

Numerical measures - exam questions

Question 1: Jan 2006 – Q3

- 3 When an alarm is raised at a market town's fire station, the fire engine cannot leave until at least five fire-fighters arrive at the station. The call-out time, X minutes, is the time between an alarm being raised and the fire engine leaving the station.

The value of X was recorded on a random sample of 50 occasions. The results are summarised below, where \bar{x} denotes the sample mean.

$$\sum x = 286.5 \quad \sum (x - \bar{x})^2 = 45.16$$

- (a) Find values for the mean and standard deviation of this sample of 50 call-out times. (2 marks)

Question 2: Jan 2006 – Q4

The time, x seconds, spent by each of a random sample of 100 customers at an automatic teller machine (ATM) is recorded. The times are summarised in the table.

Time (seconds)	Number of customers
$20 < x \leq 30$	2
$30 < x \leq 40$	7
$40 < x \leq 60$	18
$60 < x \leq 80$	27
$80 < x \leq 100$	23
$100 < x \leq 120$	13
$120 < x \leq 150$	7
$150 < x \leq 180$	3
Total	100

- (a) Calculate estimates for the mean and standard deviation of the time spent at the ATM by a customer. (4 marks)

Question 3: Jun 2010 – Q2

- 2 Before leaving for a tour of the UK during the summer of 2008, Eduardo was told that the UK price of a 1.5-litre bottle of spring water was about 50p.

Whilst on his tour, Eduardo noted the prices, x pence, which he paid for 1.5-litre bottles of spring water from 12 retail outlets.

He then subtracted 50p from each price and his resulting differences, in pence, were

-18 -11 1 15 7 -1 17 -16 18 -3 0 9

- (a) (i) Calculate the mean and the standard deviation of these differences. (2 marks)
- (ii) Hence calculate the mean and the standard deviation of the prices, x pence, paid by Eduardo. (2 marks)
- (b) Based on an exchange rate of €1.22 to £1, calculate, in euros, the mean and the standard deviation of the prices paid by Eduardo. (3 marks)

Question 4: Jan 2010 – Q2

Lizzie, the receptionist at a dental practice, was asked to keep a weekly record of the number of patients who failed to turn up for an appointment. Her records for the first 15 weeks were as follows.

20 26 32 a 37 14 27 34 15 18 b 25 37 29 25

Unfortunately, Lizzie forgot to record the actual values for two of the 15 weeks, so she recorded them as a and b . However, she did remember that $a < 10$ and that $b > 40$.

- (a) Calculate the median and the interquartile range of these 15 values. *(4 marks)*
- (b) Give a reason why, for these data:
 - (i) the mode is **not** an appropriate measure of average;
 - (ii) the standard deviation **cannot** be used as a measure of spread. *(2 marks)*
- (c) Subsequent investigations revealed that the missing values were 8 and 43.
Calculate the mean and the standard deviation of the 15 values. *(2 marks)*

Question 5: Jun 2007 – Q4

A library allows each member to have up to 15 books on loan at any one time.

The table shows the numbers of books currently on loan to a random sample of 95 members of the library.

Number of books on loan	0	1	2	3	4	5–9	10–14	15
Number of members	4	13	24	17	15	11	5	6

- (a) For these data:
 - (i) state values for the mode and range; *(2 marks)*
 - (ii) determine values for the median and interquartile range; *(4 marks)*
 - (iii) calculate estimates of the mean and standard deviation. *(4 marks)*
- (b) Making reference to your answers to part (a), give a reason for preferring:
 - (i) the median and interquartile range to the mean and standard deviation for summarising the given data; *(1 mark)*
 - (ii) the mean and standard deviation to the mode and range for summarising the given data. *(1 mark)*

Question 6: Jun 2008 – Q4

The runs scored by a cricketer in 11 innings during the 2006 season were as follows.

47 63 0 28 40 51 a 77 0 13 35

The exact value of a was unknown but it was greater than 100.

- (a) Calculate the median and the interquartile range of these 11 values. *(4 marks)*
- (b) Give a reason why, for these 11 values:
 - (i) the mode is **not** an appropriate measure of average;
 - (ii) the range is **not** an appropriate measure of spread. *(2 marks)*

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Question 1: Jan 2006 – Q3

(a)	$\text{Mean} = \frac{286.5}{50} = 5.73$ $\text{Standard deviation} = \sqrt{\frac{45.16}{49 \text{ or } 50}} =$ <p style="text-align: right; margin-right: 100px;">0.95 to 0.961</p>	B1		
		B1	2	

Question 2: Jan 2006 – Q4

(a)	$\sum fx = 8025$ $\sum fx^2 = 739975$ <p>Mean (\bar{x}) = 80.2 to 80.3</p> <p>Standard Deviation (s_n, s_{n-1}) = 30.9 to 31.2</p> <p>MPs (x): 25, 35, 50, 70, 90, 110, 135, 165</p> <p style="text-align: center; margin-top: 20px;">$\text{Mean} (\bar{x}) = \frac{\sum fx}{100}$</p>	B2		
		B2	2	
		(B1)	2	
		(M1)	4	

Question 3: Jun 2010 – Q2

2	-18 -11 1 15 7 -1 17 -16 18 -3 0 9			
(a)(i)	Mean, $\bar{d} = 1.5$ Standard deviation, σ_d or s_d $= 11.7 \text{ to } 12.3$	B1	2	
(ii)	Mean, $\bar{x} = 50 + \bar{d} = 51.5$ $x: 32 \ 39 \ 51 \ 65 \ 57 \ 49 \ 67 \ 4 \ 68 \ 47 \ 50 \ 59$ Standard deviation, σ_x or s_x $= 11.7 \text{ to } 12.3$	B1F	2	
(b)	[Values, mean or sd in (a)(i) or (a)(ii)] $\times \frac{1.22}{100}$ or 1.22 Mean = 0.628 to 0.63 Standard deviation = 0.14 to 0.151	M1 A1 A1	3	

Question 4: Jan 2010 – Q2

2(a)	Ordering values gives: (a) 14 15 18 20 25 25 26 27 29 32 34 37 37 (b) Median = 26 IQR = 34 - 18 = 16 Special Case: Identification that LQ = 18 and UQ = 34	M1 A1 A2 (A1)		4
(b)(i)	Two values (25 and 37) of mode No unique value Sparse data Many different values	B1	2	
(ii)	a and b (two values) unknown Impossible to calculate Cannot be calculated	B1	2	
(c)	$\text{Mean} = \frac{\sum x}{n} = \frac{390}{15} = 26$ <p>If not identified, assume order is \bar{x} then s</p> $\text{SD} (\sum x^2 = 11472) = 9.4 \text{ to } 9.8$ <p>Special Case: Evidence of $\frac{\sum x}{15}$</p>	B1 (M1)	2	
Total			8	

Question 5: Jun 2007 – Q4

(a)(i)	Mode = 2 Range = 15	B1		
(ii)	CF: 4 17 41 58 73 84 89 95 $x: 0 \ 1 \ 2 \ 3 \ 4 \ 9 \ 14 \ 15$ Median (48 th) = 3 Interquartile Range (72 nd - 24 th) $= 4 - 2 = 2$ If neither correct but CF attempted and matched correctly with ≥ 5 x-values	B1 B2 B2 (M1) (A1)	2	4
(iii)	Mean (\bar{x}) = 4.2 Standard Deviation (s_n, s_{n-1}) $= 3.88 \text{ to } 3.91$ If neither correct but mid-points of 7 and 12 seen and use of mean (\bar{x}) = $\frac{\sum fx}{95}$	B2 B2 (B1) (M1)	4	
(b)(i)	Unknown values (16) have no effect on median and IQR or median and IQR are exact values but \bar{x} and s are estimates	B1	1	
(ii)	Use all available data or Enable further analyses	B1	1	
Total			12	

Question 6: Jun 2008 – Q4

4(a)	Ordering: 0 0 13 28 35 40 47 51 63 77 a Median (6 th) = 40 IQR = $Q_3(9^{\text{th}}) - Q_1(3^{\text{rd}})$ $= 63 - 13 = 50$	M1 B1 (B1) B2		4
(b)(i)	Mode: Zero is not representative / sensible reason Wide range of (known) values Small number of values mostly different	B1	2	
(ii)	Range: Largest value, a, is unknown Cannot be calculated	B1	2	
Total			6	