Caldwell
30	60.7	.01			Technique	Schumm
31	50.0	.27		*	Technique	Schumm
32	37.2	.31		*	Technique	Caldwell
33	92.9	.46	A, B	*	Technique	Jarvis
34	83.2	.24	A, B	*	Technique	Ley
35	34.2	.41		*	Technique	Ley
36	14.8	.38		*	Technique	Ley
37	82.7	.23	A	*	Technique	Caldwell
38	79.1	.54	B	*	Technique	Caldwell
39	5.1	.33			Technique	Schumm
40	64.3	.46		*	Technique	Caldwell
41	29.6	-.11			Technique	Schumm
42	79.6	.46	C, D	*	Technique	Caldwell
43	65.3	.30	D	*	Technique	Lewis
44	69.5	.519	D	*	Technique	Jarvis
45	54.6	-.04	D		Technique	Caldwell
46	78.6	.19	A	*	Technique	Caldwell
47	21.4	.24		*	Technique	Ley
48	17.9	.21		*	Technique	Ley
49	92.3	.37	A, C		Technique	Jarvis
50	52.0	.43		*	Technique	Jarvis
51	96.4	.31	B, C		Terminology	Lewis
52	61.2	.49	D	*	Terminology	Wallace
53	81.1	.50		*	Terminology	Wallace
54	78.6	.38		*	Terminology	Caldwell
55	85.7	.47	D	*	Terminology	Wallace
56	42.9	.29		*	Technique	Wallace
57	32.1	.45		*	Technique	Wallace
58	14.3	.11			Technique	Wallace
59	29.1	.06			Technique	Wallace
60	79.6	.23		*	Technique	Wallace
61	23.5	.01			Technique	Wallace

ARCHERY (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
62	59.2	.56		*	Technique	Wallace
63	69.4	.21		*	Technique	Wallace
64	41.3	.09			Technique	Wallace
65	57.1	.32		*	Technique	Wallace
66	35.7	-.08			Technique	Wallace
67	46.4	.22		*	Technique	Wallace
68	73.5	.35		*	Technique	Wallace
69	38.3	.49		*	Technique	Wallace
70	36.2	.08			Technique	Wallace

BADMINTON

Number of Tests: 297

Mean: 58

Standard Deviation: 10.00

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
1	82.2	.11			History	Farrow
2	77.1	.21	D	*	Equipment	Hennis
3	59.6	.37		*	Equipment	Farrow
4	78.5	.31	B	*	Etiquette	Scott
5	36.7	.28		*	Etiquette	Griot
6	43.1	.54	C	*	Terminology	Jones
7	61.3	.43		*	Terminology	Fox
8	80.8	.27	D	*	Terminology	Scott
9	91.3	.53	A		Terminology	Farrow
10	37.4	.25		*	Strategy	Pankonin
11	92.6	.27	A		Strategy	Texas
12	86.9	.14	D		Strategy	Ley
13	54.2	.26		*	Strategy	Ley
14	60.3	.23	D	*	Strategy	Ley
15	63.0	.30		*	Strategy	Ley
16	44.1	.25		*	Strategy	Ley
17	67.7	.41		*	Strategy	Farrow
18	83.5	.27	A	*	Strategy	Hennis
19	59.9	.42	C	*	Technique	Griot
20	19.9	-.11	B		Technique	Jones
21	52.2	.20	C	*	Technique	Farrow
22	63.6	.54		*	Technique	Hennis
23	74.1	.20	A	*	Technique	Griot
24	50.2	.45		*	Technique	Farrow
25	43.8	.16			Technique	Farrow
26	54.2	.53		*	Technique	Farrow
27	47.5	.21		*	Technique	Hennis
28	74.4	.26		*	Technique	Fox
29	71.4	.37		*	Technique	Scott

BADMINTON (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
30	33.7	.39		*	Technique	Fox
31	73.7	.16	C		Technique	Farrow
32	79.1	.36		*	Technique	Texas
33	50.5	.23		*	Technique	Farrow
34	66.3	.24		*	Technique	Farrow
35	81.1	.45	A, D	*	Technique	Ley
36	40.7	.08	D		Technique	Ley
37	41.8	.12			Technique	Ley
38	31.3	.13			Technique	Ley
39	63.0	.31		*	Technique	Hennis
40	72.4	.17			Technique	Hennis
41	42.1	.30		*	Technique	Fox
42	52.2	.23		*	Technique	Scott
43	79.5	.54		*	Technique	Griot
44	58.9	.54		*	Technique	Farrow
45	39.4	.11			Technique	Farrow
46	22.2	.20		*	Technique	Griot
47	32.0	.31		*	Technique	Griot
48	14.8	.36	D	*	Technique	Farrow
49	28.0	.31		*	Technique	Griot
50	65.7	.34		*	Technique	Griot
51	43.8	.24		*	Technique	Fox
52	24.6	.16			Technique	Farrow
53	30.6	.29		*	Technique	Farrow
54	50.2	.33		*	Technique	Farrow
55	76.4	.36		*	Technique	Fox
56	38.4	.11			Technique	Ley
57	26.9	.11			Technique	Ley
58	32.0	.18	D		Technique	Ley
59	94.3	.20	A		Rules/Scoring	Scott
60	65.7	.49		*	Rules/Scoring	Texas
61	80.8	.39	B	*	Rules/Scoring	Griot
62	42.1	.41		*	Rules/Scoring	Texas
63	61.3	.41		*	Rules/Scoring	Texas
64	32.0	.14			Rules/Scoring	Griot
65	56.2	.21	C	*	Rules/Scoring	Hennis

BADMINTON (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
66	73.1	.38	C	*	Rules/Scoring	Hennis
67	92.9	.12	C	*	Rules/Scoring	Texas
68	92.3	.35	A		Rules/Scoring	Texas
69	90.6	.35	D	*	Rules/Scoring	Farrow
70	77.1	.37		*	Rules/Scoring	Jones

BOWLING
(9 weeks term)

Number of Tests: 205

Mean: 57

Standard Deviation: 10.4

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
1	68.8	.52			History	Trice
2	74.6	.65		*	History	Hennis
3	97.6	-.21	A, B, C		Equipment	Texas
4	71.2	.58		*	Equipment	Ohio
5	80.5	.46	B	*	Equipment	Farrow
6	22.0	.18			Equipment	Hennis
7	62.4	-.01			Equipment	Ley
8	77.1	.57	B	*	Etiquette	Hennis
9	84.9	.53		*	Etiquette	Farrow
10	23.4	.40	A	*	Etiquette	Farrow
11	50.2	.12	A		Etiquette	Farrow
12	72.7	.36	A		Etiquette	Farrow
13	73.7	.52		*	Rules & Scor.	Ley
14	93.2	.50	A, D		Rules/Scoring	Kemp
15	45.4	.45		*	Rules/Scoring	Farrow
16	93.2	.47	A, C		Rules/Scoring	Ley
17	77.1	.45		*	Rules/Scoring	Hennis
18	43.9	.43		*	Rules/Scoring	Hennis
19	80.0	.48	D		Rules/Scoring	Trice
20	92.7	.47	A		Rules/Scoring	Farrow
21	82.0	.47		*	Rules/Scoring	Howells
22	38.0	.15	A		Rules/Scoring	Farrow
23	95.1	.27	C, D		Terminology	Farrow
24	91.7	.55	B, D		Terminology	Farrow
25	16.6	-.25			Terminology	Hennis
26	84.4	.48	C, D	*	Terminology	Trice
27	68.8	.54	A	*	Terminology	Farrow
28	75.6	.60	C	*	Terminology	Howells

BOWLING (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
29	83.9	.31		*	Rules/Scoring	Farrow
30	39.0	.10			Safety	Klaus
31	70.2	.51	B	*	Safety	Ley
32	42.9	.12			Safety	Farrow
33	63.4	.23		*	Strategy	Droste
34	74.1	.38		*	Strategy	Hennis
35	64.4	.70		*	Strategy	Droste
36	32.2	.14			Strategy	Droste
37	24.4	.30	C, D		Strategy	Trice
38	21.0	.18			Strategy	Howells
39	62.4	.55		*	Strategy	Howells
40	52.7	.23		*	Strategy	Howells
41	49.8	.17	A		Strategy	Farrow
42	40.0	.51		*	Strategy	Trice
43	29.8	.16			Strategy	Ley
44	36.6	.17			Strategy	Ley
45	20.0	.38		*	Strategy	Ley
46	75.1	.23			Strategy	Ley
47	17.6	-.19			Strategy	Ley
48	65.9	.35		*	Strategy	Ley
49	46.3	.47	A, D		Strategy	Ley
50	84.4	.56		*	Value	Farrow
51	41.5	.46		*	Technique	Howells
52	51.7	.37		*	Technique	Droste
53	40.5	.11			Technique	Ley
54	29.8	.15			Technique	Droste
55	72.2	.14			Technique	Hennis
56	30.2	.26			Technique	Droste
57	67.3	.40		*	Technique	Howells
58	31.7	.30		*	Technique	Ley
59	68.3	.47		*	Technique	Ley
60	34.6	-.03			Technique	Droste
61	34.1	-.24			Technique	Ley
62	87.8	.42		*	Technique	Trice
63	79.0	.36	A	*	Technique	Ley
64	71.7	.40		*	Technique	Hennis
65	55.1	.23			Technique	Hennis
66	50.2	.45		*	Technique	Ley

BOWLING (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
67	72.7	.25			Technique	Droste
68	85.0	.26			Technique	Howells
69	49.8	.36		*	Technique	Ley
70	34.6	.06		*	Technique	Trice
71	82.9	.38	A		Technique	Droste
72	84.4	.58	A	*	Technique	Droste
73	76.6	.52		*	Technique	Howells
74	70.7	.44		*	Technique	Trice
75	67.8	.34			Technique	Howells
76	89.8	.53	D		Technique	Trice
77	48.3	.31			Technique	Ley
78	68.3	.47		*	Technique	Trice
79	60.0	.53		*	Technique	Hennis
80	55.6	.01			Technique	Trice
81	76.6	.29		*	Technique	Droste
82	31.7	.35		*	Technique	Trice
83	63.9	.25			Technique	Droste
84	59.5	.35	A	*	Technique	Ley
85	50.2	.24			Technique	Ley
86	62.9	.33		*	Technique	Ley
87	73.7	.58		*	Technique	Ley
88	30.7	.18	A		Technique	Hennis
89	55.1	.07			Technique	Ley
90	90.2	.38			Technique	Trice
91	36.6	.03			Technique	Ley
92	42.9	.38		*	Technique	Trice
93	53.7	.43		*	Technique	Ley
94	60.0	.39		*	Technique	Farrow
95	73.2	.49		*	Technique	Hennis
96	52.7	.16			Technique	Farrow
97	59.5	.31			Technique	Klaus
98	51.7	-.03			Technique	Hennis
99	71.7	.49		*	Technique	Howells
100	14.6	-.11			Technique	Farrow

BOWLING
(Full-Term)

Number of Tests: 240

Mean: 62

Standard Deviation: 8.4

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
1	60.4	.22		*	History	Trice
2	23.3	.00			History	Hennis
3	98.8	.31	A, B, C		Equipment	Texas
4	70.8	.05	C		Equipment	Ohio
5	77.1	.18			Equipment	Farrow
6	22.5	.35		*	Equipment	Hennis
7	52.9	.26		*	Equipment	Ley
8	90.8	.46	B, C		Etiquette	Hennis
9	86.7	.55		*	Etiquette	Farrow
10	45.8	.16	A		Etiquette	Farrow
11	39.6	.33	A	*	Etiquette	Farrow
12	71.3	.42	A	*	Etiquette	Farrow
13	82.5	.35		*	Rules/Scoring	Ley
14	99.6	.24	A, C, D		Rules/Scoring	Kemp
15	67.9	.42		*	Rules/Scoring	Farrow
16	96.7	.42	A, C, D		Rules/Scoring	Ley
17	79.2	.37	C	*	Rules/Scoring	Hennis
18	60.0	.44		*	Rules/Scoring	Hennis
19	91.3	.25	D		Rules/Scoring	Trice
20	97.9	.31	A, B, D		Rules/Scoring	Farrow
21	92.5	.53	C		Rules/Scoring	Howells
22	38.3	.35	A	*	Rules/Scoring	Farrow
23	98.3	.37	B, C, D		Terminology	Farrow
24	92.5	.46	B, D		Terminology	Farrow
25	15.4	-.17			Terminology	Hennis
26	93.8	.49	C, D		Terminology	Trice
27	70.4	.57	A	*	Terminology	Farrow
28	67.1	.47		*	Terminology	Howells

BOWLING (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
29	94.6	.29	A, C		Rules/Scoring	Farrow
30	43.3	.36		*	Safety	Klaus
31	85.8	.48		*	Safety	Ley
32	51.3	.28			Safety	Farrow
33	60.0	.36	A	*	Strategy	Droste
34	82.1	.47	A	*	Strategy	Hennis
35	74.2	.57		*	Strategy	Droste
36	41.7	.01			Strategy	Droste
37	29.2	.45		*	Strategy	Trice
38	21.7	.11			Strategy	Howells
39	84.2	.38		*	Strategy	Howells
40	64.6	.24		*	Strategy	Howells
41	57.5	.24		*	Strategy	Farrow
42	54.2	.20			Strategy	Trice
43	33.8	.04	A		Strategy	Ley
44	27.9	.15			Strategy	Ley
45	32.9	.41		*	Strategy	Ley
46	12.9	.03			Strategy	Ley
47	47.5	.22			Strategy	Ley
48	74.2	.19			Strategy	Ley
49	65.8	.45	A, D	*	Strategy	Ley
50	69.6	.24	A	*	Value	Farrow
51	62.1	.35		*	Technique	Howells
52	57.9	.52		*	Technique	Droste
53	38.8	.35		*	Technique	Ley
54	41.3	.31		*	Technique	Droste
55	60.8	.16		*	Technique	Hennis
56	28.8	.18			Technique	Droste
57	68.3	.34		*	Technique	Howells
58	42.1	.22			Technique	Ley
59	62.5	.35		*	Technique	Ley
60	37.9	.26			Technique	Droste
61	15.8	-.03			Technique	Ley
62	95.0	.44	A, B		Technique	Trice
63	81.3	.13	A		Technique	Ley
64	70.4	.44		*	Technique	Hennis
65	61.7	.05	C		Technique	Hennis
66	42.1	.41		*	Technique	Ley

BOWLING (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
67	66.7	.23		*	Technique	Droste
68	86.7	.29	B	*	Technique	Howells
69	58.3	.51		*	Technique	Ley
70	45.0	.05			Technique	Trice
71	82.1	.37	A	*	Technique	Droste
72	88.3	.29	A		Technique	Droste
73	84.2	.33		*	Technique	Howells
74	84.6	.39		*	Technique	Trice
75	60.4	.15			Technique	Howells
76	92.5	.11	D		Technique	Trice
77	23.3	.08			Technique	Ley
78	82.1	.47		*	Technique	Trice
79	65.0	.42		*	Technique	Hennis
80	40.4	-.15			Technique	Trice
81	80.4	.48		*	Technique	Droste
82	61.7	.18			Technique	Trice
83	68.8	.41		*	Technique	Droste
84	76.7	.38		*	Technique	Ley
85	55.0	.30			Technique	Ley
86	62.9	.35		*	Technique	Ley
87	83.8	.45		*	Technique	Ley
88	34.2	.28	A		Technique	Hennis
89	56.7	.31			Technique	Ley
90	90.4	.28	C		Technique	Trice
91	31.7	.22			Technique	Ley
92	42.5	.42		*	Technique	Trice
93	58.3	.32		*	Technique	Ley
94	64.2	.20			Technique	Farrow
95	77.9	.30	D	*	Technique	Hennis
96	63.3	.20			Technique	Farrow
97	62.5	.45		*	Technique	Klaus
98	68.3	.21	B		Technique	Hennis
99	92.5	.45	A		Technique	Howells
100	22.1	-.10			Technique	Farrow

GOLF

Number of Tests: 187

Mean: 51

Standard Deviation: 9.5

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
1	70.6	.30	A	*	History	Owens
2	5.9	.13			Etiquette	Owens
3	70.1	.41	A	*	Etiquette	Ohio
4	89.8	.44		*	Eitquette	Malizola
5	89.3	.48	A	*	Equipment	Texas
6	26.7	.40		*	Safety	Snell
7	81.3	.40	B	*	Rules/Scoring	Simpson
8	44.9	.52	B	*	Rules/Scoring	Owens
9	44.4	.36		*	Rules/Scoring	Owens
10	28.9	.56	D	*	Rules/Scoring	Owens
11	12.8	.09			Rules/Scoring	Malizola
12	57.2	.00	B		Rules/Scoring	Malizola
13	73.3	.24	A, D	*	Rules/Scoring	Snell
14	50.8	.42		*	Technique	Simpson
15	72.7	.25	C	*	Technique	Ohio
16	66.8	.46		*	Technique	Malizola
17	41.7	.38		*	Technique	Malizola
18	80.2	.18			Technique	Snell
19	70.1	.49		*	Technique	Ley
20	66.8	.03			Strategy	Malizola
21	54.0	.26		*	Strategy	Malizola
22	95.7	.22	A, B, D		Strategy	Texas
23	46.5	.45		*	Strategy	Ohio
24	68.4	.51		*	Strategy	Malizola
25	43.3	.38		*	Strategy	Ley
26	77.5	.30	A	*	Strategy	Ley
27	89.3	.41	D	*	Terminology	Snell
28	77.0	.46	D	*	Terminology	Malizola

GOLF (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
29	73.3	.13	B, C		Terminology	Malizola
30	69.0	.28	A	*	Terminology	Malizola
31	55.6	.36		*	Technique	Ohio
32	85.0	.41		*	Technique	Ohio
33	75.9	.11			Technique	Ohio
34	32.1	.39		*	Technique	Ohio
35	70.1	.30		*	Technique	Ohio
36	54.0	.23		*	Technique	Ohio
37	51.3	.41		*	Technique	Owens
38	52.9	.36		*	Technique	Owens
39	49.2	.27	C, D	*	Technique	Owens
40	44.4	.21			Technique	Owens
41	33.7	.38		*	Technique	Owens
42	34.2	.35		*	Technique	Malizola
43	15.0	.06			Technique	Malizola
44	11.8	.29		*	Technique	Malizola
45	25.1	.20			Technique	Malizola
46	25.1	.41		*	Technique	Ley
47	49.7	.23		*	Technique	Ley
48	22.5	.29		*	Technique	Ley
49	18.7	.12			Technique	Ley
50	56.1	.10			Technique	Ley
51	35.8	.34		*	Technique	Ley
52	32.1	.11			Technique	Ley
53	22.5	-.05			Technique	Ley
54	31.6	.22		*	Technique	Ley
55	83.4	.24	D	*	Technique	Ley
56	73.3	-.05			Technique	Ohio
57	51.9	.39		*	Technique	Malizola
58	18.7	.56		*	Technique	Malizola
59	18.7	.17			Technique	Ley
60	73.8	.26		*	Technique	Malizola
61	40.6	.20			Technique	Malizola
62	35.2	.22		*	Technique	Ley
63	86.6	.24	A	*	Technique	Ley
64	41.2	.34		*	Technique	Ohio
65	82.9	.50		*	Technique	Malizola
66	8.6	-.18			Technique	Malizola

GOLF (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
67	49.7	.37		*	Technique	Ley
68	50.3	.42		*	Technique	Malazola
69	47.1	.16			Technique	Malazola
70	31.6	.27		*	Technique	Simpson

TENNIS

Number of Tests: 249

Mean: 60.1

Standard Deviation: 10.8

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
1	65.1	.30	A, D	*	Equipment	Childrey
2	8.5	.10	D		Equipment	Hennis
3	76.5	.09	B		Etiquette	Hennis
4	40.2	.42		*	Etiquette	J-X
5	38.1	.53	D	*	History	Johnston
6	70.8	.23		*	Rules/Scoring	J-X
7	69.0	.20			Rules/Scoring	Utter
8	79.4	.32	A	*	Rules/Scoring	J-X
9	51.2	.21			Rules/Scoring	J-X
10	42.0	.39		*	Rules/Scoring	J-X
11	82.2	.46	A, B	*	Rules/Scoring	J-X
12	63.0	.47	C	*	Rules/Scoring	J-X
13	53.7	.45		*	Rules/Scoring	J-X
14	50.2	.21		*	Technique	Day
15	70.5	.42		*	Technique	Johnston
16	56.9	.32		*	Technique	Hennis
17	52.0	.23		*	Technique	Hennis
18	56.2	.43	B, D	*	Technique	Thompson
19	30.2	-.02			Technique	Thompson
20	60.9	.15			Technique	Johnson
21	75.4	.33	B	*	Technique	Day
22	68.0	.44	D	*	Technique	Johnston
23	67.3	.39	A	*	Technique	Hennis
24	26.0	.30			Technique	Farrow
25	64.4	.40		*	Technique	Mariello
26	43.8	.57		*	Technique	Ohio
27	32.7	.52		*	Technique	Hennis
28	51.6	.67		*	Technique	Thompson
29	23.5	.05	A		Technique	Hennis

TENNIS (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
30	45.6	.34		*	Technique	Hennis
31	35.2	.42			Technique	Hennis
32	43.8	.43		*	Technique	Hennis
33	67.6	.43		*	Technique	Hennis
34	70.1	.53		*	Strategy	Hennis
35	75.4	.41	A, D	*	Technique	Mariello
36	75.4	.15			Technique	Alexander
37	46.6	.21	B	*	Technique	Wilke
38	22.1	.14			Technique	Farrow
39	13.9	.31		*	Technique	Johnson
40	55.9	.64		*	Technique	Johnson
41	61.6	.42		*	Technique	Mariello
42	42.3	.47		*	Technique	Hennis
43	34.2	.18			Technique	Farrow
44	50.2	.39		*	Technique	Farrow
45	54.4	.34	A	*	Technique	Farrow
46	59.1	.15			Technique	Wilke
47	53.4	.22	B	*	Technique	J-X
48	66.5	.32	D	*	Technique	Johnston
49	59.1	.07	A		Technique	Farrow
50	76.9	.55	A	*	Technique	B.G.U.
51	68.7	.34		*	Technique	Alexander
52	55.9	.16			Technique	Hennis
53	63.3	.26	A	*	Technique	Hennis
54	59.4	.23			Technique	Alexander
55	46.6	.61		*	Technique	Johnston
56	70.5	.31	D	*	Technique	J-X
57	50.2	.23			Technique	Hennis
58	30.2	.36		*	Technique	Johnson
59	72.2	.23			Technique	Mariello
60	66.2	.44		*	Technique	J-X
61	56.9	.39			Terminology	Alexander
62	58.0	.43		*	Terminology	Utter
63	47.3	.37		*	Terminology	J-X
64	71.9	.40		*	Terminology	J-X
65	81.9	.23	C, D		Strategy	Texas
66	59.1	.29		*	Strategy	Utter
67	43.1	.27		*	Strategy	Johnston

TENNIS (continued)

Question Number	Difficulty Rating	Index of Discrimination	Non-functioning Responses	*Selected for Final Exam	Type of Item	Source of Item
68	29.5	.30	A	*	Strategy	Hennis
69	50.2	.25		*	Strategy	Wilke
70	12.8	.23			Strategy	Day

APPENDIX C

KNOWLEDGE TEST SCALES

T-Scores	Raw Scores					
	Archery	Badminton	Bowling ½ term	Bowling full term	Golf	Tennis
80	99.70	94.99	109.19	105.49	91.79	101.79
79	98.41	93.79	107.65	104.14	70.53	100.43
78	97.12	92.59	106.11	102.79	89.27	99.07
77	95.83	91.39	104.57	101.44	88.01	97.71
76	94.54	90.19	103.03	100.09	86.75	96.35
75	93.25	88.99	101.49	98.74	85.49	94.99
74	91.96	87.79	99.95	97.39	84.23	93.63
73	90.67	86.59	98.41	96.04	82.97	92.27
72	89.38	85.39	96.87	94.69	81.71	90.91
71	88.09	84.19	95.33	93.34	80.45	89.55
70	85.80	82.99	93.79	91.99	79.19	88.19
69	85.51	81.79	92.25	90.64	77.93	86.83
68	84.22	80.59	90.71	89.29	76.67	85.47
67	82.93	79.39	89.17	87.94	75.41	84.11
66	81.64	78.19	87.63	86.59	74.15	82.75
65	80.35	76.99	86.09	85.24	72.89	81.39
64	79.06	75.79	84.55	83.89	71.63	80.03
63	77.77	74.59	83.01	82.54	70.37	78.67
62	76.48	73.39	81.47	81.19	69.11	77.31
61	75.19	72.19	79.93	79.84	67.85	75.95
60	73.90	70.99	78.39	78.49	66.59	74.59
59	72.61	69.79	76.85	77.14	65.33	73.23
58	71.32	68.59	75.31	75.79	64.07	71.87
57	70.03	67.39	73.77	74.44	62.81	70.51
56	68.74	66.19	72.23	73.09	61.55	69.15
55	67.45	64.99	70.69	71.74	60.29	67.79
54	66.16	63.79	69.15	70.39	59.03	66.53
53	64.87	62.59	67.61	69.04	57.77	65.07
52	63.58	61.39	66.07	67.69	56.51	63.71
51	62.29	60.19	64.53	66.34	55.25	62.35
50	61.00	58.99	62.99	64.99	53.99	60.99
49	59.71	57.79	61.45	63.64	52.73	59.63
48	58.42	56.59	59.91	62.29	51.47	58.27
47	57.13	55.39	58.37	60.94	50.21	56.91
46	55.84	54.19	56.83	59.59	48.95	55.55
45	54.55	52.99	55.29	58.24	47.69	54.19
44	53.26	51.79	53.75	56.89	46.43	52.83
43	51.97	50.59	52.21	55.54	45.17	51.47
42	50.68	49.39	50.67	54.19	43.91	50.11
41	49.39	48.19	49.13	52.84	42.65	48.75
40	48.10	46.99	47.59	51.49	41.39	47.39
39	46.81	45.79	46.05	50.14	40.13	46.03
38	45.52	44.59	44.51	48.79	38.87	44.67

T-Scores	Archery	Badminton	Bowling	Raw Scores Bowling	Golf	Tennis
37	45.23	43.39	42.97	47.44	37.61	43.31
36	42.94	42.19	41.43	46.09	36.35	41.95
35	41.65	40.99	39.89	44.74	35.09	40.59
34	40.36	39.79	38.35	43.39	33.83	39.23
33	39.07	38.59	36.81	42.04	32.57	37.87
32	37.78	37.39	35.27	40.69	31.39	36.51
31	36.49	36.19	33.73	39.34	30.05	35.16
30	35.20	34.99	32.19	37.99	28.79	33.80
29	33.91	33.79	30.65	36.64	27.53	32.44
28	32.62	32.59	29.11	35.29	26.27	31.08
27	31.33	31.39	26.57	33.95	25.01	29.72
26	30.04	30.19	26.03	32.59	23.75	28.36
25	28.75	28.99	24.49	31.24	22.49	27.00
24	27.46	27.79	22.95	29.89	21.24	25.64
23	26.17	26.59	21.42	28.54	19.98	24.28
22	24.88	25.99	19.88	27.20	18.72	22.92
21	23.59	24.20	18.34	25.85	17.46	21.56
20	22.30	23.00	16.80	24.50	16.20	20.20

APPENDIX D

ARCHERY

Scales for Ten and Twenty Yards Combined

T-Scores	Raw Scores
80	355.28
79	350.14
78	344.99
77	339.84
76	334.70
75	329.55
74	324.40
73	319.26
72	314.11
71	308.81
70	303.81
69	298.67
68	293.52
67	288.37
66	283.23
65	278.08
64	272.93
63	267.79
62	262.64
61	257.49
60	252.34
59	247.20
58	242.05
57	236.90
56	231.76
55	226.61
54	221.46
53	216.32
52	211.17
51	206.02
50	200.87
49	195.73
48	190.58
47	185.43
46	180.29
45	175.14
44	169.99
43	164.85
42	159.70
41	154.55
40	149.40

T-Scores	Raw Scores
39	144.26
38	139.11
37	133.96
36	128.82
35	123.67
34	118.52
33	113.38
32	108.23
31	103.08
30	97.93
29	92.79
28	87.64
27	82.49
26	77.35
25	72.20
24	67.05
23	61.91
22	56.76
21	51.61
20	46.47

BADMINTON

Scales for Men and Women Combined

T-Scores	Raw Scores			
	Clear	Serve	Bounce	Footwork
80	125.49	92.86	201.44	25.65
79	123.15	91.05	198.39	26.13
78	120.81	89.24	195.33	26.61
77	118.47	87.43	192.28	27.09
76	116.13	85.62	189.22	27.57
75	113.80	83.80	186.16	28.05
74	111.46	81.99	183.11	28.53
73	109.12	80.18	180.05	29.01
72	106.78	78.37	177.00	29.49
71	104.44	76.56	173.94	29.97
70	102.11	74.74	170.88	30.45
69	99.77	72.93	167.83	30.94
68	97.43	71.12	164.77	31.42
67	95.09	69.31	161.72	31.90
66	92.75	67.50	158.66	32.38
65	90.42	65.68	155.60	32.86
64	88.08	63.87	152.55	33.34
63	85.74	62.06	149.49	33.82
62	83.40	60.25	146.44	34.30
61	81.06	58.44	143.38	34.78
60	78.73	56.62	140.32	35.26
59	76.39	54.81	137.27	35.75
58	74.05	53.00	124.21	36.23
57	71.71	51.19	131.16	36.71
56	69.37	49.38	128.10	37.19
55	67.04	47.56	125.04	37.67
54	64.70	45.75	121.99	38.15
53	62.36	43.94	118.93	38.63
52	60.02	42.13	115.88	39.11
51	57.68	40.32	112.82	39.58
50	55.34	38.50	109.76	40.07
49	53.01	36.69	106.71	40.56
48	50.67	34.88	103.65	41.04
47	48.33	33.07	100.60	41.52
46	45.99	31.26	97.54	42.00
45	43.66	29.44	94.48	42.48
44	41.32	27.63	91.43	42.96
43	38.98	25.82	88.37	43.44
42	36.64	24.01	85.32	43.92
41	34.30	22.20	82.26	44.40
40	31.96	20.39	79.21	44.88

T-Scores	Raw Scores			
	Clear	Serve	Bounce	Footwork
39	29.63	18.57	76.15	45.37
38	27.29	16.76	73.09	45.85
37	24.95	14.95	70.04	46.33
36	22.61	13.14	66.98	46.81
35	20.27	11.33	63.92	47.29
34	17.94	9.51	60.87	47.77
33	15.60	7.70	57.81	48.25
32	13.26	5.89	54.76	48.73
31	10.92	4.08	51.70	49.21
30	8.58	2.27	48.65	49.69
29	6.25	0.45	45.59	50.18
28	3.91		42.53	50.66
27	1.57		39.48	51.14
26			36.42	51.62
25			33.37	52.10
24			30.31	52.58
23			27.25	53.06
22			24.20	53.54
21			21.14	54.02
20			18.09	54.50

BADMINTON

Scales for Men

T-Scores	Raw Scores Clear	Serve	Bounce	Footwork
80	113.85	94.76	228.47	21.59
79	112.50	93.18	225.52	22.01
78	111.14	91.59	222.56	22.43
77	109.78	90.00	219.61	22.85
76	108.42	88.42	216.65	23.27
75	107.06	86.83	213.70	23.69
74	105.70	85.24	210.74	24.11
73	104.34	83.66	207.79	24.53
72	102.98	82.07	204.83	24.95
71	101.62	80.48	201.88	25.37
70	100.26	78.89	198.92	25.79
69	98.91	77.31	195.97	26.22
68	97.55	75.72	193.01	26.64
67	96.19	74.13	190.06	27.06
66	94.83	72.55	187.10	27.48
65	93.47	70.96	184.15	27.90
64	92.11	69.37	181.19	28.32
63	90.75	67.79	178.24	28.74
62	89.39	66.20	175.28	29.16
61	88.03	64.61	172.33	29.58
60	86.67	63.02	169.37	30.00
59	85.32	61.44	166.42	30.43
58	83.96	59.85	163.46	30.85
57	82.60	58.26	160.51	31.27
56	81.24	56.68	157.55	31.69
55	79.88	55.09	154.60	32.11
54	78.52	53.50	151.64	32.53
53	77.16	51.92	148.69	32.95
52	75.80	50.33	145.73	33.37
51	74.44	48.74	152.78	33.79
50	73.08	47.15	139.82	34.21
49	71.73	45.57	136.87	34.64
48	70.37	43.98	133.91	35.06
47	69.01	42.39	130.96	35.48
46	67.65	40.81	128.00	35.90
45	66.29	39.22	125.05	36.32
44	64.93	37.63	122.09	36.74
43	63.57	36.05	119.14	37.16
42	62.21	34.46	116.18	37.58
41	60.85	32.87	113.23	38.00

T-Scores	Raw Scores			
	Clear	Serve	Bounce	Footwork
40	59.49	31.28	110.27	38.42
39	58.14	29.70	107.32	38.85
38	56.78	28.11	104.36	39.27
37	55.42	26.52	101.41	39.69
36	54.06	24.94	98.45	40.11
35	52.70	23.35	95.50	40.53
34	51.34	21.76	92.54	40.95
33	49.98	20.18	89.59	41.37
32	48.62	18.59	86.63	41.79
31	47.26	17.00	83.68	42.21
30	45.91	15.41	80.72	42.63
29	44.55	13.83	77.77	43.06
28	43.19	12.24	74.81	43.48
27	41.83	10.65	71.86	43.90
26	40.47	9.07	68.90	44.32
25	39.11	7.48	65.95	44.74
24	37.75	5.89	62.99	45.16
23	36.39	4.31	60.04	45.58
22	35.03	2.72	57.08	46.00
21	33.67	1.13	51.13	46.42
20	32.32		51.17	46.84

BADMINTON

Scales for Women

T-Scores	Raw Scores			
	Clear	Serve	Bounce	Footwork
80	121.62	90.89	184.25	29.42
79	119.29	89.09	181.56	29.81
78	116.96	87.28	178.87	30.21
77	114.63	85.48	176.18	30.60
76	112.30	83.67	173.49	31.00
75	109.97	81.86	170.80	31.39
74	107.64	80.06	168.11	31.79
73	105.31	78.25	165.42	32.19
72	102.98	76.45	162.73	32.58
71	100.65	74.64	160.04	32.98
70	98.31	72.83	157.35	33.37
69	95.98	71.03	154.66	33.77
68	93.65	69.22	151.97	34.17
67	91.32	67.42	149.28	34.56
66	88.99	65.61	146.59	34.96
65	86.66	63.80	143.90	35.35
64	84.33	62.00	141.21	34.75
63	82.00	60.19	138.52	36.15
62	79.67	58.39	135.83	36.54
61	77.34	56.58	133.14	36.94
60	75.00	54.77	130.45	37.33
59	72.67	52.97	127.76	37.73
58	70.34	51.16	125.07	38.13
57	68.01	49.36	122.38	38.52
56	65.68	47.55	119.69	38.92
55	63.35	45.74	117.00	39.31
54	61.02	43.94	114.31	39.71
53	58.69	42.13	111.62	40.11
52	56.36	40.33	108.93	40.50
51	54.03	38.52	106.24	40.90
50	51.69	36.71	103.55	41.29
49	49.36	34.91	100.86	41.69
48	47.03	33.10	98.17	42.09
47	44.70	31.30	95.48	42.48
46	42.37	29.49	92.79	42.88
45	40.04	27.68	90.10	43.27
44	37.71	25.88	87.41	43.67
43	35.38	24.07	84.72	44.07
42	33.05	22.27	82.03	44.48
41	30.72	20.46	79.34	44.86

T-Scores	Raw Scores			
	Clear	Serve	Bounce	Footwork
40	28.38	18.65	76.65	45.25
39	26.05	16.85	73.96	45.65
38	23.72	15.04	71.27	46.05
37	21.39	13.24	68.58	46.44
36	19.06	11.43	65.90	46.84
35	16.73	9.63	63.20	47.23
34	14.40	7.82	60.51	47.63
33	12.07	6.01	57.82	48.03
32	9.74	4.21	55.13	48.42
31	7.41	2.40	52.44	48.82
30	5.07	0.60	49.75	49.21
29	2.74		47.06	49.61
28	0.41		44.37	50.01
27			41.68	50.40
26			38.99	50.80
25			36.30	51.19
24			33.61	51.59
23			30.92	51.99
22			28.23	53.38
21			25.54	52.17
20			22.85	53.17

BOWLING

Scales for Semesters Combined

T-Scores

	Women ½ Term	Women Full Term	Men
80	863.31	992.94	1137.92
79	854.40	983.79	1126.84
78	845.48	974.64	1115.75
77	836.57	965.49	1104.66
76	827.65	956.34	1093.57
75	818.74	947.18	1082.48
74	809.82	938.03	1071.40
73	800.91	928.88	1060.31
72	791.99	919.73	1049.22
71	783.08	910.58	1038.13
70	774.16	901.42	1027.04
69	765.25	892.27	1015.96
68	756.33	883.12	1004.87
67	747.42	873.97	993.78
66	738.50	864.82	982.69
65	729.59	855.66	971.60
64	720.67	846.51	960.52
63	711.76	837.36	949.43
62	702.84	828.21	938.34
61	693.93	819.06	927.25
60	685.01	809.90	916.16
59	676.10	800.75	905.08
58	667.18	791.60	893.99
57	658.27	782.45	882.90
56	649.35	773.30	871.81
55	640.44	764.14	860.72
54	631.52	754.99	849.64
53	622.61	745.84	838.55
52	613.69	736.39	827.46
51	604.78	727.54	816.37
50	595.86	718.38	805.28
49	586.95	709.23	794.20
48	576.03	700.08	783.11
47	569.12	690.93	772.02
46	560.20	681.78	760.93
45	551.29	672.62	749.84
44	542.37	663.47	738.76
43	533.46	654.32	727.67

T-Scores	Women ½ Term	Women Full Term	Men
42	524.54	645.17	716.58
41	515.63	636.02	705.49
40	506.71	626.86	694.40
39	497.80	617.71	683.32
38	488.88	608.56	672.23
37	479.97	599.41	661.14
36	471.05	590.26	650.05
35	462.14	581.10	638.96
34	453.22	571.97	627.88
33	444.31	562.80	616.79
32	435.39	553.65	605.70
31	426.48	544.50	594.61
30	417.57	535.34	583.52
29	408.65	526.19	572.44
28	399.74	517.04	561.33
27	390.82	507.89	550.26
26	381.91	498.74	539.17
25	372.99	489.59	528.08
24	364.08	480.43	517.00
23	355.16	471.28	505.91
22	346.25	462.13	494.82
21	337.33	452.98	483.73
20	328.42	443.83	472.65

TENNIS

Scales Men and Women Combined

T-Scores	Raw Scores Broer-Miller	Timmer	Wisconsin
80	173.89	89.32	377.37
79	170.67	87.19	371.21
78	167.45	85.05	265.05
77	164.22	82.91	358.88
76	161.00	80.78	352.72
75	157.77	78.64	346.55
74	154.55	76.50	340.39
73	151.33	74.37	334.23
72	148.10	72.23	328.06
71	144.88	70.09	321.90
70	141.65	67.95	315.73
69	138.43	65.82	309.57
68	135.21	63.68	303.41
67	131.98	61.54	297.24
66	128.76	59.41	291.08
65	125.53	57.27	284.91
64	122.31	55.13	278.75
63	119.09	53.00	272.59
62	115.86	50.86	266.42
61	112.64	48.72	260.26
60	109.41	46.58	254.09
59	106.19	44.45	247.93
58	102.97	42.31	241.77
57	99.74	40.17	235.60
56	96.52	38.04	227.44
55	96.29	35.90	223.27
54	90.07	33.76	217.11
53	86.85	31.63	210.95
52	83.62	29.49	204.78
51	80.40	27.35	198.62
50	77.17	25.21	192.45
49	73.95	23.08	186.29
48	70.73	20.94	180.13
47	67.50	18.80	173.96
46	64.28	16.67	167.80
45	61.05	14.53	161.63
44	57.83	12.93	155.47
43	54.61	10.26	149.31
42	51.38	8.12	143.14

T-Scores	Raw Scores		
	Broer-Miller	Timmer	Wisconsin
41	48.16	5.98	136.98
40	44.93	3.84	130.81
39	41.71	1.71	124.65
38	38.49		118.49
37	35.26		112.32
36	32.04		106.16
35	28.82		99.99
34	25.59		93.83
33	22.37		87.67
32	19.14		81.50
31	15.92		75.34
30	12.70		69.17
29	9.47		63.01
28	6.25		56.85
27	3.02		50.68
26			44.52
25			38.35
24			32.19
23			26.03
22			19.86
21			13.70
20			7.53

TENNIS

Scales for Men

T-Scores	Raw Scores Broer-Miller	Timmer	Wisconsin
80	199.61	120.12	390.35
79	196.54	117.56	386.35
78	193.46	115.00	382.35
77	190.39	112.44	378.35
76	187.31	109.88	374.35
75	184.24	107.32	370.34
74	181.16	104.76	366.34
73	178.09	102.20	362.34
72	175.01	99.64	358.34
71	171.94	97.08	354.34
70	168.86	94.51	350.33
69	165.79	91.95	346.33
68	162.71	89.39	342.33
67	159.64	86.83	338.33
66	156.56	84.27	334.33
65	153.49	81.71	330.32
64	150.41	79.15	326.32
63	147.34	76.59	323.32
62	144.26	74.03	318.32
61	141.19	71.47	314.32
60	138.11	68.90	310.31
59	135.04	66.34	306.31
58	131.96	63.78	302.31
57	128.89	61.22	298.31
56	125.81	58.66	294.31
55	122.74	56.10	290.30
54	119.66	53.54	286.30
53	116.59	50.98	282.30
52	113.51	48.42	278.30
51	110.44	45.86	274.30
50	107.36	43.29	270.29
49	104.29	40.73	266.29
48	101.21	38.17	262.29
47	98.14	35.61	258.29
46	95.06	33.05	254.29
45	91.99	30.49	250.28
44	88.91	27.93	246.28
43	85.84	25.37	242.28
42	82.76	22.81	238.28

T-Scores	Raw Scores		
	Broer-Miller	Timmer	Wisconsin
41	79.69	20.25	234.28
40	76.61	17.68	230.27
39	73.54	15.12	226.27
38	70.46	12.56	222.27
37	67.39	10.00	218.27
36	64.31	7.44	214.27
35	61.24	4.88	210.26
34	58.16	2.32	206.26
33	55.09		202.26
32	52.01		198.26
31	48.94		194.26
30	45.86		190.25
29	42.79		186.25
28	39.71		182.25
27	36.64		178.25
26	33.56		174.25
25	30.49		170.25
24	27.41		166.24
23	34.34		162.24
22	21.26		158.24
21	18.19		154.24
20	15.11		150.24

TENNIS

Scales for Women

T-Scores	Raw Scores Broer-Miller	Timmer	Wisconsin
80	142.33	64.47	225.58
79	139.81	62.95	223.56
78	137.28	61.93	221.54
77	134.75	59.91	219.52
76	132.22	58.39	217.50
75	129.69	56.86	215.48
74	127.17	55.34	213.46
73	124.64	53.82	211.44
72	122.11	52.30	209.42
71	119.58	50.78	207.40
70	117.05	49.25	205.38
69	114.53	47.73	203.36
68	112.00	46.21	201.34
67	109.47	44.69	199.32
66	106.94	43.17	197.30
65	104.41	41.64	195.28
64	101.89	40.12	193.26
63	99.36	38.60	191.24
62	96.83	37.08	189.22
61	94.30	35.56	187.20
60	91.77	34.04	185.18
59	89.25	32.51	183.16
58	86.72	30.99	181.14
57	84.19	29.47	179.12
56	81.66	27.95	177.10
55	79.14	26.43	175.08
54	76.61	24.90	173.06
53	74.08	23.38	171.04
52	71.55	21.86	169.02
51	69.02	20.34	167.00
50	66.50	18.82	164.98
49	63.97	17.29	162.96
48	61.44	15.77	160.94
47	58.91	14.25	158.92
46	56.38	12.73	156.90
45	53.85	11.21	154.88
44	51.33	9.68	152.86
43	48.80	8.16	150.84
42	46.27	6.64	148.82

T-Scores	Raw Scores		
	Broer-Miller	Timmer	Wisconsin
41	43.74	5.12	146.80
40	41.21	3.59	144.78
39	38.69	2.07	142.76
38	36.16	0.55	140.74
37	33.63		138.72
36	31.10		136.70
35	28.58		134.68
34	26.05		132.66
33	23.52		130.64
32	20.99		128.62
31	18.46		126.60
30	15.94		124.58
29	13.41		122.56
28	10.88		120.54
27	8.35		118.52
26	5.82		116.50
25	3.30		114.48
24	0.77		112.46
23			110.44
22			108.43
21			106.41
20			104.39