Measures of central tendency

95 marks

Hints online, answers free with an account: mathswariz.uk/worksheets/a-level-statistics-measures-of-central-tendency/

Date

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A Do Now

Quick questions to start. Some use earlier lessons; some set a slip that the examiner reports say costs marks.

A1 Needed today [3 marks]

Find the mean, the median and the mode of these nine values: $12, 7, 9, 15, 7, 11, 8, 7, 14$.

Answer .....

A2 Needed today [2 marks]

Classify each variable as discrete or continuous: (i) the number of breakdowns of a lift in a week, (ii) the daily mean temperature at a weather station.

A3 Common slip [2 marks]

A class of 20 students has a mean mark of 64. Another class of 30 students has a mean mark of 54. Find the mean mark of all 50 students.

Answer .....

A4 Needed today [2 marks]

(i) Masses are recorded to the nearest kilogram. Write down the class boundaries and the midpoint of the class 40–49 kg. (ii) Ages are recorded in completed years. Write down the class boundaries and the midpoint of the class 16–25 years.

Answer .....

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PART 1 Mode, median and mean of a list

EXAMPLE 1 · I DO

Kofi records the number of emails he receives on 11 days:

$14,\ 9,\ 17,\ 12,\ 9,\ 21,\ 15,\ 9,\ 13,\ 18,\ 11$

(a) Find the mode, the median and the mean. (b) On the next day he receives 13 emails. Without recalculating, state the effect on the mean, the median and the mode.

Hint Put the values in order first. For (b), compare 13 with the mean, and look at where 13 falls in the ordered list.

YOUR TURN · WE DO

B1 The masses, x grams, of 15 apples are recorded and $\sum x = 2085$. A 16th apple is then added, and the mean mass of the 16 apples is 141 g.

(a) Find the mean mass of the first 15 apples. [2 marks]

Answer .....

(b) Find the mass of the 16th apple. [2 marks]

Answer .....

Total for B1: 4 marks

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EXAMPLE 2 · I DO

A sample of 25 observations has mean 6.4. A second sample of 15 observations has mean 8. (a) Find the mean of all 40 observations. (b) One value of 11 in the second sample was recorded wrongly and should be 5. Find the correct mean of all 40 observations.

Hint Turn each mean back into a total: $\sum x = n\bar{x}$. Add the totals, then divide by the total number of observations.

YOUR TURN · WE DO

B2 In a test, 18 students in Year 12 have a mean score of 72. The n students in Year 13 have a mean score of 80. The mean score of all the students is 75.2. Find n. [4 marks]

Answer .....

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C1 The mean of 12 numbers is 15. Two of the numbers, 9 and x, are removed. The mean of the other 10 numbers is 16. Find x. [3 marks]

Answer .....

C2 At shop A, 40 customers spend a mean of £18.50. At shop B, 10 customers spend a mean of £31. Jo says the mean spend of all 50 customers is $\frac{18.5+31}{2} = 24.75$ pounds. Explain why Jo is wrong, find the correct mean, and say when Jo's method would be correct. [4 marks]

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PART 2 Averages from frequency tables

EXAMPLE 3 · I DO

The table shows the number of goals scored in 35 football matches. Find the mode, the median and the mean. A website wants one number to describe "a typical match". Which average would you use? Give a reason.

Goals, x	0	1	2	3	4
Frequency, f	7	12	9	5	2

Hint The mode is the value with the highest frequency, not the highest frequency itself. For the median, add up the frequencies until you pass the middle position.

YOUR TURN · WE DO

B3 The table shows the number of pets owned by each person in a survey. The mean number of pets is 1.5.

Pets, x	0	1	2	3	4
Frequency, f	9	p	11	6	4

(a) Find p. [3 marks]

Answer .....

(b) Find the median number of pets. [2 marks]

Answer .....

Total for B3: 5 marks

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EXAMPLE 4 · I DO

The times taken by 50 people to complete a puzzle are recorded to the nearest minute. Estimate the mean time, state the class that contains the median, and explain why your mean is an estimate.

Time (min)	Frequency
10–14	6
15–19	14
20–24	18
25–34	9
35–49	3

Hint Times to the nearest minute: the class 10–14 is $9.5 \leqslant t < 14.5$. Use the midpoint of each class as the value for every time in it.

YOUR TURN · WE DO

B4 The ages, in completed years, of 40 people at a concert are shown in the table.

Age (years)	Frequency
16–25	8
26–35	15
36–45	12
46–65	5

(a) Explain why the midpoint of the class 16–25 is 21. [2 marks]

(b) Estimate the mean age. [3 marks]

Answer .....

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(c) Write down the class that contains the median. [1 mark]

Answer .....

Total for B4: 6 marks

PRACTICE · YOU DO

C3 The shoe sizes of 40 students are shown in the table. Ravi says the median is 8, because the middle of the frequencies $3, 8, 14, 10, 5$ is 14 and he takes the shoe size 8 from the end. Explain his mistake, and find the median and the mean shoe size. [4 marks]

Shoe size	4	5	6	7	8
Frequency	3	8	14	10	5

Answer .....

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C4 The masses of 40 potatoes are shown in the table. Sam writes "estimated mean $= \dfrac{\sum fx}{5}$", because there are 5 classes. Explain Sam's mistake. State the modal class and find a correct estimate of the mean mass. [4 marks]

Mass, m (g)	Frequency
$100 \leq m < 120$	4
$120 \leq m < 140$	11
$140 \leq m < 160$	16
$160 \leq m < 180$	7
$180 \leq m < 200$	2

Answer .....

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C5 The number of texts sent in a day by 30 people is shown in the table. Lena estimates the mean using the values $4, 9, 14$ and 24 for the four classes. Explain her mistake, and find a correct estimate of the mean. [5 marks]

Texts	0–4	5–9	10–14	15–24
Frequency	5	9	10	6

Answer .....

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PART 3 Missing values, trace values and choosing an average

EXAMPLE 5 · I DO

A weather station records the daily total rainfall, in mm, for the 30 days of June. As in the large data set, 6 of the days are recorded as "tr". The other 24 days have $\sum r = 57.6$. (a) What does "tr" mean? (b) Ana removes the tr days and says the mean is $\frac{57.6}{24} = 2.4\ \text{mm}$. Explain why this is not a good estimate, and give a better one.

Hint A tr day did have some rain, but less than $0.05\ \text{mm}$. Which days does Ana's mean leave out?

YOUR TURN · WE DO

B5 For the 31 days of July the same station has 9 days recorded as tr, and the other 22 days have $\sum r = 68.2$. Estimate the mean daily rainfall for July, stating the value you use for tr. Explain why removing the tr days would give an overestimate. [4 marks]

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C6 The annual salaries, in thousands of pounds, of the 9 staff in a small office are [5 marks]

$$22,\ 24,\ 24,\ 25,\ 27,\ 28,\ 30,\ 31,\ 95$$

Find the mean, the median and the mode. A job advert gives the mean as "the average salary". Explain why the median is a better average to describe a typical salary here.

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C7 A weather station records the daily mean windspeed, in knots, for 14 days in May. As in the large data set, one day is recorded as n/a. The other 13 days are

$$6,\ 8,\ 5,\ 9,\ 11,\ 7,\ 6,\ 21,\ 8,\ 10,\ 6,\ 9,\ 7$$

(a) Explain what n/a means and how it should be dealt with when finding an average. [2 marks]

(b) Find the mean and the median of the 13 windspeeds. [3 marks]

Answer .....

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(c) State, with a reason, which of these two averages better describes a typical day. [2 marks]

(d) The missing day is later found. The mean of all 14 days is 9 knots. Find the windspeed on the missing day and state the effect on the median. [2 marks]

Answer .....

Total for C7: 9 marks

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D1 The times, t minutes, that 60 commuters spend travelling to work are shown in the table.

Time, t (min)	Frequency
$0 < t \leq 10$	8
$10 < t \leq 20$	15
$20 < t \leq 30$	21
$30 < t \leq 45$	12
$45 < t \leq 60$	4

(a) Write down the class that contains the median. [2 marks]

Answer .....

(b) Calculate an estimate of the mean time. [3 marks]

Answer .....

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(c) Explain why your answer to (b) is an estimate, and state the assumption you made. [2 marks]

(d) A second group of 40 commuters has a mean time of 21.5 minutes. Estimate the mean time of all 100 commuters. [3 marks]

Answer .....

Total for D1: 10 marks

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D2

The table shows the number of nights stayed by 50 guests at a hotel. The mean number of nights is 2.6. Ella says: "The median is 3, because 3 is in the middle of the values 1 to 5."

Ella is wrong.

(a) Find the values of a and b. [5 marks]

Nights, x	**1**	**2**	**3**	**4**	**5**
Frequency, f	14	a	9	b	3

Answer .....

(b) Explain Ella's mistake and find the median. [3 marks]

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(c) The hotel wants to quote the "most common length of stay". State this average and give its value. [2 marks]

Total for D2: 10 marks

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E Extension

Stretch

No route is given. The hints are at the end of the sheet. Use one at a time.

E1 The ten values [9 marks]

$$9,\ 12,\ 15,\ 18,\ 19,\ 21,\ 24,\ 27,\ 30,\ 35$$

have mean 21 and median 20. Two more values, a and b with $a \leqslant b$, are added. The mean of the twelve values is still 21, and the median of the twelve values is 20.5. Find a and b, showing that no other pair works.

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Extension hints

Cover these with paper. Uncover one at a time.

E1

Hint 1 The mean does not change, so the two new values add up to 2×21.

Hint 2 With twelve values the median is the mean of the 6th and 7th values in order. Ask where a and b must sit for these two values to change.

Hint 3 Try the cases: both new values below 20, one either side of 20, both above 20. Only one case can give 20.5.

How did it go?

Colour one circle on each line: not yet, nearly, yes.

I can find the mean, median and mode of raw data and of a frequency table, and estimate the mean of grouped data from the midpoints.	○ ○ ○
I can combine the means of two groups and find an unknown value, frequency or group size from a given mean.	○ ○ ○
I can use class boundaries correctly, including data to the nearest unit and ages.	○ ○ ○
I can choose and justify the best average in context, including data from the large data set.	○ ○ ○

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