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QUESTION NO.1

ANSWER:

An average is essentially just one number that represents a whole group of numbers. Most of the numbers in your group of data are close to this number, which is why this number is called "central tendency". The main point is to take a messy pile of numbers and simplify them, something that you can easily compare with other data. The three main averages that you will come across are the mean, the median, and the mode.

What makes an average good, in fact?

• Firstly, it needs to be clear and exact. You want a formula that anyone can follow and get the same result, regardless of who is doing the calculation. The mean works well for this, but the mode can be a bit tricky—sometimes there isn't just one answer.

• Secondly, it shouldn't be complicated. If you need a calculator and a pile of notes just to figure it out, then most people will stop trying. The median, for example, is quite easy to determine, even if your data is messy or doesn't have clear endpoints.

• Third, the average that is correct will consider all the values. It should not be just the few numbers that the focus is on while the rest are ignored. The mean does this—it considers all the data. On the other side, the mode is only interested in the most frequent number and ignores the rest.

• Fourth, it needs to be reliable. If you take different samples from the same population, your average should not vary significantly. It's what statisticians refer to as "sampling stability". The mean is usually the one to make a short stay, but the median and mode might be more volatile.

• Fifth, you should be able to use your average for other math problems—like calculating the standard deviation or combining averages from different groups. This type of thing is done most easily by the mean.

And one more thing: a good average should not be influenced by a few strange numbers. Outliers can significantly affect the mean, while the median rejects them and hardly changes. This is the reason why people choose the median when there are extreme values in the data.

QUESTION NO. 2

ANSWER:

Classifying data essentially means that you have to take a large amount of numbers or information that are raw and sort them into groups that share some characteristics. Instead of looking at a pile of data that is messy, you get something that you can actually understand.

Usually, people have four main methods of doing this:

1. Geographical Classification

It is quite simple; you divide the data depending on the source. For instance, you may want to check the sales in different cities or understand how population density changes from one region to another. When you sort things out by location, those kinds of comparisons become a lot more convenient.

2. Chronological Classification

Time is the only thing that matters here. You put the data in order of the time when the events occurred be it by year, month, week, or whatever fits your case. If your purpose is to find the trends or understand how an issue varies over time, then this method is your choice.

3. Qualitative Classification

It's not always about the numbers. Sometimes, you have to arrange data according to the qualities or characteristics of people, such as gender, religion, or whether a person can read. This method categorizes the data by features instead of numbers. It can just be as dividing people into male and female, or you may use more categories if necessary.

4. Quantitative Classification

Here we talk about the world of numbers- anything that can be measured, counted, or given a value. For example, height, weight, income, or the number of children in a family. To show the whole picture in a simple way, you can divide these numbers into ranges or groups.

After data is organized in such a way, it is no longer just a heap of numbers but rather something that can be dealt with.

QUESTION NO.3

ANSWER:

➢ Index Number:

Basically, an index number is a method of recording changes that are happening over time or at various places. Think of it as a tool for recording the inflation or deflation of prices, costs, or any other values, and it always refers everything back to the initial period - the base period. Generally, it indicates such changes as percentages, thus making the extent of the changes quite clear. In fact, it is merely an average which assists in comparing current figures with the old ones.

FORMULA (Simple Price Index)

$$P_{01} = P_1/P_0 \times 100$$

P_{01} is the Index Number; P_1 is the price in the current period; P_0 is the price in the base.

➢ Use of Index Numbers:

Index numbers are everywhere—economics, business, social sciences, just to mention a few. They really matter in these places:

1. Measuring What Your Money Can Buy

The most important role of index numbers? Determining how much you are getting for your money. Consider the Consumer Price Index (CPI). In a situation where it changes from 100 to 150, the same goods basket that was ₹100 is now worth ₹150. So, your money just doesn't stretch as far as it used to.

2. Guiding Economic Decisions

Governments and businesses take decisions about the likes of wages, taxes, production, or trade depending on the Wholesale Price Index and similar things. These figures reflect the reality to them, thus leading to logical moves.

3. Adjusting for Inflation

If you want to know the "real" value of something, not just the numbers on the surface, index numbers help you remove the inflation impact. Suppose you are examining national income. Don't forget to use a price index to reveal actual growth in the economy and not just higher-value numbers caused by the increased prices.

4. Spotting Trends and Predicting What's Next

They say analysts can't live without index numbers if they want to identify long-term trends such as production, stock prices, and trade, and so on. This benefits everyone as it paves the way for future planning and readiness.

5. Making Fair Comparisons

The comparison between a company and other companies from the same industry will be as simple as an index number is if the company chooses to use it. They level the playing field so that comparisons are done with the same units.

> Types of Index Numbers

You can classify index numbers into four major groups according to the subject of measurement:

1. Price Index Numbers: These indicate price changes from one time period to another. Examples are Consumer Price Index (CPI) and Wholesale Price Index (WPI).

2. Quantity Index Numbers: These demonstrate the changes in production or consumption. The Index of Industrial Production (IIP) is one of these—it tells whether industrial output has increased or decreased.

3. Value Index Numbers: These figures show the change in total value (price times quantity) of some goods. For instance, there are value indices for exports or imports.

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QUESTION NO.4

ANSWER :

The Chi-Square Test

It's a tool that people use when they're figuring out if their real results match their expected ones. This test is used mainly for categorical data, like colors, types, or yes/no answers.

The x^2 test statistic is calculated using the following formula:

$$x^2 = \sum (O - E)^2 / E$$

Where :

O = Observed frequency

E = Expected frequency

Such differences in your findings and expectations would be a matter of chance if a Chi-Square value, i.e. the X^2 number you get from the formula, is small meaning that your observed results are pretty close to your expected results. However, things are not going as expected if that number goes up. To find out whether the difference is really significant, you compare your calculated

value with a figure from the chi-square table. The only things you need to know are the significance level you set and your degrees of freedom. If your value is higher than the number in the table, you reject the null hypothesis and say that there is a significant difference between your observed and expected results.

Significance of the Chi-Square Test in Statistically Analyzed Data: The chi-square test is a vital element in the research methodology of statisticians and data analysts as it opens up the world of qualitative and categorical data to them under the situations when other conventional parametric tests (like t-tests, or z-tests) are not applicable.

➢ We could summarize the importance of the test by outlining its two principal areas of application:

1. Goodness of Fit Test: Importance: This application is used to find the difference between a known or theoretical distribution (e.g. Poisson, normal, or uniform distribution) and that of the observed frequency distribution statistically. It provides the researcher with a way of determining whether the data sampled could have come from the population distribution that has been hypothesized.

2. Attributes' Independence Test:

Importance: This is the most common example. It identifies whether a statistically significant relationship (dependence) exists between two categorical variables or attributes. The null hypothesis assumes the two characteristics to be independent.

QUESTION NO.5
ANSWER:

This ideal research report presents the work, results, and conclusions in a clear and methodical manner. Its layout takes the reader step-by-step through the entire research process, thus from the problem definition up to the final suggestions.

➢ The Optimal Format for a Research Report

Generally, research reports consist of three main parts, which in turn have several chapters. The Preliminaries, Main Body, and End Matter are these parts.

1. The Preliminaries (The Front Matter):

• Title Page: This is the page where you provide the name of the project, your name in capital letters, roll number, program, semester, course title, and code.

• Certificate/Declaration: In this section, you acknowledge that the work is yours and it hasn't been plagiarized.

• Acknowledgements: It is the opportunity to express gratitude to the people or the institution that helped or supported you during the process.

• Table of Contents: It is merely a listing of all the sections and subsections of your report along with the page numbers which enables the readers to locate those sections easily.

• List of Tables/Figures/Charts: These are individual lists indicating the titles and page numbers of all the tables, figures, and charts, respectively.

• Executive Summary/Abstract: The section is a brief one-page overview of your study-what the aim was, how you accomplished it, the major findings, and your significant conclusions. This section is what most people browse first.

2. The Main Body:

Chapter 1: Introduction:

- Problem Statement: The central point of identifying an issue or question that the research will deal with.
- Objectives of the Study: The points of the research that the researchers are expected to achieve.
- Scope and Limitations: The extent of the research and the restrictions imposed on it are described here.
- Review of Literature: Here is an optional section, however, it is mandatory in most of the reports. The review of literature means presenting the relevant academic works.
- Hypotheses: This part, if available, identifies the assumptions that will be proven.

Chapter 2: Methodology:

- Research Design: The central idea or the framework of the work (e.g., exploratory, descriptive, experimental).
- Data Collection: Data about the source (primary/secondary), the instrument used (e.g., questionnaire, interview schedule), and the sampling method.
- Data Analysis Techniques: A statement of the utilized statistical methods (e.g., regression, x^2 test, ANOVA).

Chapter 3: Results and Findings (Analysis of Data):

- Presentation of Data: The devices for presenting the data gotten from the research, for instance, tables, charts, and graphs.
- Analysis and Interpretation: The chosen statistical techniques are implemented and the findings clarified. This part is completely objective and only concentrates on the facts that the data reveal.

Chapter 4: Discussion and Conclusions:

- Discussion: Evaluating the evidence in relation to the hypotheses and objectives set at the beginning. Pointing to the significance of the findings.
- Conclusions: The main points of the research that have been emphasized.
- Recommendations: The hands-on advisories that are given basing on the conclusions.

3. The End Matter (The Appendices):

- Bibliography/References: The alphabetical list of all the books, articles, websites, and other sources that were referred to in the writing of the report.

- Appendices: Supplementary material that is necessary for the record but is far too detailed for the main section. Survey forms, statistical data tables, interview transcripts, and technical notes of any kind may be there.

The layout is, in essence, a well-planned, logical, and justified outline of the report that makes it convenient for the reader to comprehend and critically evaluate the research.

QUESTION NO.6
ANSWER:

Time series are essentially data sets that illustrate changes recorded over time, such as stock prices by the day, the rate of unemployment by the month, or sales figures by the year. Time series analysis is a look back at the change of a variable with the aim of making a forecasting of the upcoming values.

The changes or fluctuations in a time series are normally considered to be composed of four different components that are singled out and investigated by decomposition methods.

➤ The Four Factors of a Time Series

1. Secular Trend (T):

The main objective of this section is to represent the long-term, stable, and overall trend of the data movement over a long period of time. Such a trend, which usually lasts more than a year and is either upward, downward, or even constant, reflects major long-term changes in population, technology, or the economy. Hence, it is a gradual, evolutionary process.

Examples of this are a country's population steadily increasing over several decades or the usage of renewable energy continuously going up for the last 20 years.

2. Variation by Season (S):

The section's main aim is to represent short-term fluctuations that occur frequently within a single calendar year. The weather, festivals, holidays, and social customs are the main reasons for these recurring changes.

For example, the retail sales of air conditioners peak during the holiday season (December) and rise during the summer (June–August).

3. Variation in Cycles (C):

That part of the data is from the data-series that the variances last for more than a year and normally are irregular but recurring. These changes, which include the stages of prosperity, recession, depression, and recovery, are almost entirely related to the business cycle. Unlike seasonal fluctuations, the duration of a full cycle is variable and usually lasts from five to ten years or more.

For example, the economy of a country can go through repeated cycles of boom (high economic activity) and recession (low economic activity).

4. Random/Irregular Variation (I):

This section's main objective is to represent the residual, erratic, and unpredictable fluctuations in the dataset that cannot be accounted for by the trend, seasonal, or cyclical components. These almost always have a short duration, do not happen again, and are caused by unanticipated, rare events.

For instance, the abrupt fall of the stock market prices caused by a political coup or the sudden rise in the demand of building materials caused by natural disasters such as an earthquake or flood.

➢ Models of Time Series

Four components are combined either in one of two ways to model the time series data (Y):

- Additive Model: The model assumes that the components are independent: $Y = T + S + C + I$

- Multiplicative Model: The model assumes that the components interact and are proportional to the trend (which is most commonly used in business and economic analysis): $Y = T \times S \times C \times I$

By knowing these factors, analysts can uncover the trend movement (trend) that is hidden in the medium-term fluctuations (cyclical) and short-term noise (seasonal), thus, enhancing forecasting and decision-making.