

Biostatistics

Descriptive Questions

Introduction of Biostatistics

Q.1 What is biostatistics? Describe its uses and examples.

09411001

Ans. Introduction

Biostatistics is a branch of statistics that applies statistical methods to biological sciences. Biostatistics is essential for designing biological experiments, clinical trials, and epidemiological studies.

Uses of Biostatistics

The major uses of biostatistics include:

1. Designing Experiments and Studies

Introduction

Biostatistics helps in planning and structuring experiments to ensure that the data collected will be relevant and sufficient to answer the research questions.

Example

In a clinical trial testing a new drug, biostatisticians determine the sample size needed to detect a significant effect.

2. Analyzing Biological Data

Introduction

Biostatistics involves applying statistical techniques to analyse data. This analysis can uncover trends, correlations and patterns.

Example

Analyzing the growth rates of plants under different environment conditions can reveal how factors like light and water affect growth.

3. Interpreting Results

Introduction

After analyzing data, biostatistics helps interpret the result in a meaningful way.

Example

Interpreting the results of a survey on the prevalence of a disease in a population can guide public health interventions.

4. Predicting Outcomes

Introduction

Biostatistics can be used to create models that predict future outcomes based on current data.

Example

Predicting the spread of an infectious disease within a population helps in planning vaccination campaigns and allocating resources.

5. Public Health and Policy Making

Introduction

In public health biostatistics provides evidence-based insights that guide policy

decision and health guidelines.

Example

Statistical analysis of a data on COVID-19 rates can lead to the implementation of COVID-19 vaccination campaign.

Examples of the uses of the Biostatistics

1. Epidemiology

Introduction

Epidemiologists use biostatistics to study the distribution and determinants of health and diseases in populations.

Example

Analysing data on COVID -19 infection rates, recovery rates and the effectiveness of vaccines involves biostatistical methods.

2. Genetics

Introduction

Biostatistics is used in genetic research to analyse the inheritance of traits and the association of genetic variations with diseases.

Example

Genetic studies use biostatistics to identify genetic markers linked to diseases like diabetes and cancer.

3. Agriculture

Introduction

In agricultural research biostatistics helps in analyzing crop yields, the effectiveness of fertilizers, and the resistance of plants to pests and diseases.

Example

Comparing the yield of different wheat varieties under various farming practices involves statistical analysis.

4. Clinical Trials

Introduction

Biostatistics is crucial in the design and analysis of clinical trials that test new treatments and drugs.

Example

Determining whether a new medication is more effective than a placebo requires rigorous statistical testing to ensure the results are statistically significant

Mean, Median and Mode

Q.2 Discuss the differences between mean, median and mode. Include examples where each measure is most appropriate to use.

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Ans. Mean, Median and Mode

The mean, median and mode are the measures that help summarize and understand data sets.

1. Mean

Introduction

The mean also known as the average is the sum of all the values in a data set divided by the number of values. It represents the central value of a data set.

Formula

$$\text{Mean} = \frac{\text{Sum of All Data Points}}{\text{Number of Data Points}}$$

Examples

Consider the following data set representing the heights (in cm) of five students:
150, 160, 165, 155, 170

$$\text{Mean} = \frac{150+160+165+155+170}{5} = \frac{800}{5} = 160$$

So the mean height is 160 cm.

2. Median

Introduction

The median is the middle value of a data set when the values are arranged to ascending or descending order. If the number of values is odd, the median is the middle value. If the number of values is even, the median is the average of the two middle values.

Steps to Calculate Median

- Arrange the data in ascending order.
- If the number of values (n) is odd, the median is the value at the position $\frac{n+1}{2}$
- If the number of values (n) is even, the median is the average of the values at positions $(\frac{n}{2})$ and $(\frac{n}{2} + 1)$.

Examples

Consider the data set: 150, 160, 165, 155, 170.

- Arrange in ascending order: 150, 155, 160, 165, 170.
- Number of values (n) = 5 (odd).
- Median is the value at position $\frac{5+1}{2} = 3$.

So, the median height is 160 cm.

For an even number of values, consider the data set: 150, 160, 165, 155.

- Arrange in ascending order: 150, 155, 160, 165
- Number of values (n) = 4 (even).
- Median is the average of the values at positions $(\frac{4}{2}) = 2$ and $(\frac{4}{2} + 1) = 3$.

$$\text{Median} = \frac{155+160}{2} = \frac{315}{2} = 157.5$$

So, the median height is 157.5 cm.

3. Mode

Introduction

The mode is the value that appears most frequently in a data set. A data set may have one mode more than one mode or no mode at all.

Steps to Calculate Mode

- Count the frequency of each value in the data set.
- The value with the highest frequency is the mode.

Example 1

Consider the data set 150, 160, 165, 155, 160.

- Frequencies 150 (1), 160 (2), 165 (1), 155 (1).
- The value with the highest frequency is 160.

So the mode of the data set is 160.

Example 2

Consider the data set 150, 160, 160, 155, 155

- Frequencies 150 (1), 160 (2), 155 (2).
- The values with the highest frequency are 160 and 155.

So the data set is bimodal with modes 160 and 155.

Example 3

Consider the data set 150, 160, 165, 155, 170

- Frequencies 150 (1), 160 (1), 165 (1), 155 (1), 170 (1).
- All the values have the same frequency.

So this data set has no mode.

Bar Chart

Q.3 Describe the steps involves in creating a bar chat using excel. Include a discussion on how to customize the chart for better visualization and interpretation of data?

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Ans. Introduction

A bar chart is a graphical representation of data using bars of different heights or lengths.

Uses

It is used to compare the quantities of different categories. Bar charts are effective for comparing different categories and visually representing the distribution of data.

Steps to Create a Bar Chart

- i. Gather the data to be represented in the bar chart.
- ii. Arrange the data into categories and their corresponding values.
- iii. Draw a horizontal axis (x-axis) and a vertical axis (y-axis).
- iv. Label the x-axis with the categories and the y-axis with the values.
- v. Determine the scale for the y-axis based on the range of values in the data set. Divide the axis into equal intervals.
- vi. For each category draw a bar with a height corresponding to its value. Ensure the bars are of equal width and are spaced evenly.
- vii. Label each bar with its category name and value.

Example

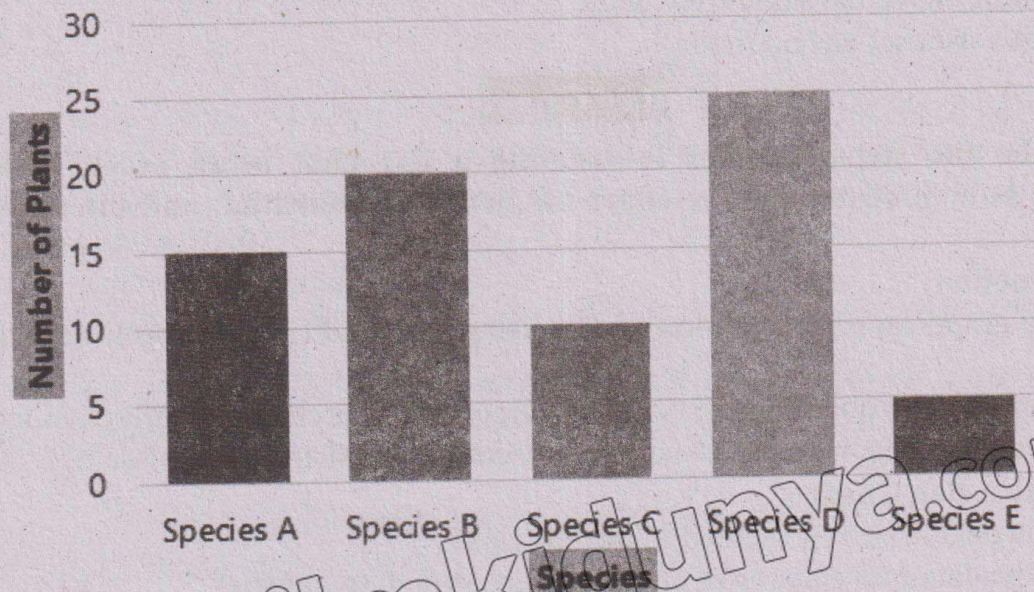
Consider the following data representing the number of different species of plants found in a field survey:

Species	Number of Plants
Species A	15
Species B	20
Species C	10
Species D	25
Species E	5

1. **Collect Data:** This data is already collected in the table above.
2. **Organize Data:** Data is organized in the table with species and their corresponding number of plants.
3. **Draw Axes:** Draw the x-axis and y-axis

4. **Label the x-axis with the species:** A, B, C, D, E. Label the y-axis with the values i.e. number of plants.
5. **Scale the Axes:** The highest value is 25. Use a scale with intervals of 5 i.e. 0, 5, 10, 15, 20, 25.
6. **Draw Bars:** For each species draw a bar up to the corresponding number of plants.
7. **Label the Bars:** Label each bar with the species name and its value.

Chart: Number of Plants



Q.4 Provide a detailed example of how to calculate mean, median and mode of a data set. Use the following data set for your calculations: 09411004

12, 15, 22, 8, 19, 25, 15

Ans.

1. Mean

The mean is the average of all values in the data set.

Steps

Add all the values together:

$$12 + 15 + 22 + 8 + 19 + 25 + 15 = 116$$

Divide the total by the number of values (7)

$$\text{Mean} = \frac{116}{7} = 16.57$$

2. Median

The median is the middle value of the data set when it is arranged in ascending order.

Steps

Arrange the data in ascending order:

8, 12, 15, 15, 19, 22, 25

Identify the middle value

Since there are 7 values (odd number) the median is the 4th value.

Median = 15

3. Mode

The mode is the values that occur most frequently in the data set.

Steps

Identify the frequency of each values

8	=	1 time
12	=	1 time
15	=	2 times
19	=	1 time
22	=	1 time
25	=	1 time

The value that occurs most frequently is 15

Mode = 15

Summary of Results

Mean = 16.57

Median = 15

Mode = 15

Q.5 You are given the following data set, create a bar chart to represent the number of different types of fruits sold at a market in one week. 09411005

Apples = 30

Bananas = 45

Oranges = 20

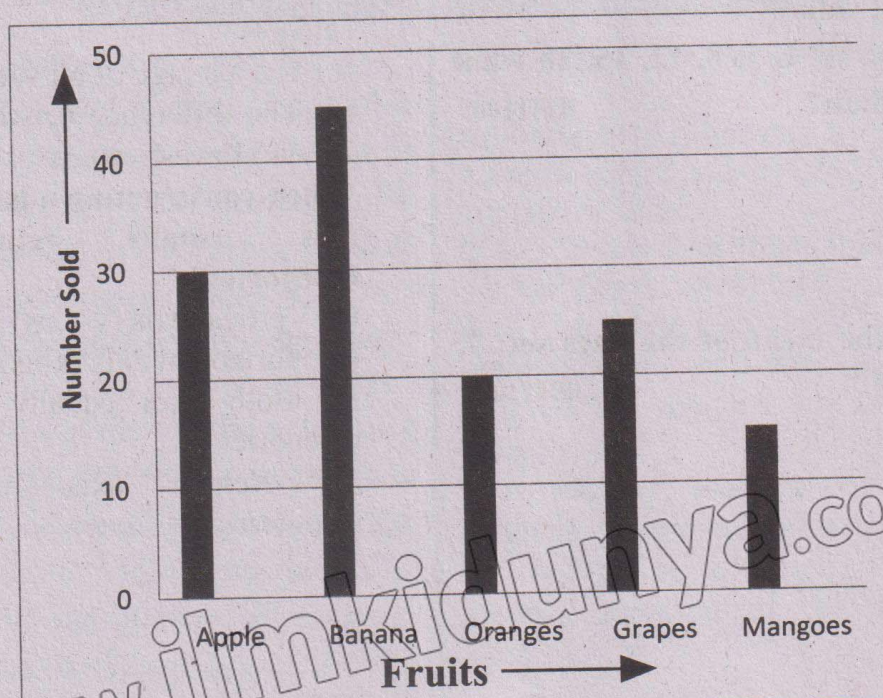
Grapes = 25

Mangoes = 15

Ensure to label the axes and provide a title for the chart.

Ans. The following bar chart representing the number of different types of fruits sold at a market in one week. The chart includes labeled axes and a title for clarity.

Number of different types of fruits sold in one week.



Multiple Choice Questions (Exercise)

1. What is the primary purpose of biostatistics? 09411006
 - (a) To analyse financial data.
 - (b) To apply statistical methods to biological sciences
 - (c) To design engineering models
 - (d) To study historical events
2. In biostatistics which method is used to predict future outcome based on current data? 09411007
 - (a) Designing experiments
 - (b) Interpreting results
 - (c) Predicting outcomes
 - (d) Analysing data
3. Which of the following best describes the mean of a data set? 09411008
 - (a) The most frequent occurring value.
 - (b) The middle value when data is ordered.
 - (c) The sum of all values divided by the number of values
 - (d) The difference between the highest and lowest values
4. If the data set is 5, 8, 12, 15, 20 what is the median? 09411009
 - (a) 8.
 - (b) 12
 - (c) 15
 - (d) 20
5. What is the mean of the data set: 7, 8, 9, 10, 11? 09411010
 - (a) 7
 - (b) 8
 - (c) 9
 - (d) 10
6. When the number of values in a data set is even, how is the median calculated? 09411011
 - (a) By choosing the middle value.
 - (b) By taking the average of the two middle values
 - (c) By selecting the most frequent value
 - (d) By adding all values and dividing by the total number of values
7. In a data set with values 3, 3, 6, 7, 8, 9, 9. what is the mode? 09411012
 - (a) 3
 - (b) 6
 - (c) 7
 - (d) Both 3 and 9
8. If a data set has no repeated values what is the mode? 09411013
 - (a) The highest value
 - (b) The average of the data set
 - (c) There is no mode
 - (d) The median value
9. In a bar chart what does the height or length of each bar represent? 09411014
 - (a) The total number of categories
 - (b) The value of the corresponding category
 - (c) The average of all values
 - (d) The difference between the highest and lowest values
10. When constructing a bar chart which axis usually represents the categories? 09411015
 - (a) Vertical axis (y-axis)
 - (b) Horizontal axis (x-axis)
 - (c) Both axes equally represent the categories
 - (d) Neither axis represents the categories

Multiple Choice Questions (Additional)

Biostatistics and Its Applications

11. Biostatistics is essential for: 09411016

- (a) Designing biological experiments
- (b) Chemical trials
- (c) Epidemiological studies
- (d) All above

12. Genetic studies use biostatistics to identify genetic markers linked to diseases like: 09411017

- (a) Hepatitis
- (b) Cancer
- (c) Diabetes
- (d) Both B & C

Mode, Median and Bar Chart

13. Which of the following is effective for comparing different categories and visually representing the distribution of data: 09411018

- (a) Mode
- (b) Mean
- (c) Median
- (d) Bar charts

14. The value that appears most frequently in a data: 09411019

- (a) Mode
- (b) Mean
- (c) Median
- (d) All above

15. The middle value of a data set when the values are arranged in ascending or descending order is called:

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- (a) Mean
- (b) Median
- (c) Mode
- (d) None above

Answer Key

1	b	2	c	3	c	4	b	5	c
6	b	7	d	8	c	9	b	10	b
11	d	12	d	13	d	14	a	15	b

Short Answer Questions (Exercise)

Q.1. Define biostatistics. 09411021

Ans. Biostatistics is a branch of statistics that applies statistical methods to biological sciences. Biostatistics is essential for designing biological experiments, clinical trials, and epidemiological studies.

Q.2. What is the median of a data set?

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Ans. The median is the middle value of a data set when the values are arranged to ascending or descending order. If the number of values is odd, the median is the middle value. If the number of values is even, the median is the average of the two middle values.

Q.3. How is the mean calculated?

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Ans. Mean is calculated by adding all the values together and dividing the total by the number of values.

Q.4. What does the height of a bar in a bar chart represent? 09411024

Ans. A bar chart is a graphical representation of data using bars of different heights or lengths.

Uses

It is used to compare the quantities of different categories. Bar charts are effective for comparing different categories and visually representing the distribution of data.

Q.5. What is the mode of a data set?

09411025

Ans. The mode is the value that appears most frequently in a data set. A data set may have one mode more than one mode or no mode at all.

Steps to Calculate Mode

- i. Count the frequency of each value in the data set.

- ii. The value with the highest frequency is the mode.

Example 1

Consider the data set 150, 160, 165, 155, 160

- Frequencies 150 (1), 160 (2), 165 (1), 155 (1).
- The value with the highest frequency is 160. So the mode of the data set is 160.

Short Answer Questions (Additional)

Biostatistics and Its Applications

Q.6. Enlist the uses of biostatistics.

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Ans. (a) Designing biological experiments
(b) Chemical trials
(c) Epidemiological studies

Q.7. Explain any two uses of biostatistics.

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Ans. Uses of Biostatistics

The major uses of biostatistics include:

1. Designing Experiments and Studies

Introduction

Biostatistics helps in planning and structuring experiments to ensure that the data collected will be relevant and sufficient to answer the research questions.

Example

For instance, in a clinical trial testing a new drug, biostatisticians determine the sample size needed to detect a significant effect.

2. Analyzing Biological Data

Introduction

Biostatistics involves applying statistical techniques to analyze data. This analysis can uncover trends, correlations and patterns.

Example

Analyzing the growth rates of plants under different environmental conditions can reveal how factors like light and water affect growth.

Q.8. Give two examples of the uses of biostatistics.

09411028

Ans.

i. Epidemiology

Introduction

Epidemiologists use biostatistics to study the distribution and determinants of health and diseases in populations.

Example

Analyzing data on COVID -19 infection rates recovery rates and the effectiveness of vaccines involves biostatistics methods.

ii. Genetics

Introduction

Biostatistics is used to genetic research to analyze the inheritance of traits and the association of genetic variations with diseases.

Example

For instance, genetic studies use biostatistics to identify genetic markers linked to diseases like diabetes and cancer.

Median and Mode

Q.9. Write the steps to calculate median and mode.

09411029

Ans. Steps to Calculate Median

- i. Arrange the data in ascending order.

ii. If the number of values (n) is odd, the median is the value at the position $\frac{n+1}{2}$.

iii. If the number of values (n) is even, the median is the average of the values at positions $(\frac{n}{2})$ and $(\frac{n}{2} + 1)$

Steps to Calculate Mode

- i. Count the frequency of each value in the data set.
- ii. The value with the highest frequency is the mode.

Bar Chart

Q.10. How can a bar chart created?

09411030

Ans. Steps to create a bar chart

- i. Gather the data to be represented in the bar chart.
- ii. Arrange the data into categories and their corresponding values.
- iii. Draw a horizontal axis (x-axis) and a vertical axis (y-axis)
- iv. Label the x-axis with the categories and the y-axis with the values.
- v. Determine the scale for the y-axis based on the range of values in the data set. Divide the axis into equal intervals.
- vi. For each category draw a bar with a height corresponding to its value. Ensure the bars are of equal width and are spaced evenly.
- vii. Label each bar with its category name and value.