Statistics topic test 5 - design, evidence and limitations

10 questions | 40 marks | 65 minutes

A progressive original paper on investigation design, numerical summaries and evidence-based interpretation.

Equivalent correct methods earn the corresponding marks.

1. A student investigates whether paid-work status is associated with school-night sleep in Year 11. [4 marks]

(a) Define a comparison question and the two variables. [2 marks]

Use a common period and consistent sleep definition.

Answer: Compare school-night sleep hours for current Year 11 students with/without paid work; record sleep hours and job status.

(b) Why will a survey not establish that work caused any sleep difference? [2 marks]

Observational comparisons do not isolate one causal factor.

Answer: Commuting, family responsibilities and study load may also differ.

2. The cohort contains 120 students with paid work and 280 without. Select 80 proportionally. [4 marks]

(a) Find allocations. [2 marks]

$80(\frac{120}{400}) = 24$ and $80(\frac{280}{400}) = 56$.

Answer: 24 with work; 56 without.

(b) Describe selection and one remaining limitation. [2 marks]

Proportional allocation alone does not guarantee the measured sample is representative.

Answer: Select randomly within each stratum; non-response or self-report error may remain.

3. Sleep records include 7 h 30, 7.5, blank and 0. [4 marks]

(a) Give a consistent numeric coding rule. [2 marks]

Values must share a definition and unit.

Answer: Use decimal hours: 7 h 30 becomes 7.5; keep blank missing and verify other entries.

(b) Why check zero rather than automatically deleting it? [2 marks]

Use the source response to distinguish these.

Answer: It may mean no sleep or may be a missing-code error.

4. Sleep A: 5, 6, 6, 7, 7, 8, 8, 9. Sleep B: 4, 6, 7, 7, 8, 8, 9, 11. [4 marks]

(a) Find both means and medians. [2 marks]

Totals 56 and 60; divide by 8. Average each middle pair.

Answer: A: mean 7, median 7; B: mean 7.5, median 7.5.

(b) Find IQRs using medians of halves. [2 marks]

A $Q_1 = 6$, $Q_3 = 8$; B $Q_1 = 6.5$, $Q_3 = 8.5$.

Answer: Both 2 hours.

5. Another group records 6, 7, 8 hours with frequencies 3, 4, 3. [4 marks]

Hours	6	7	8
Frequency	3	4	3

(a) Calculate weighted mean. [2 marks]

Weighted total $18 + 28 + 24 = 70$; count 10.

Answer: 7 hours.

(b) Find percentage reporting at least 8 hours. [2 marks]

Three of 10 observations.

Answer: 30%.

6. A school-night sample has $Q_1 = 6$ hours, $Q_3 = 8$ hours. [4 marks]

(a) Find both 1.5-IQR fences. [2 marks]

IQR 2; subtract/add 3.

Answer: 3 and 11 hours.

(b) Is 12 hours flagged, and what should be checked? [2 marks]

A flag initiates checking rather than proving error.

Answer: Yes; verify original value, units and whether it refers to a school night.

7. Two samples have mean 7 hours and sample SDs 0.8 and 1.6 hours. [4 marks]

(a) Compare typical level and variability. [2 marks]

Its values are more spread around their mean.

Answer: Same mean; the second has twice the sample SD.

(b) Must their medians also be equal? [2 marks]

Different shapes can share the same mean.

Answer: No.

8. A bar chart compares 6.8 and 7.2 hours with a vertical axis starting at 6.7. [4 marks]

(a) Calculate the actual difference in hours and minutes. [2 marks]

$7.2 - 6.8 = 0.4$ and $0.4(60) = 24$.

Answer: 0.4 hour; 24 minutes.

(b) Suggest a less misleading presentation. [2 marks]

Truncated bars can exaggerate a small difference in centre.

Answer: Use an honest common scale or a distribution plot showing variability.

9. Of 60 respondents, 20 have paid work. In the 400-person population, 120 have paid work. [4 marks]

(a) Compare sample and population percentages. [2 marks]

$\frac{20}{60} \times 100 \approx 33.3\%;\ \frac{120}{400} \times 100 = 30\%.$

Answer: Sample about 33.3%; population 30%.

(b) Does the difference alone prove sampling bias? [2 marks]

Bias is systematic; inspect method, coverage and non-response.

Answer: No; it can arise through random sampling variation.

10. The study uses 60 respondents at one school in one week. Group medians differ by 0.5 hour; no direction is supplied. [4 marks]

(a) Write the main finding without inventing direction or causation. [2 marks]

Do not invent which group slept less.

Answer: In this sample, median sleep in the two paid-work groups differed by 0.5 hour during the survey week.

(b) Give two limits and one practical next step. [2 marks]

The improvement addresses real design limitations.

Answer: One school and one week limit generalisation; repeat across comparable weeks with consistent definitions and record non-response.