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1 Statistics Basics Assignment questions :

1.0.1 1. Explain the different types of data (qualitative and quantitative) and provide examples of each. Discuss nominal, ordinal, interval, and ratio scales.

Data can be classified into qualitative and quantitative categories:

(i) Qualitative (Categorical) Data: These are non-numeric data used to describe characteristics or qualities.

Example: Nominal Scale (no natural order): Gender (Male, Female), Eye Color (Blue, Brown, Green), Marital Status (Single, Married).

Example: Ordinal Scale (with a natural order, but intervals are not consistent): Education Level (High School, College, Graduate), Rating (Poor, Average, Excellent).

(ii) Quantitative (Numerical) Data: These are numerical values that represent counts or measurements.

Example: Interval Scale (numbers have meaningful differences, but no true zero): Temperature (Celsius, Fahrenheit).

Example: Ratio Scale (like interval, but with a true zero, allowing for meaningful ratios): Height, Weight, Age.

1.0.2 2. What are the measures of central tendency, and when should you use each? Discuss the mean, median and mode with examples and situations where each is approprteiaia

Central tendency measures the center of a dataset. The three most common are:

(i) Mean: The average of all data points.

Use: Appropriate for normally distributed data without extreme outliers.

Example: The average height of a group of people.

(ii) Median: The middle value when the data is ordered.

Use: Useful when data contains outliers or is skewed (non-symmetrical).

Example: The median income of a population.

(iii) Mode: The most frequent value in a dataset.

Use: Useful for categorical data, or when identifying the most common item.

Example: The most popular car model sold in a year

1.0.3 3. Explain the concept of dispersion. How do variance and standard deviation measure the spread of data

Dispersion refers to the spread or variability of data. Key measures are:

(i) Variance: The average squared deviation from the mean.

Use: Helps measure how spread out the values in the data set are.

(ii) Standard Deviation: The square root of the variance.

Use: Provides a measure of spread in the same units as the data, making it easier to interpret.

Example: A small standard deviation means the data points are close to the mean, and a large standard deviation means they are more spread out.

1.0.4 4. What is a box plot, and what can it tell you about the distribution of data?

A box plot (or box-and-whisker plot) displays the distribution of data based on five key summary statistics:

(i) Minimum: The lowest data point within the 1.5 IQR (Interquartile Range).

(ii) Q1 (First Quartile): The median of the lower half of the data.

(iii)Median (Q2): The middle value.

(iv) Q3 (Third Quartile): The median of the upper half of the data.

(v) Maximum: The highest data point within the 1.5 IQR.

1.0.5 5. Discuss the role of random sampling in making inferences about populations.

Random sampling is a method where every individual in a population has an equal chance of being selected. It is essential for making inferences because:

(i) It reduces bias.

(ii)It ensures the sample is representative of the population.

(iii)It allows the use of statistical inference methods (e.g., confidence intervals, hypothesis testing).

1.0.6 6. Explain the concept of skewness and its types. How does skewness affect the interpretation of data?

Skewness measures the asymmetry of the data distribution:

(i) Positive skew (right skew): The tail is stretched to the right.

Effect: Mean > Median.

Example: Income distribution (a few people earn much higher than the average).

(ii) Negative skew (left skew): The tail is stretched to the left.

Effect: Mean < Median.

Example: Age at retirement.

(iii)No skew: The data is symmetric (Mean Median)

1.0.7 7. What is the interquartile range (IQR), and how is it used to detect outliers?

The Interquartile Range (IQR) is the difference between the first quartile (Q1) and third quartile (Q3): IQR = Q3−Q1

Outliers are typically defined as:

Below Q1 - 1.5 IQR

Above Q3 + 1.5 IQR

1.0.8 8. Discuss the conditions under which the binomial distribution is used.

The binomial distribution is used when:

(i) The experiment consists of n trials.

(ii) Each trial has two possible outcomes (success or failure).

(iii)The probability of success p is the same for each trial.

(iv)The trials are independent

1.0.9 9. Explain the properties of the normal distribution and the empirical rule (68-95-99.7 rule).

The normal distribution is a bell-shaped curve, symmetrical around the mean. Key properties:

(i) It is defined by two parameters: mean ( ) and standard deviation ( ).

(ii) 68-95-99.7 Rule (Empirical Rule):

68% of data falls within 1 standard deviation of the mean.

95% of data falls within 2 standard deviations of the mean.

99.7% of data falls within 3 standard deviations of the mean

1.0.10 10. Provide a real-life example of a Poisson process and calculate the probability for a specific event.

A Poisson process models the number of events occurring in a fixed interval of time or space. Example:

(i) The number of cars passing a checkpoint in an hour.

(ii)If the average number of cars is 3 per hour, you can calculate the probability of seeing exactly 5 cars in an hour using the Poisson formula.

1.0.11 11. Explain what a random variable is and differentiate between discrete and continuous random variables.

(i)A random variable is a variable whose value is subject to randomness.

(ii) Discrete Random Variable: Takes on a finite or countable number of values (e.g., number of students in a class).

(iii)Continuous Random Variable: Takes on an infinite number of values within a range (e.g., height, time).

1.0.12 12. Provide an example dataset, calculate both covariance and correlation, and interpret the results.

Covariance and correlation both measure the relationship between two variables:

(i) Covariance: Measures the direction of the linear relationship between variables.

Positive covariance means the variables increase together; negative covariance means one increases while the other decreases. Correlation: Standardizes the covariance to a value between -1 and 1. Correlation of 1: Perfect positive linear relationship. Correlation of -1: Perfect negative linear relationship. Correlation of 0: No linear relationship.