"You Do It" Solution

Lecture 3: Numerical Descriptive Measures

Prepared as a classroom-ready detailed solution set for ECOM5005

Exercise 1: Finding the First Quartile

Question

Find the first quartile of the following ordered array:

$$11,\ 12,\ 13,\ 16,\ 16,\ 17,\ 18,\ 21,\ 22.$$

Detailed Solution

Step 1: Confirm that the data are ranked.
Quartiles are determined from **ordered data**. The values are already arranged from smallest to largest, so no re-ordering is required.

Step 2: Identify the sample size.
There are nine observations, so

$$n = 9.$$

Step 3: Use the Lecture 3 formula for the position of the first quartile.
The lecture defines the position of the first quartile as

$$\text{Position of } Q_1 = \frac{n+1}{4}.$$

Substituting $n = 9$ gives

$$\text{Position of } Q_1 = \frac{9+1}{4} = \frac{10}{4} = 2.5.$$

Step 4: Apply the course rule for a fractional-half position.
The calculated position is **2.5**. Under the calculation rule used in Lecture 3, a fractional-half position means that we average the two data values surrounding that position: the 2nd and 3rd ranked observations.

Rank	1	**2**	**3**	4	5	6	7	8	9
Value	11	**12**	**13**	16	16	17	18	21	22

Therefore,

$$Q_1 = \frac{12+13}{2} = \frac{25}{2} = \boxed{12.5}.$$

Exercise 1: Interpretation and Final Answer

Interpretation

The first quartile is $Q_1 = 12.5$. Conceptually, Q_1 marks the lower-quarter location of the ordered data: it separates the lower part of the distribution from the remaining observations. In this exercise the quartile falls halfway between the second observation (12) and the third observation (13), so the quartile value itself does not have to be one of the original observations.

Position versus Quartile Value

A common mistake is to stop after obtaining the number 2.5. That number is only the **ranked position** of Q_1; it is not the quartile itself. Because position 2.5 lies halfway between ranks 2 and 3, the lecture rule requires us to average the corresponding observations:

$$\text{rank } 2 = 12, \qquad \text{rank } 3 = 13,$$

so the actual quartile is 12.5.

Connection to Other Lecture 3 Measures

The first quartile is one element of the **five-number summary**: minimum, Q_1, median, Q_3, and maximum. It is also used to calculate the interquartile range,

$$\text{IQR} = Q_3 - Q_1,$$

which measures the spread of the middle 50% of the data. Correct quartile calculation therefore matters for later topics such as IQR and box-and-whisker plots.

Answer Summary

Final answer:

$$\boxed{Q_1 = 12.5}$$

Calculation:

$$\frac{n+1}{4} = \frac{10}{4} = 2.5 \quad \Longrightarrow \quad Q_1 = \frac{12+13}{2} = 12.5.$$

Final Check

For quartile questions in this lecture, always: (1) rank the data, (2) calculate the quartile *position*, and (3) apply the stated position rule. Do not confuse the position 2.5 with the quartile value 12.5.

Exercise 2: Measure of Location versus Measure of Variation

Question

Which of the following is **not** a measure of location?

A. Mean
B. Median
C. Variance
D. Mode

Detailed Solution

Step 1: Recall what a measure of location describes.
In the terminology used in this lecture, measures of location describe the **central or typical position** of a distribution. Earlier in Lecture 3, the three principal measures of central tendency are identified as the **mean**, **median**, and **mode**.

Step 2: Examine each option.

Option	Explanation
A. Mean	The arithmetic mean gives an average or central value. It is a measure of central tendency/location.
B. Median	The median is the middle ranked value (or the average of the two middle values when the sample size is even). It is a measure of central tendency/location.
C. Variance	Variance describes the **scatter or dispersion** of observations around the mean. It is a measure of **variation**, not location.
D. Mode	The mode is the most frequently occurring value. It is another measure of central tendency/location.

Step 3: Select the option that does not belong to the location group.
Because variance measures **spread** rather than **central position**, the correct answer is

$$\boxed{\text{C. Variance}}.$$

Exercise 2: Interpretation and Final Answer

Why Variance Is Different

Variance is calculated from squared deviations from the mean:

$$S^2 = \frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}.$$

The purpose of this calculation is to quantify how far observations are dispersed around the mean. A larger variance indicates greater spread; a smaller variance indicates greater concentration. Thus, variance answers a different question from mean, median, and mode.

Location versus Spread: A Quick Diagnostic

Ask what the statistic is designed to summarise:

- If it tells us **where the distribution is centred**, it is a location/central-tendency measure.
- If it tells us **how dispersed the observations are**, it is a variation measure.

Mean, median, and mode answer the first question. Variance answers the second. This distinction is also reflected in the lecture sequence: central tendency is introduced first, followed by measures of variation such as range, IQR, variance, standard deviation, and coefficient of variation.

Answer Summary

Correct answer: C. Variance.

Measure	Main purpose	Classification
Mean	Describes the average centre	Location / central tendency
Median	Describes the middle position	Location / central tendency
Mode	Describes the most frequent value	Location / central tendency
Variance	Describes dispersion around the mean	**Variation**

Final Check

A useful exam shortcut is to ask: *Does this statistic describe where the data are centred, or how widely the data are spread?* Mean, median, and mode describe location; variance describes spread.