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STATISTICS IN PSYCHOLOGY

By: Kshyama Sagar Meher

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CONTENTS

STATISTICS IN PSYCHOLOGY

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S.No. ***Chapterwise Reference Book*** *Page*

INTRODUCTION TO STATISTICS

CENTRAL TENDENCIES AND DISPERSION

❐❐

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QUESTION PAPER

(June – 2019)

(Solved)

STATISTICS IN PSYCHOLOGY

Time: 2 Hours] ***[Maximum Marks: 50***

Note: ***All*** *sections are* ***compulsory****. Use of simple calculator is permitted.*

SECTION-A

Note: Answer the following questions:

Q. 1. Define Statistics. Describe various types of statistics.

Ans. Ref.: See Chapter-1, Page No. 2, 'Definition of Statistics' and 'Types of Statistics'.

Q. 2. Discuss the meaning and functions of measures of central tendency.

Ans. Ref.: See Chapter-2, Page No. 12-13, 'Measures of Central Tendency'.

Q. 3. Compute Spearman's rho for the following data:

	Scores in Test I	Scores in Test II
A	19	20
B	14	17
C	12	37
D	10	24
E	23	11
F	26	13
G	27	26
H	30	32
I	36	29
J	41	43

Ans.

	Score in Test-I (X)	Score in Test-II *(y)*	Rx	Ry	D = RX – RY	D^2
A	19	20	4	4	0	0
B	14	17	3	3	0	0
C	12	37	2	9	–7	49
D	10	24	1	5	–4	16
E	23	11	5	1	4	16
F	26	13	6	2	4	16
G	27	26	7	6	1	1
H	30	32	8	8	0	0
I	36	29	9	7	2	4
J	41	43	10	10	0	0
n = 10						$ED^2 = 102$

$$r_s = 1 - \frac{6\Sigma D^2}{n\left(n^2 - 1\right)}$$

$$= 1 - \frac{6 \times 102}{10\left(100 - 1\right)}$$

$$= 1 - \frac{612}{990}$$

$$= 1 - .618$$

$$= .382.$$

The value of rho is .382. This is aparitive value. It means the correlation between the ranks of emotional intelligence and self-concept is positive. The relationship is positively monotonic. The value is very close to which implies that the strength of association is very high.

Q. 4. Compute Chi-square for the following data:

	Early Adolescence	Late Adolescence
Boys	**20**	**50**
Girls	**40**	**10**

Critical Value = 3.841 at 0.05 level of significance.
= 6.635 at 0.01 level of significance.

Ans.

	Early Adolescence	Late Adolescence	Total
Boys	20 (30)	50 (30)	70
Girls	40 (30)	10 (30)	50
Total	60	60	120

Computation of r^2 from contingency table.

f_o	f_e	$f_o - f_e$	$(f_o - f_e)^2$	$(f_o - f_e)^2 / f_e$
20	30	–10	100	3.33
50	30	20	400	13.33
40	30	10	100	3.33
10	30	–20	400	13.33
			Total	33.32

$r^2 = (f_o - f_e)^2 / fe$

$r^2 = 33.32$, $df = (r - 1)(c - 1) = (2 - 1)(2 - 1)$

$df = 1$

Critical value 1 df is 3.841

at. 05 level and 6.635 at .01 level.

The value we got is 33.32 which is far higher than the table value.

SECTION-B

Note: Answer the following questions:

Q. 5. What is Hypothesis Testing? Describe the errors in hypothesis testing.

Ans. Ref.: See Chapter-3, Page No. 20, 'Hypothesis Testing' and Page No. 21, 'Errors in Hypothesis Testing'.

Q. 6. Compute mean, median and mode for the following data:

25, 30, 13, 12, 14, 15, 15, 16, 15, 17, 15, 15, 20, 30, 65, 71, 82, 91, 92, 36.

Ans.

$$\text{Mean} = \frac{25+30+13+12+14+15+15+16+15+17+15+15+20+30+65+71+82+92+36}{20}$$

$$= \frac{689}{20} = 34.45$$

$$\text{Median} = \left(\frac{n}{2}\right)^{\text{th}} \text{ item}$$

Here, N = 20

$$= \frac{20}{2} = 10^{\text{th}} \text{ term}$$

Data: 12, 13, 14, 15, 15, 15, 15, 15, 16, 17, 20, 25, 30, 30, 36, 65, 71, 82, 91, 92

Median = 17

Median = 3 Median – 2 Mean

= 3 × 17 – 2 × 34. 45

= 51– 68.9

= 17.9

Q. 7. Compute standard deviation for the following data:

7, 5, 3, 5, 10, 12, 13, 11, 19, 10.

Ans. Data: 7, 5, 3, 5, 10, 12, 13, 11, 19, 10

$$\bar{x} = \frac{\text{Sum of observation}}{\text{Total No. of observation}}$$

$$= \frac{7+5+3+5+10+12+13+11+19+10}{10}$$

$$= \frac{95}{10} = 9.5$$

$$S = \sqrt{\frac{\Sigma(x-\bar{x})^2}{N}}$$

x	$(x - \bar{x})^2$	$(x - \bar{x})^2$
7	7–9.5 = – 2.5	6.25
5	5–9.5 = – 4.5	20.25
3	3–9.5 = – 6.5	42.25
5	5–9.5 = – 4.5	20.25
10	10–9.5 = .5	.25

Sample Preview of The Chapter

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STATISTICS IN PSYCHOLOGY

INTRODUCTION TO STATISTICS

Introduction to Statistics

1

INTRODUCTION

We use statistics in our day to day life. We use for general calculation; like the number of trains operating, number of passenger's freight and the number of people participating. We use statistics to take decision about various problems as per the quantitative and qualitative information available to us. In behavioural sciences, however statistics is different from how we define it. In this, we draw statistical inference about population according to the available quantitative information. Through statistics, we reduce data to convenient descriptive terms and draw inferences from them. In this chapter, we will understand the meaning, the nature and use of statistics.

CHAPTER AT A GLANCE

MEANING OF STATISTICS

The word statistics is derived from Latin word '*status*' or Italian '*Statista*' which means statesman. It was used in the 18th century by Professor Gott Fried Achenwall. These words were used for political state during the early period. '*Statista*' was used to keep the census records or data on state's wealth. Its meaning and usage gradually have changed.

Statistics conveys different meanings in singular and plural sense.

Statistics in Singular Sense

In singular sense, it is a branch of science that deals with classification, tabulation and analysis of numerical facts and makes decision on that basis. It includes statistical methods for collection, classification, analysis and interpretations of data.

Statistics in Plural Sense

In plural sense, statistics means that quantitative information or available 'data'. For instance, information on population or demographic features of a country, enrolment of students in a college are statistics.

Websters define statistics as the classified facts on the conditions of the people in a State and those facts can be presented in number or in tables of number or classified arrangement.

In plural sense, Horace Secrist describes statistics "as aggregates of facts affected to a marked extent by multiplicity of causes numerically expressed, enumerated or estimated as per the reasonable standard of accuracy, collected in a systematic manner for a predetermined purpose and placed in relation to each other." Thus, statistics should have the following characteristics:

1. They must be aggregate of facts i.e., no individual figure is regarded as statistics.
2. They are affected by multiplicity of factors; like circumstances. For example, any yield of crop is affected by various circumstances i.e., soil, seed, rainfall and temperature etc.
3. They must be enumerated or estimated according to reasonable standards of accuracy. However, degree of accuracy depends on nature of data. Again, whatever standard of accuracy is once adopted, it should be maintained throughout the whole study.
4. They must be collected in a systematic manner for a predetermined purpose i.e., the data must be properly arranged.

5. They must be placed in relation to each other i.e., the facts should be comparable regarding time, space or condition.

Thus, we can say that all statistics are numerical statements of facts, but all numerical statements of facts cannot be called statistics.

Definition of Statistics

Statistics deals with classification, tabulation and analysis of numerical facts. Statisticians have defined these aspects of statistics in different ways.

A.L. Bowley defines statistics in the following ways:

(*i*) Statistics is the science of counting. Its focus is on enumeration aspect.
(*ii*) Statistics is the science of average.
(*iii*) It is the science of measurement of social organism as a whole in all its manifestations.

Yet Bowely did not include all aspects of statistics with these definitions.

Selligman defines statistics as the science that deals with the methods of collecting, classifying, presenting, comparing and interpreting numerical data collected with a purpose to reveal in an enquiry.

According to Croxton and Cowden, statistics is the collection, presentation, analysis and interpretation of numerical data. This definition covers all aspects statistics.

Given below are different aspects of statistics:

Collection of Data: This is the first basic step in a study. Collection of data may be from primary or secondary source or from both the sources as per the requirement.

Classification and Presentation: This process comes after data collection. It means arranging data in a format to draw some conclusions. Classification of data means arrangement of data in groups as per their similarities.

Tabulation: It is the presentation of data in a table. Classified and tabulated data can be presented in diagrams and graphs.

Analysis of Data: Analysis of data is conducted to process the observed data and transform it in such a manner as to make it suitable for decision-making.

Interpretation of Data: Data is interpreted to make that data useful in real life. The quality of interpretation depends on the experience of the researcher.

TYPES OF STATISTICS

Statistics can be classified in two ways–on the basis of functions and on the basis of distribution.

On the Basis of Functions

On this basis, statistics can be classified into three types:

(*i*) Descriptive statistics,
(*ii*) Correlational statistics, and
(*iii*) Inferential statistics.

***(i)* Descriptive Statistics:** Descriptive statistics describes the main features of a collection of information. It aims to summarize a sample, rather than use the data to learn about the population that the sample of data is thought to represent. Some measures that are commonly used to describe a data set are measures of central tendency and measures of variability or dispersion. Measures of central tendency include the mean, median and mode, while measures of variability include the standard deviation, the minimum and maximum values of the variables.

***(ii)* Correlational Statistics:** Correlational statistics show whether and how strongly pairs of variables are related. An intelligent correlation analysis can lead to a greater understanding of the data. Correlation can tell whether the relationship is positive or negative and the strength of relationship. Correlation is a powerful tool that provides these vital pieces of information.

***(iii)* Inferential Statistics:** Statistical inference is the process of drawing conclusions from data that are subject to random variation. Inferential statistics are used to test hypotheses and make estimations using sample data. The outcome of statistical inference may be an answer to the question what should be done next, where this might be a decision about making further experiments or surveys, or about drawing a conclusion before implementing some organizational or governmental policy.

On the Basis of Distribution of Data

On the basis of distribution of data statistics can be classified as parametric and non-parametric statistics. Both deal with population or sample – which means the total number of items in a sphere. In statistics, the number of a population is finite. Kerlinger defines the term population and universe as all the members of any well-defined class of people, events or objects. Statistical population may include three types of properties:

(*a*) finite number knowable items,
(*b*) finite number of unknowable items, and
(*c*) infinite number of items.

Sample is a set of data collected and/or selected from a statistical population by a defined procedure. Since the population is very large, making a census or a complete enumeration of all the values in the population impractical or impossible, sample represents a subset of manageable size. Samples are collected and statistics are calculated from the samples so that one can make inferences or extrapolations from the sample to the population. This process of collecting information from a sample is referred to as sampling.

Parametric statistics assumes that the data has come from a type of probability distribution and makes inferences about the parameters of the distribution. Most well-known elementary statistical methods are parametric.

Generally, speaking parametric methods make more assumptions than non-parametric methods. If those extra assumptions are correct, parametric methods can produce more accurate and precise estimates. They are said to have more statistical power. However, if assumptions are incorrect, parametric methods can be very misleading. For that reason they are often not considered robust. On the other hand, parametric formulae are often simpler to write down and faster to compute. In some, but definitely not all cases, their simplicity makes up for their non-robustness, especially if care is taken to examine diagnostic statistics. Parametric statistics moves after confirming its population's property of normal distribution.

Advantages of parametric statistics are that it is more reliable and authentic relative to the non-parametric statistics. It is also more powerful to establish the statistical significance of effects and differences among variables. It is also more appropriate in research applications.

Disadvantages of parametric statistics are that it follows rigid assumption of normal distribution and it narrows the scope of its usage. In case of small sample, parametric statistics cannot be used since normal distribution cannot be achieved. Besides, in parametric statistics computation is lengthy and complex because of large samples and numerical calculations. Some of the major parametric statistics used for data analysis include T-test, F-test and *r*-test.

In **non-parametric statistics,** we do not have to make any assumption of normality for the population we are studying. Indeed, the methods do not have any dependency on the population of interest. It is for this reason that non-parametric methods are also referred to as distribution free methods. Non-parametric methods are growing in popularity and influence for a number of reasons. The main reason is that we are not constrained for making as many assumptions about the population that we are working with as what we have to make with a parametric method. Many of these non-parametric methods are easy to apply and to under-stand. Chi-square, Spearman's rank difference method of correlation, Kendall's rank difference method and Mann-Whitney U-test are some of the non-parametric methods.

SCOPE AND USE OF STATISTICS

The scope of statistics is wide and vast. Given below are some of them:

Policy Planning: Statistics is used in analyzing data for policy planning. For instance, companies use previous sales data to make future strategies to achieve maximum benefit in sales and profit.

Management: Statistics is used for effective management. Organisations use data in various aspects of work and well being of the employees and management of the business.

Behavioural and Social Sciences: In social sciences, statistics is used to understand the patterns of behaviour/trend. Parametric statistics or non-parametric statistics are used to explain the pattern of activities when the characteristics of the population being studied are normally distributed.

Education: The use of statistics has become indispensable for educational research. Statistics is used to describe and analyse the groups surveyed by means of quantitative treatment. In using statistical techniques various problems are involved.

Commerce and Accounts: Statistics has been inevitable in commerce and accounts on estimating money matters to manage the funds properly enabling efforts in various sectors. It is used in the cost and benefit analysis for maximum benefit at minimum cost.

Industries: Statistics is used to handle daily matters at various levels in big as well as small organization. It is used to manage the data with respect to expenditure and the staff.

Statistical tools are used to differentiate among employees.

Pure Sciences and Mathematics: Statistical tools are used in pure sciences and to see differences on different occasions in various conditions. Statistics is a branch of mathematics. It helps in understanding

differences among properties of various applications in mathematics.

Problem Solving: It helps in finding out the best applicable solution in a problem situation. It is used to analyse the pattern of response and the correct solution and thus minimizes the error factor.

Theoretical Researches: Statistical measures are used to decide on the facts and data whether a particular theory can be maintained or challenged. The significance of facts for a particular paradigm or phenomena is established by statistical analyses.

LIMITATIONS OF STATISTICS

Although flexible nature of statistics makes it popular generally in every field, it has also some limitations. These are as follows:

1. Statistics deals only with those studies, which are capable of being quantitatively measured and numerically expressed.
2. Statistics deals with the aggregates of facts only. It does not pay attention to individuals.
3. Statistical methods are not exact. Interpretation and conclusions based on them are only approximate.
4. Statistical results are not mathematically correct. Results are estimated according to a reasonable standard of accuracy.
5. Statistics can be misused by establishing wrong conclusions. Therefore, results must be drawn on the advice of experts only.

DISTRUST AND MISUSE OF STATISTICS

Statistics sometimes is used by inexperienced people to fulfil their self motives irrespective of the nature and trend of the data. Sometimes statistics is called unscrupulous science because of the misuse of statistical tools.

Some of the misgivings about statistics are:

- It can prove anything.
- It is a unreliable science.
- It is one of the three types of lies. The other two are lies and damned lies.
- An ounce of truth will produce tons of statistics.

Thus, statistics should be used carefully. It should not be used as a blind man uses a lamp-post for the support instead of illumination.

Today, statistics is used in agriculture, space, medicine, geology, technology, etc. to predict results and in decision-making.

SELF ASSESSMENT QUESTIONS

Q. 1. Define the term sample and population with one example each.

Ans. A sample is a group of units selected from a larger group, the population. By studying the sample it is hoped to draw valid conclusions about the larger group. A sample is generally selected for study because the population is too large to study in its total. The sample should be representative of the general population. This is often best achieved by random sampling. Also, before collecting the sample, it is important that the researcher carefully and completely defines the population, including a description of the members to be included. For example, in a study of health of all children born in India in the 2010s, the sample might be all children born on 7th May in any of the years.

A population is any entire collection of people, animals, plants or things from which we may collect data. It is the entire group we are interested in, which we wish to describe or draw conclusions about. In order to make any generalisation about a population, a sample, that is meant to be representative of the population, is often studied. For each population there are many possible samples. A sample statistic gives information about a corresponding population parameter. For example, the sample mean for a set of data would give information about the overall population mean. It is important that the investigator carefully and completely defines the population before collecting the sample, including a description of the members to be included. For example, in a study of infant health, the population may be all the children born in India in the 2010s.

Q. 2. Write three applications of statistics in daily life.

Ans. Statistics is a significant and relevant part of things we do every day.

Most people budget their household expenditure in one way or another. Whether this is a notebook, a complex spreadsheet or a basic balance in their head, most people decide whether they can afford something. This will be a decision based on how much money they have in the bank, versus what they need to pay for. The remaining disposable income will then be analyzed to decide whether the person can or should buy something. If you have ever decided that you can or cannot afford something, then you have used statistics to reach that decision.