TEST AND MEASUREMENT IN PHYSICAL EDUCATION

Bachelor of Physical Education (B.P.Ed.)
Course Material for Students circulation

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BCC401 TEST AND MEASUREMENT IN PHYSICAL EDUCATION

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INTRODUCTION

Some students look forward with relish to a course in statistics. The word itself evokes feelings of apprehension and the thought of working with mathematical formulae causes many to anticipate difficulties that need never arise. Why the concern? Many fear that statistics will be too difficult for them to grasp because their knowledge of mathematics is rudimentary and much of what they once knew is now forgotten. We can reassure readers that the level of arithmetical skills and the knowledge of elementary algebra necessary to follow this text are well within the ability of an average 13-14 year old pupil. That said, statistics is a branch of mathematic and the statistical methods and formulae that we introduce are mathematically derived. However, it is neither our intention to present mathematical explanations of statistical techniques, nor at the other extreme, to provide a cookbook of statistical recipes.

One purpose of this text is to help students understand the test and measurement and statistical methods so that they can tackle their research problems successfully. By working through the book carefully and systematically, students should gain a thorough grasp of the most widely used the test and measurement and statistics in Education and Physical Education. The text teaches basic statistical methods and their application to those who may lack a strong background in mathematics. In doing so, mathematical derivations of formulae are completely omitted and, apart from a minimal number of essential shorthand' mathematical symbols, familiar examples drawn from Education and Physical Education data are presented in a nonmathematical form throughout.

In planning the scope and content of the text, we have in mind the needs of those students who are required to undertake small scale empirical research as part fulfillment of the requirements of the award of Advanced Diplomas and both undergraduate, and postgraduate qualifications in Education and Physical

Education. Their research needs are often quite specific; first to find an appropriate design for their particular research topic and second, to apply appropriate statistical tests in the analysis of their data. The first sections of the text teach basic statistics and prepare students to tackle research problems with confidence and intelligence. The latter half of the book (Choosing an Appropriate Test) provides students with concrete examples drawn from Education and Physical Education data which illustrate the most commonly-used research designs in undergraduate and postgraduate studies. A standard format is employed, throughout. It consists of:

1. a tabular presentation of research design
2. a concrete example of the research design using education or physical education data
3. that example is then worked through, using an appropriate statistical test and illustrating each stage of the computation in full.

Today, statistics is a familiar and accepted aspect of our modern world. We have statistics in the shape of sports results, long range weather forecasts, stock market trends, consumer reports, cost of living indices and life insurance premiums. It is impossible to imagine life without some form of statistical information being readily at hand.

The word .statistics is used in two senses. It refers to collections of quantitative information and methods of handling that sort of data. Domes day Book, that mammoth stocktaking exercise of William the Conqueror, is an example of this first sense in which the word is used. Statistics also refers to the drawing of inferences about large groups on the basis of observations made on smaller ones. The calculation of swings in the nation’s party political preferences before an election is based upon information gathered in carefully selected interviews and illustrates the second sense in which the word statistics is used. Statistics then, is to do with ways of organizing, summarizing and describing quantifiable data, and methods of drawing inferences and generalizing upon them.

A second reason why statistical literacy is important to teachers is that if they are going to undertake research on their own account, then a grasp of statistical methods is al. With such understanding our hypothetical Infants' teacher could use the reading readiness test that she selects, describe her results and make inferences from them. Similarly, our physical education teacher could replicate the experiment he has read about and decide for himself whether the special coaching involved in Method A results in a higher level of skill performance on the part of its recipients.

Whether teachers are actively involved in research or not, membership of the teaching profession carries with it an obligation to keep abreast of developments in their specific areas of interest and expertise. Studying research reports, evaluating new techniques and approaches in teaching generally requires acquaintance with statistical principles and methods.

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UNIT - 1

MEASUREMENTS AND EVALUATION IN PHYSICAL EDUCATION

There are numerous reasons why physical educators should employ testing in their programs. They may categorized in many different ways. The reason for testing have been categorized into 9 reasonable discrete categories. 1. Classification of Students 2. Diagnosis of Students needs and Weaknesses 3. Evaluation of instruction 4. Evaluation of Programmes 5. Marking 6. Motivation 7. Instruction 8. Predication 9. Research

Each child is a unique problem with his own peculiar background and capabilities, differing horn others in innumerable ways. The fundamental function of physical and health educator is to understand each person's needs in order to give adequate guidance and to adapt programmes to meet needs.

TEST:

> "Tests are instruments designed to ascertain the quantity of particular attributes possessed by students, teachers an the educational environment" - Sheeham

> "A test is a specific tool of measurement and implies a response from the person being measured" - Barrow and Mc Gee

> "A test is a form of questioning and/or measuring used to assess retention of knowledge and capability or to measure ability in some physical endeavor" - Johnson and Nelson

MEASUREMENTS:

> "Measurement is a evaluative procedure for collection of data. In other words, measurement is

a part of evaluation; it is a qualitative procedure using tools or instruments" - Sheehan

"Measurement is a technique of evaluation which makes use of procedures which are generally precise and objective, which will generally result in quantitative data, and which 'characteristically can express its results in numerical form. It may be applied to qualitative procedures, however,, when its techniques are objectified".

- Barrow and Mc Gee

"Measurement is an aid to evaluation process in that various tools and techniques are used in collection of data".

- Johnson and Nelson.

EVALUATION:

"Evaluation may be defined as the process of apprising the effectiveness of the attainment of educational goals. In other words, "Evaluation is the act of comparing the quantity of attributes possessed by students, teachers or educational environments with other students, teachers or educational environment" - Sheehan

"Evaluation is the art of judgment scientifically applied according to some predetermined standards". "Evaluation is a process of education which makes use of measurement techniques which, when applied to either the product with process, result in both qualitative and quantitative data expressed in both subjective and objective manner and used for comparison with preconceived criteria." -Barrow and Mc Gee

"Evaluation transcends mere measurement in that basically subjective judgments are based upon the data collected in the measurement process. Such judge merits may aid us in determining the extent to which we are accomplishing our objectives”.

- Johnson and Nelson

NEED FOR TESTS, MEASUREMENTS AND EVALUATION:

1. Help the teacher assess students’ performances.
2. Help students evaluate their with knowledge and/or skills in various physical activities.
3. Enable the teacher to objectively measure improvement by testing before and after the unit of instruction.
4. Assist the teacher in pinpointing the limitations as well as the strong point in a programme.
5. Aid the teacher and evaluating different methods of instruction.
6. Provide a means determining the better performance within a group and gain insight as the potential ability of others.
7. Motivate students when there appears to be a leveling off of interest in the instruction. Test also help the teacher to end the unit of instruction with a high level of interest.
8. Provide a basis for the classification of players and teams for practice and competition.
9. Diagnose needs in relation to body mechanics, fitness and motor skills.
10. Help to establish age, sex and grade level norms for use within a school or district as well as comparison with national norms.

11. Determine status and changes in status brought about by physical education for public relation purposes.
12. Collect data for Research.
13. Help to determine the relative values of sports activities in terms of meeting desired objectives.
14. Determine the needs of individuals within the programme and to extent which educational objectives have been accomplished. . ,
15. Enable the teacher to evaluate his own teaching effectiveness.

IMPORTANCE OF TEST AND MEASUREMENTS IN PHYSICAL EDUCATION

History reveals that as man became more civilized, he also became more scientific and as he became more scientific, he sought more exact way to measure A brief survey of the history of tests and measurements will not only aid us in appreciating the efforts of our professional predecessors, but also afford us a better understanding of this feature of our profession. The history can be divided roughly into periods running from about 1860 to the present.

Physical Capacity & Development

- Anthropometric measurements 1860—1890
- Strength tests 1880—1910
- Cardio vascular tests 1900—1925

Ability and Efficiency to Perform

- Athletic ability test 1900—1930 efficiency to perform
- Social measurements and intangibles 1920

- Sports skill tests 1920
- Process evaluation 1930
- Knowledge tests 1940
- Fitness tests 1940

The first three periods reflected an emphasis on physical capacity and development, whereas the remaining ones were more indicative of the changing emphasis toward ability and efficiency to perform.

Anthropometric Measurements:

Anthropology deals with the study of man; that is the study of body and mind and their inter relationships. Anthropometry is the science of measuring the human body and if its parts. It is. used. as an aid to the study of human evolution and variation. Baran Quetelet, a French Mathematician used the term Anthropometric (Father Anthropometric)

In Egyptian sculpture, the length of the middle finger was considered a common measure of all body proportions. For instance, five finger lengths to the knee, ten to the public arch, and eight the length of the arm reach. The Greeks were experts in body proportions. Hippocrates, the first known test and measurement expert introduced a method of anthropometry by dividing the subject into two body types aesthetic dominated by the vertical dimension and Anthropometric dominated by Horizontal dimension Kretchmer, classified the soma to types as ectomorphy, Measomorphy and endomorphy. Skills introduced a fourth soma to type called Mesomorph. which is characterized by a V-type build with large shoulders and chest and small hips and legs. Edward Hitchcock, the leading figure in Anthropometric testing used measurement factors such as height, weight, age, reach, girth, vital Capacity and some strength items. ud1ey Allen Sargent, began a measurement programme at Harvard University and compiled more than forty different measurements of Anthropometric types.

Strength Measurements:

Around 1880 there was a shift in emphasis of measurements away from size an symmetry to strength. Sergeant was the pioneer in strength testing and recognized that capacity city for performance was a more important quality than size and symmetry. In 1894 J.K. Kellogg invented the Dynamometer and used to test the isometric strength of large number of muscles. By using the Dynamometer and Spiro meter Brigham and Sergeant devised a. strength test compressed of strength measures of the legs, back, handgrip, and arms along with a measure of vital capacity. E.G. Martin developed a resistance strength test to measure the strength of muscle groups with a flat-faced type spring balance. Frederick Rand Rogers refined the strength test and proved the validity as a measure of general athletic ability. Rogers also created the PHYSICL FITNESS INDEX (PFI) with norms. H. Harrrison clarke by using Tensio meter developed strength tests to measure the muscle groups responsible for 38 joint movements.

Cardiovascular Measurements:

The first test of cardiac function was published by Cromption in 1905. This was followed by Mccurdy’s test in 1910 and Schneider's test for evaluating cardiovascular condition of British pilots. In 1925 camp bell published a test involving breath holding and recovery after exercise called Campbell pulse ratio test. Tuttle influenced by campbell’s work developed Tuttle pulse ratio test. In 1943 the Harvard Step test was developed by Brouha and his associated to determine general capacity of the body to adapt and recover from work. Dr. Kenneth Cooper did extensive research on circulo respiratory endurance and provide a simple 12 minute run—walk test.

Athletic Ability Test:

The American Association developed the Athletic Badge test in 1913 for both boys and girls. The items included running, high jump, pull—ups, short dashes, standing high jump, rope climb, push—ups and shotput. Basketball throw, short dabses, and vaulting comprised events for girls. George Meylon of Columbia University employed the first college achievement test that measured knowledge of Physical fitness, body mechanics, and swimming. In the late 1920’s and early 1930’s several well constructed tests were developed in general motor ability, motor capacity and motor educability. First prize using the latest scientific techniques and developed a battery of motor ability tests. Later Mc cloy revised this battery and adapted for Skill Test of General Motor Capacity.

Social Measurements

Since the character, personality and other social values had been considered outcomes of the new sports and games programme and were listed as objectives, it is imperative that the status arid progress in them be measured in some way. Van Bush kurk, first used rating scale to appraise social and moral qualities. Later Mc cloy developed a character inventory, and Blanchard developed a Behaviour Rating scale.

Sports Skill Testing:

Brace in 1924, was the first to use the T-scale method for constructing norms and presented one of the earliest, skill test on basketball for girls. Skill tests for achievement in specific sports were devised in great numbers during the 30’s.

Process Evaluation

As programme of health and physical education grew in number and quality there was a corresponding need t evaluate them The first quantitative device to receive wider recognition was devised by Laporte and his Committee.

Knowledge Testing:

The first knowledge test was. published by J.G. Bliss in 1929. Snell and, her co-works at the University of Minnesota published Scientifically constructed knowledge test.

Fitness Testing

Physical fitness has always been one of the foremost goals of physical education. In 1958 the AAHPER Youth fitness test was developed for boys and girls with norms. Recent attempts at physical fitness test is to include at least one item of strength, flexibility, muscular endurance, cardiovascular endurance and body composition or height-weight rating.

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UNIT - II

CRITERIA FOR SELECTION OF TESTS

In order to make satisfactory selection of the test, the teacher should evaluate available tests in terms of their scientific attributes. There are three general evaluative criteria.

SCIENTIFIC AUTHENTICITY

Validity

Objectivity

Norms

Duplicate form fitness

Standardized

ADMINISTRATIVE FEASIBILITY : Economy

EDUCATIONAL APPLICATIONS

Tests are Major recreational sports

Sports skills

Physical fitness

Screening tests

Social fitness

Direction

Social fitness

Hence the teacher should answer the following questions in order to select the best and most useful tests.

1. Does the test measure the quality for which it is to be used? (Validity)
2. Can the test be administered accurately? (Reliability & Objectivity)
3. Can the test scores be interpreted in terms of relative performance? (Norms and standards)

4. Is the test economical? (Economy).

VALIDITY:

A test is valid, it measures what it purports to measure, A test is designed to measure the ability of an individual. To serve a tennis ball, it is important that the test accomplishes this, if a test is presented as a measure of the Volley, that to be valid, it must measure volleying ability ideally, it must measure it to such a degree that other influencing factors such as height and weight are incidental to the final results.

Methods of Establishing Validity

Subjective rating

Previously validated tests

Composite scores

Tournament standings

Face validity (Empirical judgment)

Subjective Rating

The subjective rating is given by the teacher to use in grading. When used for establishing validity, they are given by at least three judges and often five or seven. The tennis serve will provide an example. The techniques of the serve, its execution, force, form accuracy and the like will be noted for each student by three judges. Then the same students are given a service placement test. Then the composite or average of three judges' ratings is compared with the objective service placement test score for each student. Two assessments are available for each student, they are correlated and the resultant coefficient is used as the basis for interpreting the validity of the service placement test. If the scores on the test rank the students were approximately the same order that the judges evaluated them the coefficient will be relatively high and the service test will be said to be valid on the basis of the criteria of Judges' ratings.

Previously Validated Tests

Some skill tests are already available. The test may be simplified, shortened, or revised in some way. The old form of the test is administered to a group and then 'the new form is given to the same group. If the standings of the people in the group remain similar, then the new test may be said to be measuring appreciably what the old test was measuring.

Composite Scores

A composite score is achieved by administering complete tests, each supposedly related to the measurement area in question. The scores are put into same type of comparable form such as T—scores, and are added to get one total or composite score. Other tests or perhaps even so even some which were in the composite listing are then correlated with the composite score, each in turn, and in various combinations.

Tournament Standings

Some tests are designed for beginners, others for advanced players, some for young players and others for more developed players. A round robin or ladder tournament is conducted and the players are put in proper order of playing excellence. Then assigned some numerical value and it can be compared with various tests which measure the fundamental skills in the game.

Face Validity (Empirical Judgment)

The 50 yards dash is considered to be a measure of running ability if speed of running also means excellence of running. The tester considers the dash and arbitrarily says it is a measure of running. He concludes this on the basis of logic, commonsense, judgment and so called face validity, that is to say that one can book it a test and see inherently what it is measuring.

RELIABILITY

A reliable test will yield the same scores for one pupil, or number of pupils, regardless, of the number of times of teacher repeats it. In other words a test is said to be reliable if it is dependable, if similar results will occur when the test is repeated by the same group under like conditions. The statically technique used for ascertaining reliability is a correlation coefficient.

Four Methods of Establishing Reliability

Test - retest

Parallel forms

Split half

Rational equivalence

Test-retest method

Administer the test completely one time and after a given period of time administer the test again to the same pupil. Usually the second administration is on the next day or two and under very similar conditions and certainly before forgetting, practicing and learning factors become too influential in the results.

The statistical technique used for this is reliability coefficient.

Parallel forms

This type of reliability is used generally with written tests. The object is to construct two tests of similar difficulty and content. The students take both tests. If they perform similarly on them and if the two forms .f the test really are parallel. Then the test may be considered reliable.

Split half : (odd and even)

The test is split in half, and the two halves are compared statistically to arrive at a reliability coefficient ie administer the test and then correlate the total of even numbered trials with the total of odd numbered trials.. In a 10 trial test, the 1, 3, 5, 7 and 9th trials totalled would provide one score and the 2, 4, 6, 8 and the 10th trials totalled would provide the second scope for the correlation problem.

This method requires the subsequent use of the Spearman— Brown prophecy formula.

$$r_x = \frac{nr}{1+(n-1)r}$$

r = Stepped—up coefficient

n = Proportion ± increase in the test

r = Split—halves coefficient

Split halves coefficient 0.55

Rational equivalence or Kuder—Richardson method

By this method the reliability is established by determining the performance of pupils from item to item, within the test.

OBJECTIVITY:

Objectivity is the degree of uniformity with which various persons score the same test. If a test is scored by two instructors, concurrently and independently the results should be similar. For example, in order to find out the objectivity in badminton test, we need atleast two examiners, one gathering the first set of scores and the other collecting the second set of data from same subjects. If the two sets ± data agreed it would be concluded that the test was objective.

Objectivity in measurement is secured by the following means 1. Accurably shared and fully detailed instruction in measuring procedures. 2. Simplicity of measuring procedures. 3. The use, wherever possible of mechanical tools of measurement. 4. preduction of results to mathematical scores. 5. Maintenance of professional or scientific attitudes by testers. 6. Selecting of intelligent measures can be carefully trained. 7. Un-remitting supervision of measuring procedures: by administrative officers. The statistical technique employed for ascertaining objectivity is correlation. The correlation coefficient produced from the two sets of scores should be high. The objectivity is enhanced by clear test directions, precise scoring methods and adherence to them.

NORMS:

A norm is a standared to which an obtained score may be compared. In other words, a norm is a scale which permits Conversion from a raw score to a score capable of comparison and interpretation. For example, a raw score of 16 is meaningless, but that 16 fails at the 78 percent or its equivalent to a T-score of 58, it becomes capable of comparison and interpretations.

Construction of Norms

The first Steps would be to test large group of youngsters for when' we want the norms to apply. Let us say that the norms are to be used for high school boys, not only would have to test a large number, but also should have obtain the scores from the random selection of such youngsters. Samples would have to take from urban as well as rural schools. If the norms were to apply nationally, the random selection should be extended throughout the country.

After the data have been gathered the norms may be computed by finding the average score for a particular body size. For example, if norms were to be based upon age, height and weight, the average score of all pupils of a given age in a a particular body classification would constitute that norm.

Norm charts themselves must be evaluated. The general evaluated factors are:

1. Sampling procedures for the construction of the norms should be based upon wide distribution of the population.
2. The testing sample should be representative of the population for which the test is intended. For example, data collected for skill test norms collected from athletes would be representative of athletes, but not of the population as a whole.
3. Norms should be used for the specific groups for which they are prepared.
4. Norms for standard tests should be based upon a relatively large number of cases.

ECONOMY:

An economic tests is one that requires the least expenditure of money and time in administering, scoring and interpreting. Generally the economic test

1. Will be easy to administer i.e. the directions are very easily understood by the pupils and the task are unambiguous.
2. Be easy to score.
3. Be easy to interpret.
4. Not consume more than 10 to 15 percent of the total allocation of class teaching time.

Duplicate form

Boys and girls are interested in self-testing activities and are inclined to repeat and practice certain events which interest them and challenge their abilities and skills. Hence it would seem extremely desirable to provide atleast two forms of a test measuring a particular element of physical ability. These forms must be equivalent in the strict sense of the wood as used in educational measurements.

For example, suppose we wish to measure skill in arm and shoulder girdle co-ordination.. To do this 10 to 15 single throwing tests have been used and arranged in order to difficulty form of 1 to 15. Tests 1 , 7 8,13 are selected for first form and 2, 8, 14 for the second

For example, in simple test like that, in chinning the bar a number of things must be given consideration; 1) the size of the bar 2) distance of the bar from the ground 3) method of holding the hands, that is front grasp, inverted grasp or alternate grasp, 4) whether or not the arms are required to be extended at full length on the down stroke, whether rest between chin is allowed etc.

Standardized directions

The directions which are given the examiner and the student should be carefully forked out as well as the exact method of administering particular phases. The directions should be printed and the illustrations should be accompanied.

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UNIT – III

STATISTICS IN PHYSICAL EDUCATION

DEFINITION

A. Definition of Statistics

1) Statistics is the science which deals with the collection, classification, and tabulation of numerical facts, as a basis for explanation, description and comparison of phenomena. by Lovitt and Holtzelava

2) Statistics is the Science which deals with the collection, organization, analysis and interpretation of masses of numerical facts.

by Barrow and McGee

3) Statistics is a means by which a set of data may be described and interpreted in a meaningful manner and also a method by which data may be analysed and inferences and conclusions drawn.

by Barry B. Johnson and Jack K. Nelson.

STATISTICS IN MODERN RESEARCH

Research yields quantifiable data - the outcome of measurement. The data, thus derived, have to be organized, analyzed and interpreted in some meaningful way. So “Statistics”, as Best says, “is a body of mathematical techniques or processes for gathering organizing and interpreting numerical data”. For Croxton and Cowden. Statistics is “The collection; preservation, analysis and interpretation of numerical data”. in research, through ihe application of statistical procedures specific situations are generalized. Clarke and Clarke consider statistics as “one of the devices by which men try to understand the generality of life. Out of the welter of single events, human beings seek endlessly for general trends; and of the vast and confusing variety of Individual characters, they constantly search for underlying group characters, for some picture of the group to which the individual belongs”. Man lives by comparison, man acts by comparison, man fights by comparison, man laughs by comparison and man improves by comparison. Life is a series of comparisons and contrasts Every man compares himself with others and attempts to know how universal or personal his characteristics and traits are; how he is different from the group may be family, team, community, and how is the group different from him. Much of the comparison in research is done with the help of statistical techniques. Statistical methods are applied in order to gain a summarized description or analysis of the findings. In order to realize this objective, it is essential to know what kind of description is needed, what statistic or statistics will provide the most valid description, and whether or not the assumptions underlying each selected statistic are satisfied by the data being treated.

Without the application of statistics it would not be possible for the researcher to analyze and interpret results, draw conclusions and inferences. Apart from this most of the scientific literature can neither be understood nor interpreted without the knowledge of statistics. Whether the researcher chooses to Use the mean—- the simplest statistics or the covariance the most complex measure in statistics, to draw collusions is not much important. The important thing is that without statistics, there is no research. The entire theory of economics runs on statistics.

Besides, working out norms and standards - say in physical fitness for various populations is impossible without the use of statistics. Further it is extremely difficult to make the instruments, tools and data-gathering procedures valid and reliable without using relevant statistics. Through statistics, the researcher determines scientific worth of tests and tools. Annual reports of an institution or an enterprise, reports on sports competitions and performance of various teams at national or international competitions, reports on facilities. The status of institutions of physical education and sports etc. are not presented without using certain statistical concepts such as means, medians, frequency distributions, graphs etc. In the construction of certain instruments especially Offal used in psychology the knowledge of statistics is a must for the researcher. The use of statistics in research indicates how intelligent and erudite the investigator is- in writing of the research report the use of statistics is of paramount importance. Almost all competitive games and sports provide numerical data in the form of results: (i) in activities like athletics, swimming, cycling, weight lifting etc. performances are measured by stop-watch (timer), tape, weight (in kg) etc. Data of these activities are thus available in the form of time clicked, height and distance achieved in meters, centimeters and weight lifted in kilograms. (ii In games like Football, Hockey, Basketball, Cricket, Tennis etc the data are available in the form of goals, points, runs scored games and sets won or lost; (iii) in activities like gymnastics diving, best physique etc the judgment is subjective yet a definite method of awarding points has been evolved and results are announced on the basis of points scored; (iv) slow motion movies, check lists etc do provide some sort of data. The use of statistics in physical education is felt necessary oh two accounts: (i) scientific method demands the use of statistics simply because man and society are no longer satisfied with haphazard ‘guessing’ in vital matters where more exact and accurate answers can be found through statistical analysis of a phenomenon; (ii) games and sports in all their aspects, are becoming more and more scientific.

Precisely the important functions of statistics in Physical Education and Sports may be summarized as follows

1. It represents general statement in a precise and definite form because facts conveyed in exact quantitative terms are always more convincing than vague utterances.
2. It helps in condensing mass of data into a few significant figures which convey meaningful over all information about the state of things.
3. It facilitates comparison. Unless performances are compared with Others of the same kind, they are devoid of any meaning.
4. It helps the researchers in formulating and testing hypotheses.
5. It helps in prediction of future trends so that suitable policies can be formulated and the existing ones modified.

There are five kinds of statistical processes generally recognized as important in the field of research.

DESCRIPTIVE STATISTICS:

By this method the characteristics of a single group are described in various ways. The scores are arranged so that all like-sized scores are put together with the progressive increase in the size of the scores. The calculation is made from a single value which is representative of the whole series. By using the measures of central tendency and also the measures of dispersion, it is possible to describe the performance at a particular point of time.

COMPARATIVE STATISTICS :

By using comparative statistical concepts it may be possible to compare and contrast the performance of two or more groups. Comparative statistics may consist of comparison of two or more groups. Comparative statistics may consist of (a) comparison of paired-individual scores and (b) comparison of grouped scores-description of the whole population etc.

RELATIONSHIP STATISTICS :

In this, the researcher attempts to determine correlations between numerous human traits as possessed by the same population. Relation statistics enable the researcher to find out how one trait is related to other traits in a population.

INFERENTIAL STATISTICS :

Observed data from a sample are used as a basis for generalizing to the Population from which the sample was drawn. Since the entire Population cannot be examined, the researcher has to test the sample from a population and see how conclusions drawn from the sample testing approximate population parameters.

PREDICTIVE STATISTICS:

By using predictive statistics the researcher makes attempts to see how Unknown facts about the individual are predicted or inferred from known measure- able qualities.

Need for understanding statistics:

The need for understanding statistics is vital for the scientifically trained educator.

To understand, interpret, and evaluate scientific literatures of Physical Education.

The students who take a required course in statistics must be able top read, understand, interpret and evaluate the professional literature.

Learning in any field comes largely through reading. In any specialized fields, reading is largely a matter of enlarging vocabulary. One cannot read much of the literature in specialized field, without encountering statistical symbols, concepts and ideas. The use of statistical terms are common in research journals like the Research. Quarterly for Exercise and Sports, N.I.S. Scientific Journal, International Journal of Sports Psychology, Biannual for movement etc. In such research journals, research reports and articles are published utilizing more than one statistics. Understanding these articles and evaluating these research reports are impossible without a statistical background.

To Construct Tests:

The construction of tests are common in physical education research. For example, tests of muscular strength, muscular endurance, circulatory – respiratory endurance, physique type, nutritional status, posture, general motor ability and capacity, skills in many games, physical education and Sports knowledge and attitudes. A great variety of procedures have been employed in the process of test construction. Tests are vital to laboratory research since a matter; thing or phenomenon cannot be scientifically studied unless it can be measured. The investigator administers tests to a sample of subjects in order to measure various elements that are essential to research design. The analysis and interpretation of the test results can be accomplished only though appropriate statistical applications.

To Determine the Scientific worth of tests:

Although the construction of tests is a phase of research, the evaluation of tests should be a concern of all educators who use them. Statistical procedures aere utilized widely in this process: to validate, to establish accuracy, and to prepare norms. The ability, therefore to determine the scientific worth of tests is dependent upon knowledge of statistics.

To Prepare Reports based on test results:

The preparation of annual or more frequent reports of progress made in school programmes is a common responsibility of educators. An effective aspect of such reports is the inclusion of test results that show progress made by students. Tlhe utilization of graphs and some of the common easily understood statistics – such as frequency, distributions, percentages, medians, and quartiles – is of value for this purpose.

To conduct various types of Research

The knowledge of various Research metnods like Historical, philosophical, Case study. Survey, Experimental, Comparative Relationship and Productive Investigations are needed for the conduct of Scientific Research.

To find out satisfactory and unsatisfactory evidences in Research Report

A knowledge of statistics helps to analise critically about the report and evaluate them to look behind the figure to the manner in which they were derived.

Quantitative data:

The term quantitative data refers to a collection of numerical values that are usually expressed in education and psychology as scores on a test.

Quantitative data consists of two types: attributes and variables.

Attributes

An attribute has a non-gradient classification, i.e. there is no numerical basis of grouping. Attributes may be in tow or more classes.

Example:

Attributes of two class

Teachers as men and women

Students as boys and girls

Attributes more than two class

Various nationalities

Co lour of eyes and hair

Variable

A variable has a gradient classification i.e. there is a numerical basis of grouping. Variables are of two types: Continuous variables and discontinuous variables. **A continuous variable** (continuous series) is one which is capable of any degree of subdivision. Example: body weight, muscular strength, time in a run or swim, distance in a jump or throw, intelligence (I.Q.) personality traits etc.

A discontinuous variable (discrete series) cannot be, or is not generally, subdivided by less than whole numbers or units. Example: A score in basketball game: A game score for a team cannot be 551/2 points. Number of students in a class room, children in a family, school or college buildings.

POPULATION

A large collection of information about objects 0r events which vary in respect of some characteristics known as population. For eg: All the stop watches use in Olympic games are a population.

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UNIT - IV

ORGANIZATION OF DATA

THE DATA

Measurement results in some sort of data. Technically speaking, data is nothing but ‘expression of facts”. Facts may be expressed in qualitative as well as quantitative form. In statistics as well as in research, we normally have two types of data.

1. DICHOTOMOUS OR DISCRETE DATA:

Dichotomous Data are in the form of scores recorded as pass/fail, success/failure true/false, yes/no,, married/singe, White / colored etc. Such data cannot be subjected to any further division. However, it is Possible in many instances to change dichotomous data to continuous ones. Discrete data may apply to present form or status rather than show potential Possibilities of refinement It is a matter of degree of refinement from toe category to the continuous it is difficult, however, to distinguish the point when categorical data become continuous A discrete variable is a variable which can take Off numerals values that are specific distinct Points on a scale such as members of a family, number of players in a team. In discrete data the gap is real and also unbridgeable. There are 11 players in a hockey team: it cannot be seven and a half. Similarly sex of individuals is either male or female there is nothing in between. In discrete data, fractional divisibility is not accepted.

2. CONTINUOUS DATA:

A Continuous variable is one that, at least, theoretically can take any value between two points on a scale. Such variable can be measured with varying degrees. of exactness depending on the measuring instrument. For example weight, height, distance. time, percentage body-fat hemoglobin level etc etc. can be measured to an exact degree: data gathered on these variables is continuous. The limit of a score in continuous variable may extend below and above to any fraction.

Generally in social sciences, continuous data are used because of certain problems in measuring on continuous scales, most variables are given discrete values. In order to interpret such values, account is taken of the mathematical true limits of a number. In general, true limits of a number are said to extend one half a unit below and one half a unit above that number and any score within those limits is rounded off to that number. Hence 81 pounds of weight may be written 80.5 i.e. the limits of 81 extends between 80.5 to 81.5.

Without organizing and summarizing the obtained data, it would not possible for the researcher to compute required values and analyze and interpret the results logically. Most of the data are organized in the following ways:

A. FREQUENCY DISTRIBUTION

Where the number of scores is small, the data can be arrayed in order of magnitude so that one could have a quick survey of the same. Given the scores of five archers on 70 meters shooting in 4 rounds, we may array these scores in order of magnitude.

Disarrayed Data		Data Arrayed (in order of magnitude)	
1. Surjit	91	1. Surjit	91
2. Bhupinder	79	2. Bhupinder	89
3. Gurinder	89	3. Gurinder	79
4. Jagdish	73	4. Jagdish	73
5. Abhinav	62	5. Abhinav	62

Range = Highest Score – Lowest Score

= 91.5 – 61.5 = 30.0

By doing this, the researcher is in a Position to spot out the range of scores and identify the highest, the lowest and the middle scores which indicate the best as well as the worst performance for simple comparisons.

We may also call it Rank Order. Rank order indicates the placement of record in magnitude order. Each score in a group is given a rank order which corresponds to the place of the score n the total series of scores. In those instances of similar scores (if, 4 for example) the three successive ranks are averaged with each score assigned the same ranking order. The rank order technique is used where the description is made with respect to a goal: also as one of the most effective ways of individual differentiation within group. However; when the number of cases is enormous, this method may not be economical way of comparison.

b. Normally, in physical education and sports, we have a large number of scores emanating for the measurement of various performances and traits of athletes. Most often a single score is repeated many times. For this frequency table is constructed and further values are computed. ‘The Frequency Distribution consists of intervals each of the same size and includes the entire range of scores. The reference point for the description of a score may be any selected interval, or may be the distribution as a whole. The number and size of each interval is determined by how well the assumption underlying grouping is met. It is assumed that t’ie frequencies in each interval are distributed uniformly about the mid-point of each interval and the arithmetic average of the frequencies is equal to the midpoint. Construction of a frequency distribution in case of large data requires certain steps to be followed. With hypothetical scores of

37 boys on the Standing Vertical Jump test, let us develop a frequency distribution.)

CONSTRUCTION OF FREQUENCY TABLE 1

Standing Vertical High Jump Scores of 50 College Students (Measured in Cms)

52	78	63	58	64	73	57	76	67	77
60	64	54	64	49	67	62	53	70	86
61	46	74	69	80	71	56	71	72	66
59	62	64	52	65	52	68	67	90	51
78	58	55	69	83	65	50	70	77	66

The above said scores can be summarized and grouped as shown in the frequency table 1 below.

3.9 STEPS IN THE CONSTRUCTION OF TABLE 1

1. Determine the range of scores. The highest score minus the lowest score plus 1, (One is added to take into account the true limits of the numbers)

   Range = Highest score (90) – Lowest score (46) +1

   = (90 – 46) + 1

   = 45

2. Decide on how many categories or step intervals are required. Normally the number of intervals used is not less than 10 and not more than 20. In this case we have selected 15 as a convenient number of step intervals.

3. Divide the range by the number of step intervals giving the actual sixe of each step interval.

   Step interval size = $\frac{45}{15} = 3$

If the step interval size does not work out to be a whole number it is advisable to round it off. easing the arithmetical load. For example, if we had chosen 12 step intervals, the step interval size would have worked out to be $\frac{45}{12}$ = 3.7 and this would round off to 4.

Table 2 Frequency Distribution of Standing Vertical High Jump Scores of 50 College Students (Measured in cms)

Step intervals (true Limits)	Step Intervals (Limit rounded off)	Tallies	Frequency (f)
87.5 -90.5	88-91	I	1
84.5-87.5	85-88	I	1
81.5-84.5	82-85	II	2
78.5-81.5	79-82	II	2
75.5 -81.5	76-79	IIIII	5
72.5-75.5	73-76	II	2
69.5-72.5	70-73	IIIII	5
66.5-69.5	67-70	IIIII	6
63.5-66.5	64-67	IIIIIIII	8
60.5-63.5	61-64	IIII	4
57.5-60.5	58-61	IIII	4
54.5-57.5	55-58	III	3
51.5-54.5	52-55	IIII	4
48.5-51.5	49-52	II	2
45.5-48.5	46-49	I	1
			N = 52

4. Construct the step interval column starting with the lower limit of the lowest score (45.5). Add the step interval size (3) to this lower limit. The range of the lowest step interval becomes 45.5—48. The lower limit of the next interval becomes 48.5 to which 3 is added to give interval range 48.5—5 1.5. This procedure is repeated, moving up the table until the step interval column includes an interval into which the highest score (90) can be placed, namely, 87.5—90.5.

As can be seen from the table, we have included two step interval columns. One uses the exact limits of the step intervals and the other rounded off limits. It is recommended that the inexperienced student statistician uses true limits of step intervals to avoid confusion.

5. Insert, in the column provided, a tally for each individual score in the raw data table. For example, for the score 52, a tally or mark is inserted to show it falls into the step interval 5 1.5-54.5.

6. Total up the tallies within each step interval and place in the frequency column in line with the appropriate interval.

7. Total the Frequency column (N). This serves as a useful check that all the data have been included in the table.

Assumptions from frequency table

Two assumptions are made when statistics are calculated form frequency table.

1. The scores are equally distributed within the interval. This assumption is made when computing the median, percentiles, and quartile deviation.

2. The average of the scores within each interval is equal to the midpoint of the interval. This assumption is

necessary when calculating the mean and standard deviation.

HISTOGRAM

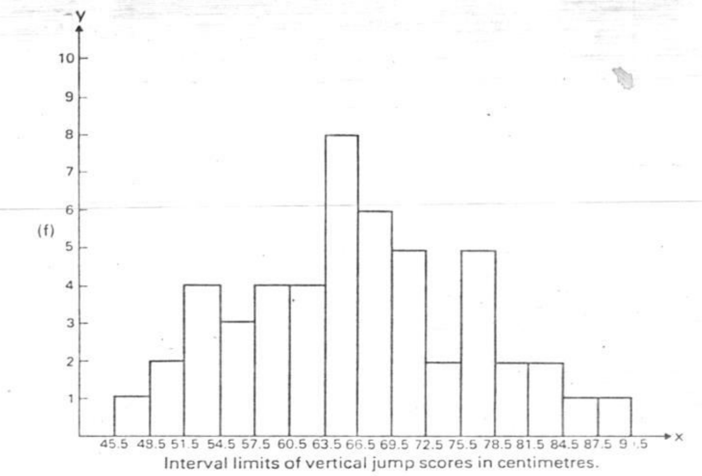
The histogram is similar to the bar graph, the only difference in presentation being that the bars are joined together.

Joining the bars together makes the histogram a suitable method for presenting data gathered from continuous variables measured on interval or ratio scales.

The vertical jump data set out in Table 4 can be represented by the histogram in Figure 3.

Each bar represents a step interval as defined in Table 4, the exact limits of the intervals producing a continuous scale along the base line of the graph. The width of each bar is the size of each step interval (3) and the height of each bar is proportional to the frequencies within that interval. The histogram gives an image at picture of how the scores are distributed.

Figure 1 Histogram showing the frequency distribution of 50 vertical jump scores.



FREQUENCY POLYGON

Another commonly used graphical technique is the frequency polygon. This form of presentation dispenses with the use of bars and employs single points joined together a series of straight lines. The reader will recognize the similarity of this approach to basic graphing techniques in mathematics.

The single point in the frequency polygon is placed at the midpoint of the step interval at a height proportional to the frequencies within an interval. Prior to constructing a frequency polygon, the midpoints of each interval are calculated. This involves adding a further column to the frequency table. Using the data in our previous example, Table 2 shows the vertical jump frequency scores with the interval midpoints included (using true limits only). The midpoints are calculated by adding half the step interval size (1.5) to the lower limit of each interval. The interval midpoints are plotted against frequencies as in Figure 2. Notice that the end points of the polygon have been positioned on the axis at the midpoints of the intervals on either side of the two extreme intervals. The area under the frequency polygon is equal to the area under a histogram constructed from the same data.

Table 3 Frequency Distribution of vertical jump scores (interval midpoints)

Step intervals	Tallies	Frequency (f)	Interval Midpoints
87.5 -90.5	I	1	89
84.5-87.5	I	1	86
81.5-84.5	II	2	83
78.5-81.5	II	2	80
75.5 -81.5	IIIII	5	77
72.5-75.5	II	2	74
69.5-72.5	IIIII	5	71

66.5-69.5	IIIII	6	68
63.5-66.5	IIIIIIII	8	65
60.5-63.5	IIII	4	62
57.5-60.5	IIII	4	59
54.5-57.5	III	3	56
51.5-54.5	IIII	4	53
48.5-51.5	II	2	50
45.5-48.5	I	1	47

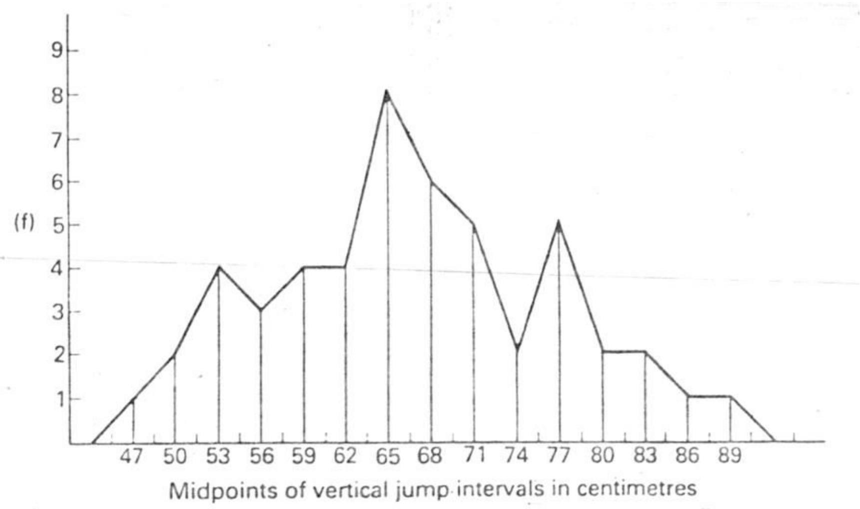


FIGURE - 2

SMOOTHED FREQUENCY POLYGON

Occasionally the researcher wishes to know what sort of frequency distribution he would have obtained had the data been collected from a larger sample or a whole population. He can get some indication of this by smoothing the original polygon. In -theory, the larger the number of results that one processes, the nearer the distribution approximates a curve. Care must be taken however, as smoothing can only give an impression of what the distribution might have been, nor what is actually is.

Smoothing a frequency polygon requires the calculation of average frequencies for each interval. The average frequency for any interval is calculated by adding the frequency of the interval to the frequencies of the two adjacent intervals, and dividing the total by 3.

For example, using the data in Table 5, the average frequency for the interval 48.5—5 1.5 is the frequency of that interval (2), added to the frequenCY of the interval 45.5—48.5 (1) and the frequency of t)e interval 5 1.5—54.5, (4), divided by 3.

$$\frac{2+1+4}{3} = 2.3$$

This is repeated for each of the step intervals. Where an interval has only one adjacent interval, then the missing interval is given a frequency of 0.

CUMULATIVE FREQUENCY GRAPH OR OGIVE

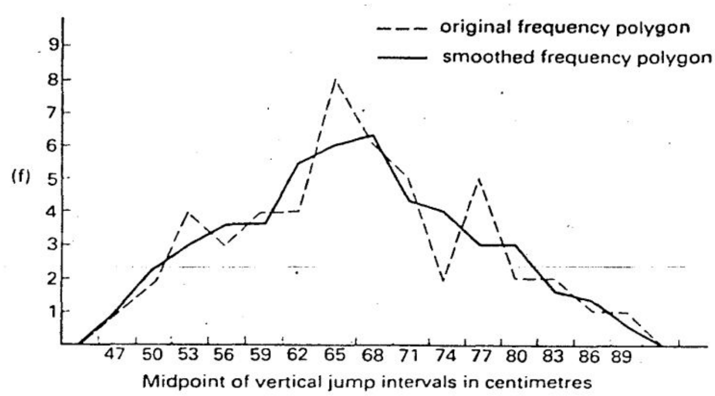
A fourth method of presenting data in a graphical form is the cumulative frequency graph or ogive. This method is particularly useful when the researcher wishes to know how many scores lie below either an individual or a step interval score. The utility of this technique will become clear later in the text when we discuss measures of relative position.

We begin to construct the ogive by adding the scores in our frequency table serially. Scores that are added serially are accumulated progressively starting with the bottom interval of the distribution. The cumulative frequency for any given interval is the frequency of that interval added to the total frequencies below that interval. For example, using our vertical jump data once again, the cumulative frequency for interval 54.5 - 57.5 is

$$3 + 4 + 2 + 1 = 10$$

The original frequency distribution with a cumulative frequency column included. The cumulative frequency graph is plotted with the scores or step interval along the horizontal axis and the cumulative frequencies along the vertical axis (see Figure 3 below).

Figure 3 Smoothed frequency polygon for vertical jump scores



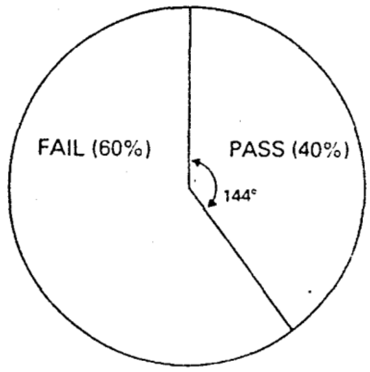
THE CIRCLE OR PIE GRAPH

The last of the five methods of presenting data is best to simple comparisons of data to do with discrete variables. It is based on proportioning a circle to equivalent percentage proportions of the frequency distribution.

For example, from our data on pass/fail students, we determined the percentage of passes and fails as 4O and 60% respectively. A circle is drawn, the area c which represents l00° of the observations. Two lines are then drawn dividing the total area. We can work out the precise positioning of the dividing lines using to represent 100%. 40°,., is then represented by an angle of 144°, that is

$$\frac{40}{100} \text{x } 360 = 144.$$

Figure 4 Circle or pie graph of pass / fail ratings.



The choice of method used in presenting data in a graphical form must rest upc- the nature of the initial data and the amount of detailed visual information that required. Remember, pictorial methods of presentation add nothing to the d:2 that isn't already there to begin with! Their task is simply to display it mare effectively.

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UNIT - V

MEASURES OF CENTRAL TENDENCY

MEASURES OF CENTRAL TENDENCY

Measures of Central Tendency denote “central position” or the tendency of scores to converge on the centre of a distribution. Truly they re averages. This “average” represents all scores made by the group, and as such gives a concise description of the performance of the group as a whole. Measures of central tendency enable the researcher to “compare two or more groups in terms of their typical performance”.

The measures of central tendency is a single score that provides an indication of general performance of the group. They seek to determine some central values of series. They show the general trend and describe the salient feature of distribution. It is a single score that represents all the scores in a distribution. Averages are said to be representative figures. They are representative of whole series. They can be substituted in the place of individual items of series. The figures of the averages are used to represents a whole series, should neither be lowest value or highest value in the series, but a value some where between these two limits. possibly in the centre where most the items in the series cluster. Therefore averages are called measures of central tendency. There are three measures of central tendency which are used in research. They are the Median. Mean & Mode. Each of these measures describes the Massing of scores in a specific manner.

MEAN

Mean is the most important measures of central tendency. It is also called average. Mean is quantity obtained by dividing the sin of values. There is less fluxuation from sample to sample, from sample to population in mean than Median & mode. The most direct method is to obtain the sum of the scores ($\sum$x) and to divide this sum by the Number(N) of scores in the distribution.

$$\bar{X} = \frac{\sum x}{N}$$

Indirect method involves the Estimation of the mean and the Subsequent determination of the mean deviation of the scores from this estimated mean ($\tilde{X}$)

$$\bar{X} = \tilde{X} + \frac{\sum x}{N}$$ x = the deviation of each scores from $\tilde{X}$.

THE MEAN

The mean is considered as the first measure of central tendency. It is representative of the typical performance of individuals in a group. As an average, it purports to show the performance of the group on a particular variable or the performance of an indivdua1 over a period of time. It may be defined as “a point along the continuum of a given set of scores, the sum of scores above which and below which is equal to magnitude’. In an ungroupeci data, the mean (average) is calculated by adding up all the scores and dividing the sum total by the number of cases or observations.

A. CALCULATING THE MEAN FROM UNGROUPED DATA TABLE 4

SCORES OF CYCLE POLO PLAYERS ON PULL UPS

Name	Scores (X)	Difference from the Mean
1. Arif Khan	10	+ 3.2
2. Ashok	9	+2.2
3. Ramesh	8	+1.2

4. Pawandeep 5 -1.8

5. Mohinder 2 -4.8 (– 6.6)

N = 5 Total Score = 34

Mean = $\sum X/N$ = 34/5 = 6.8

6.8 is not a point accredited to any of the performers. That is why it speaks of the typical performance of the group.

$\sum$ (sigma) = the " sum of "

X = Scores

N = Number of Cases.

This method is tedious when cases are very large. B. Calculating the Mean from.

B. CALCULATING THE MEAN FROM GROUPED DATA

When the data are large enough, the method of computing the mean as mentioned above, seems to be tedious but in the method given below, the raw data are arranged into a frequency table, as shown in the Table 1, and then the mean is computed.

TABLE 5

SCORES OF 20 FEMALE BASKETBALLERS ON A TEST OF INTELLIGENCE

Step Interval	Midpoint (X)	Frequency (f)	FX
30-34	32	2	64
25-29	27	2	54
20-24	22	5	110
15-19	17	6	102
10-14	12	4	48
5-9	7	1	7
		N = 20	**$\sum$fx = 385**

Mean = $\sum$fx/N = 385/20 = 19.25

C. CALCULATING THE MEAN BY SHORT METHOD. (ASSUMED MEAN METHOD)

TABLE – 6

SCORES OF 20 FEMALE BASKETBALLERS ON A TEST OF INTELLIGENCE

Step Interval	X	f	d'	fd'
30-34	32	2	+3	+6
25-29	37	2	+2	+4
50-54	22	5	+1	+5 = (+15)
$ 15-19	17	6	0	
10-14	12	4	-1	-4
5-9	7	1	-2	-2
		N = 20		**$\sum$fg' = + 9**

$ Step interval containing the mean.

True mean = AM + $\left(\frac{\sum fd'}{N}\right)Si$

= 17 + (9.20) 5

= 17 + (0.45) 5

= 17 + 2.25

= 19.25

STEPS INVOLVED IN CALCULATING THE MEAN BY SHORT METHOD

1. Tabulate the frequency distribution as previously indicated (Table 1) with the highest interval at the top and lowest at the bottom.
2. In column X, give the mid-point of each interval.

3. Arbitrarily select some class interval near the middle of the distribution, the mid-point of which would serve as “assumed mean”.
4. Column d' represents deviation in intervals both ways from the assumed mean which shows 0 values. Note that intervals below the central one (containing assumed) are negative or minus deviations and those above it are positive or plus deviations. These values represent the deviations (d’) from the mid-points of various intervals from the assumed mean in units of class or step intervals.
5. The deviations in column d’ are multiplied by the frequencies (f) against each interval to give the products recorded in column fd’. Then sum up algebraically the positive values first, then negative ones. The total ($\sum$fd’) is the difference between the positive and negative values and is recorded at the bottom of the column fd’. If, fd’ value is in plus, the mean has been assumed too low and some quantity must be added
6. to the assumed mean to get the real mean. Conversely if $\sum$fd’ is in minus; the assumed mean has been assumed too high and some quantity must be subtracted from it.
7. The quantity to be added or subtracted will be found by dividing $\sum$fd’ by N and then multiplied by step intervals. This is also called C or Correction Factor. C = $\sum$**fd' N x si**
8. Since a class interval can be represented by the midpoint the true mean will be AM + C = TM = AM + $\left(\frac{\sum fd'}{N}\right)Si$

Where there are two or more groups (with separate mean values), the continuous mean may be calculated by the following formula:

$$\text{Comb. Mean} = \frac{M_1N_1 + M_2N_2 \ldots\ldots\ldots\ldots}{M_1N_2 \ldots\ldots\ldots\ldots}$$

USES AND CHARACTERISTICS

1. It is used when the scores in a distributions are more or less symmetrically grouped (not skewed) about a central point.
2. Mean is used as a basis for other statistics, such as measures of variability or measures of association.
3. It is used to estimate the values of corresponding mena of population from which the sample taken.

MERITS OF MEAN

1. It is calculated on the basis of all the observations on the series.
2. It is a calculated value and not an average of position in the series.
3. It has a rigid defined formula. Therefore mean is a definite and a fixed figure. Hence it is a more reliable measures of central tendency.

DEMERITS OF MEAN

1. It is calculated on the basis of observations. Therefore its value may disroted by extreme and abnormal values of the series.
2. It is based on all observation on the series, but it can not be a calculated even a single item is not known.
3. Mean can be a figure which does not exit in the series at all.

4. Mean cannot be located by a mere observations.
5. Mean gives greater importance to bigger items and lesser importance to smaller items. Hence is has an upward bias.
6. The mean does not show the progressing & regressing of the series.

COMPUTATION OF MEAN

UNGROUPED DATA

Formula Mean = $\frac{\sum x}{N}$

where $\sum$x = Total score

N = Number of subject

PROBLEM

1. Scores : 10, 15, 12,14,16,14, 15

Solution : Mean = $\frac{\sum x}{N}$

x = 96

N = 7

Mean = 96/7 = 13.71

Grouped Data

Formula

Mean = Am + ($\sum$fd/N) i

MEDIAN

Median is the Middle score in a distribution. The score below or which 50% of the scores (cases) fall. It is obtained by ordering either in ascending or descending and finding it at exact middle position.

THE MEDIAN

As a second measure of central tendency, the Median is also frequently used in research studies involving statistical concepts. it may be defined as that point on the continuum of scores above which and below which lie 50% of the measures.

A. CALCULATING THE MEDIAN FROM UN GROUPED DATA

a. In the distribution 1, 3, 5, 7, 9, 11, 13 the middle score is 7 which clearly indicates that there scores above and three scores below this point. Here the measures are arranged in ascending order and the Central Point, above which and below which are equal number of scores, is thus located. The formula to locate Median at first sight will be Median = $\left(\frac{N+1}{2}\right)^{th}$ measure in order of size.

b. Where the cases are odd in number such as 8, 9, (9.5) 10, 11, 12 the Median is on $\left(\frac{6+1}{2}\right)$or 3.5th score in order of size, that is 9.5 (upper limit of score 9 or lower limit of score 10).

B. CALCULATING THE MEDIAN FROM THE GROUPED DATA

When scores in a continuous series are grouped into a frequency distribution, the median is the 50% point in the said distribution. The following steps are involved in the calculation of the Median:

1. Divide the total number of scores by two i.e. $\left(\frac{N}{2}\right)$, one half of the cases in the distribution.
2. Start at the low-end of the frequency distribution and total up the scores in each interval until the lower limit of the interval containing the median is reached. The sum of these scores is F.

3. Subtract the sum obtained in step two from the number necessary to reach the Median i.e $\left(\frac{N}{2}\right)$ - F.

4. Now calculate the proportion of the median interval that must be added to its lower limit in order to reach the median score. This is done by dividing the number obtained in step 3 above by the number of scores (fm) in the median interval and then multiplying it by the size of the interval i.e. $\frac{\frac{N}{2}-F}{fm}$

5. Add the amount obtained by the calculation made in 4 above to the exact lower limit (1) which contains the median.

6. The entire procedure, from 1 to 5 above, may be summed up in the following formula:

   i. Median = L + $\frac{\frac{N}{2}-F}{fm} xsi$

where

L the exact lower limit of the median interval

N = the total number of scores

F= the sum of the frequencies in the interval below L.

fm = the number of scores within the median interval

Si = step interval or class interval.

TABLE 7

CALCULATING THE MEDIAN FROM THE GROUPED DATA

Score (5)	Frequency (f)
155 119	1
110 -114	2
105 - 109	4
100 – 104	10
95 -99	13
90 - 94	**18 (40)**
85 – 89	22
80 – 84	18
75 -79	11
70 – 74	8
65 – 69	3
60 -64	1
	70

$ = Interval Containing the Median

Lower Limit of the interval containing the Median

Formula $= L + \frac{\frac{N}{2} - F}{fm} xsi$

$= 89.5 + \frac{\frac{70}{2} - 22}{18} x5$

$= 89.5 + 3.61$

$= 93.11$

USES AND CHARACTERISTICS

1. Median is used when the research problem calls for the knowledge of exact mid point of a distribution.

2. It is used when extreme scores distort the mean. The mean reflex the extreme values, the median does not.
3. It is used when dealing with "ODDLY – SHAPED" distribution. For eg. those in which a high proportion of extreme by high scores occurs as well as a low proportion of extremely low ones.

MERITS OF MEDIAN

1. It is based on all observations of the series.
2. It is not affected by values of extreme items.
3. It is mostly an item existing in the series.
4. It can be calculated even if you do not know only the total number of values.
5. It is used in the calculation of Mean deviation.

DEMERITS OF MEAN

1. It is not a calculated figure obtained by a mathematical formula.
2. When there are wide variations in the values of items, Median may not be a representative average.
3. It does not give the aggregate of the values when the Median and the number of values are identified.

COMPUTATION OF MEDIAN

UNGROUPED DATA

The upgrouped data formula will be used in the measured of central tendency only when the number of the subject are 30 and below.

In the case of series of individual observations, Median is the size of the middle, most items of the series. When it is arranged either in ascending order or decending order of magnitude. If there are two middle items their arithmetic average will be the Median symbolically.

$$Y = \frac{(N+1)}{2}$$, the items.

Where Y stands for Median, N stands for total number of items. Model – 1 (For Odd Numbers)

PROBLEMS

1. Findout the values of Median in the following distribution of body weight of 11 studuents in a class 40, 50, 45, 55, 60, 62, 48, 60, 62, 60 & 62 …..

Solution

Decending Order:

62, 62, 62, 60, 60, (60), 55, 50, 48, 45, 40

$Y = \frac{N+1}{2} = \frac{11+1}{2} = 0$ (the size of 6^{th} item ie 60)

Model – II (For even numbers)

PROBLEM

2. Find out the Median for the following distribution scores: 3,4,45,2,6 & 8

Solution : Decending Order - 8,6,5,4,3,2

$$Y = \frac{(N+1)}{2} \text{ the item}$$

$$Y = \frac{(6+1)}{2} = 3.5$$

By counting 3.5 scores from either end, the Median falls between 5 & 4. The Median is halfway between these two scores or 4,5, eventhough a score of 4.5 score of 4.5 does not appear; 4.5 is the Median.

GROUPED DATA OF MEDIAN

The grouped data of measures of central tendency is used when the number of the subjects are 31 & above.

Formula

$$\text{Median} = 1 + \frac{(N/2 - F)}{f_m} i \quad \text{(Or)}$$

$$\text{Median} = 1 + \frac{0.5xN - F}{f_m}$$

MODE

The most frequently occurring score in a distribution is called the mode. Technically it is referred to as the Crude Mode. The Crude Mode is not normally applied to ungrouped data because any particular score might Occur haphazardly at any point in a Series of observations and be quite unrepresentative of the data as a whole. In the series of 3,4,4,6,7,7,7 & 8, 7 is the most occurring measure. Hence 7 is the Crude Mode of this distribution

With grouped data, the modal score is hardly identified because such a score is lot within a specific interval of the grouped distribution However, it is not difficult to identify the Modal Class i.e the interval containing the maximum score. When the mean and the median of a distribution have been calculated, the mode of the distribution can be calculated by the following formula.

Mode (3 Median—2 Mean)

The Scores which appears most frequently in a distribution is called as mode. It is also obtained by counting the frequency of each score value and choosing the one that as of highest frequency. When a series as only one mode it is known as uni-mode. When it is two mode that is bi-mode, when it has several modes it is known as Multi-modes.

USES AND CHARACTEREISTICS OF MODE

1. It is used when quick and approximate way of determining the central tendency.

2. When the central concentration is especially pronounced for eg, the model age of boys in 10th standard (15 years)
3. When high concentration especially as significant.

For eg : the model canvash shoe or track shoot.

MERITS OF MODE

1. It is more representative than mean & Median
2. It is easy for computation
3. It is not affected by a extreme abonormal items
4. It can be calculated without knowing the values of extreme items.

DEMERITS OF MODE

1. It is difficult to calculate by bi-mode, multi-mode and tri-mode.
2. It is not amenable for further mathematical treatment
3. When large number of items are scattered very widely a few items of the same magnitude may determine the mode.
4. It does not give aggregate value whether mode and the number of items are multiplied.

COMPUTATION OF MODE

UNGROUPED DATA

PROBLEM

3. Scores : 10, 12,13,14,14,17,14

Decending Order : 17,14,14,14,13,12,10

Number 14 is most repeated number in the series . Hence 14 is the mode.

GROUPED DATA

Computed mode = 3 (median) – 2 (Mean)

Crude Mode = Middle score of the mid point

FREQUENCY DISTRIBUTION (EXAMPLE - 2)

It consist of grouping the scores into step inpptervals; or steps or intervals. It consists of number of intervals each of the same size over the entire range of scores. It would not be derivable or advisable to use the frequency table for a small number of scores (ie 30 and below)

RAW DATA : The height of school boys are given below:

TABLE 8

140	145	148	164	127	168	168
150	149	154	143	156	176	135
155	145	167	157	171	155	142
152	165	141	168	160	153	155
135	138	151	154	151	163	152
168	184	141	153	162	162	170
145	145	156	148	158	147	136
138	160	143	135	132	156	138
154	159	146	154	152	152	152
160	155	167	132	134	130	155

XH = 184

Xl = 127

S I = 184

= 127/57 + 1 = 58/5 = 11.6

S I = 5

MEANING OF SINGLE SCORE

The rounding of the fraction of scores, there by getting the whole number is known as a single score.

The method of rounding the score is to keep the same whole nume until the next highest whole number is reached.

For eg. the range of score of 149 would be 149.00 to 149.99. The lowest value for 149 will be 148.5 and the highest value for 149 will be 149.49.

FREQUENCY TABLE

RANGE

It is found to determine the distance over which the scores are spread. To find out the range, the highest & lowest values should be located from the raw data and the difference between the two scores will be the range. Thus the range is equal

Range = XH – XL

= 184 – 129 = 57 + 1/5 = 11.6

XH = Highest Value

XL = Lowest Value

NUMBER OF INTERVALS

The number of intervals generally will be between 10 to 20. It may be depends upon the number of scores and their range. For small scores, the numbers of intervals may be around 10. when the number of the scores are large, the intervals may be nearer to 20.

INTERVALS SIZE

The interval size may be 1,2,3,4,5,10,20,25. The interval size can be found out by dividing a range with a number. So that it gives a value around 10-20. Interval size = range / a score which gives answer around 10.

TABULATION

The step interval should be arranged in tabular form. In the table 3, the largest score should be at the top and the smallest score at the bottom. The reason for the arrangements are that it is customarily followed in practice and that it is more convenient order for calculation. For eg. in 70 students height, the highest score was 182 and thus the top interval should be 180 – 184. The lowest score should be 125 – 129. All the step intervals then be arranged from top to bottom or bottom to top. Then the number of scores in each step is there designatied with the appropriate figure. This column is know as the "frequency column", and designated by the letter "f" . The total number of frequency column is indicated by "N".

TABLE – 9

S.L	T	F	CM	d	fd
180-184	1	1	70.6	6	6
175-179	1	1	69	5	5
170-174	11	2	68	4	8
165-169	111111	7	66	3	21
160-164	111111	7	60	2	14
155-159	111111111	11	52	1	11
150-154	14	14	41	0	0
145-149	9	9	27	-1	9
140-144	6	6	18	-2	-12
135-139	7	7	12	-3	-21
130-134	4	4	5	-4	-16
125-129	1	1	1	-5	-5
		70			**-63**

Computation of measures of central tendency grouped data Mean = $Am + (\sum fd/N)i$

Where,

Am = assumed mean or middle score of mid point

$\sum$ fd = Deviation of plus values of fd and minus values of fd

N = Total Number of scores

I = Step interval

= 152 + (2/70)5

= 152 + (0.028)5

= 152 + 0.14 = 152 x 2

Median = L + $\frac{(N/2 - F)}{f_m}$

Where, L = Lowest Step interval

Fm = The number of frequencies in the mid point

F = The number of cumulated frequency one step below the mid cumulated frequency

= $149.5 - \left(\frac{70/2 - 2.7}{14}\right) - 5$

= 149.5 + (0.57) 5

= 149.5 + 2.86

= 152.36

Computed mode = 3 (Median) – 2 (Mean)

= 3(152.36) – 2 (152.14)

= 457.08 – 304 x 58 = 152.5

Crude Mode = Middle score of the mid point

Mid Point step interval = 150 – 154

The Middle score = 152 (crude Mode)

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