Statistics topic test 4 - service investigation

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 manager compares daily waiting times at two service branches. [4 marks]

(a) Write a measurable question. [2 marks]

Specify variable, groups and common period.

Answer: How do customer-wait distributions in minutes compare between the branches during the same four-week period?

(b) Give two collection rules for a fair comparison. [2 marks]

Different measurement procedures or periods can confound results.

Answer: Use the same waiting-time definition and comparable days/times.

2. Branch A records every tenth arrival after a random start. B records customers volunteering to complain. [4 marks]

(a) Name both methods. [2 marks]

Classify the actual selection rules.

Answer: A: systematic; B: voluntary response.

(b) Why may their summaries not compare the branches fairly? [2 marks]

Selection differences can create an apparent branch difference.

Answer: Complainants may have unusually long waits.

3. Waiting times are 4, 6, 7, 7, 9, 10, 12, 17 minutes. [4 marks]

(a) Find mean and median. [2 marks]

Total 72 divided by count 8; middle 7 and 9 average 8.

Answer: Mean 9 min; median 8 min.

(b) Find Q_1, Q_3, range, IQR. [2 marks]

Lower-half median 6.5; upper-half 11; $17 - 4 = 13$; $11 - 6.5 = 4.5$.

Answer: 6.5, 11, 13, 4.5.

4. Grouped waits have counts 6, 9, 5 in intervals $0 \le t < 5$, $5 \le t < 10$, $10 \le t < 15$. [4 marks]

Wait (min)	$0 \le t < 5$	$5 \le t < 10$	$10 \le t < 15$
Frequency	6	9	5

(a) What percentage waited less than 10 min? [2 marks]

15 of 20; $\frac{15}{20} \times 100 = 75\%$.

Answer: 75%.

(b) Why is the exact median unavailable? [2 marks]

Grouping loses exact observations.

Answer: The middle values are in the 5-10 interval but their individual values are unknown.

5. Summaries are A $(2, 5, 8, 13, 25)$, B $(3, 7, 9, 11, 18)$. [4 marks]

(a) Which has lower median and which lower IQR? [2 marks]

Centre and spread need separate comparisons.

Answer: A has lower median 8 vs 9; B has lower IQR 4 vs 8.

(b) Give a qualified recommendation about faster service. [2 marks]

Neither summary supplies an unqualified winner for every customer.

Answer: A has shorter typical wait, while B’s central waits are more consistent; preference depends on the criterion.

6. A sample has mean 12 min and sample SD 3 min. [4 marks]

(a) Interpret the SD. [2 marks]

It does not mean every wait lies within 3 min of 12.

Answer: It measures variability around the mean on a scale of 3 min.

(b) Convert both summaries to seconds. [2 marks]

Multiply both by 60.

Answer: Mean 720 s; sample SD 180 s.

7. The values are 5, 6, 7, 8, 34 minutes. [4 marks]

(a) Find mean and median. [2 marks]

Total 60 divided by count 5; middle 7.

Answer: Mean 12 min; median 7 min.

(b) Find mean without 34 and explain what must justify excluding it. [2 marks]

Remaining total 26 divided by count 4; a genuine long wait cannot be hidden to improve the result.

Answer: 6.5 min; exclusion needs a documented valid reason.

8. Eighty customers are sampled but 20 do not respond. [4 marks]

(a) Calculate response rate. [2 marks]

60 of 80 respond: $\frac{60}{80} \times 100 = 75\%$.

Answer: 75%.

(b) Why can non-response matter despite random initial selection? [2 marks]

The respondents may not preserve representativeness.

Answer: Busy or unhappy customers might respond at different rates.

9. A branch graph omits units and collection dates. [4 marks]

(a) Explain why each omission matters. [2 marks]

Readers should not have to guess either.

Answer: Units define values; dates establish whether periods are comparable.

(b) Recommend two summaries for strongly skewed waiting times. [2 marks]

They describe centre and central spread with less influence from isolated extremes.

Answer: Median and IQR, with context and any unusual values discussed.

10. One week before and after a new system, waits decrease. The manager claims the system caused it. [4 marks]

(a) Give two alternative explanations. [2 marks]

Before/after differences need not all come from the system.

Answer: Customer numbers, staffing, season or weekday mix may have changed.

(b) Suggest a stronger comparison. [2 marks]

A suitable comparison helps assess alternatives without automatically proving causation.

Answer: Observe comparable periods across branches, measuring workload and staffing consistently.