A-LEVEL MATHS (EDEXCEL 9MA0) · STATISTICS YEAR 1 · CHAPTER 1: DATA COLLECTION · A* EXAM PRACTICE

Hints online, answers free with an account:
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Data collection: A* questions

73 marks

Date

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X A* exam questions

A to A*

Extended Edexcel-style questions. Show every step. The hints are at the end of the sheet. Use one at a time.

X1 A club has x junior members, 300 adult members and 200 senior members. A stratified sample of 40 members is taken by age group. The number from each group is worked out and rounded to the nearest whole number, and the three rounded numbers add up to 40. The sample contains 12 juniors. Find the set of possible values of x. [8 marks]

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X2 A firm has 42 employees: 35 office staff and 7 drivers. A simple random sample of employees is taken for a survey.

(a) A simple random sample of 6 employees is taken. Find the probability that it contains no drivers. [2 marks]

Answer .....

(b) Find the smallest sample size n for which the probability that a simple random sample of n employees contains at least one driver is more than 0.9. [4 marks]

Answer .....

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(c) Instead, a stratified sample of 6 is taken by job. Find the number of each job in it. Show that each driver has the same chance of being chosen as in a simple random sample of 6, and explain why the stratified sample is still more useful for this survey. [4 marks]

Total for X2: 10 marks

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X3 A school has 720 pupils in the lower school and 280 in the upper school. To find the mean number of hours of sleep on a school night, a sample of 40 pupils is taken at random from each part of the school. The lower school sample has mean 8.6 hours and the upper school sample has mean 7.1 hours.

(a) Mia finds the mean of all 80 values, 7.85 hours, and uses it as an estimate for the whole school. Explain why this estimate is biased, and find a better estimate. [4 marks]

(b) Find the numbers from each part in a stratified sample of 80 with the sample in proportion to the parts. [3 marks]

Answer .....

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(c) Suppose the samples in (b) have the same means, 8.6 and 7.1 hours. Find the mean of all 80 values, and explain why it differs a little from your answer to (a). [3 marks]

Total for X3: 10 marks

X4 The masses of 60 parcels were recorded to the nearest 0.5 kg. The table shows the results.

Mass recorded (kg)	Frequency
0.5–2.0	12
2.5–4.0	25
4.5–7.0	16
7.5–12.0	7

(a) Write down the class boundaries and the class width of each class. [3 marks]

Answer .....

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

Answer .....

(c) It is found that the clerk did not round to the nearest 0.5 kg: each mass was written as the multiple of 0.5 kg at or below it. The frequencies are correct. Find the new estimate of the mean, and explain the change. [4 marks]

Total for X4: 10 marks

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X5 The table is set out like an extract from the large data set: the daily total rainfall at Leuchars on 15 days. The values are for this question only. [9 marks]

Kim says: "The median daily rainfall on these days is 0.1 mm."

Mo says: "The mean daily rainfall on these days is more than 0.95 mm."

In the large data set, tr means less than 0.05 mm. Decide whether each claim is true, false, or cannot be decided from the data, giving full working.

Day	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Rainfall (mm)	0	tr	2.4	tr	0	0	6.2	tr
Day	9	10	11	12	13	14	15	
Rainfall (mm)	0.1	tr	1.8	0	tr	3.4	0.2	

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X6 Ali studies the daily mean windspeed at Leeming in the large data set. The values are for this question only.
Each windspeed is recorded to the nearest knot, and each day's Beaufort description is found from its recorded value: Light 1 to 10 knots, Moderate 11 to 16 knots, Fresh 17 to 21 knots. 1 knot $= 1.15$ mph.
For 12 days only the descriptions are available: Light on 5 days, Moderate on 4 days and Fresh on 3 days.

(a) Find the median description of the 12 days, and explain why a median can be found for these data. [2 marks]

(b) Ali codes Light as 1, Moderate as 2 and Fresh as 3, and finds a mean code of 1.83, which he calls "Moderate". Give two reasons why this mean is not a valid summary of the windspeeds. [2 marks]

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(c) Find the set of actual windspeeds, in mph, on a day described as Moderate. [3 marks]

(d) A forecaster says: "On all 12 days the daily mean windspeed was below 20 mph." Decide whether this claim must be true, could be true, or must be false. [2 marks]

Total for X6: 9 marks

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X7 A machine fills bottles using six filling heads, numbered 1 to 6, in turn: bottle 1 is filled by head 1, bottle 2 by head 2, ..., bottle 7 by head 1 again, and so on. In one run of 960 bottles, a systematic sample is taken: a start s is chosen at random from 1 to k, and then every kth bottle is taken.

(a) Explain why, with $k = 12$, every bottle in the sample was filled by the same head. [2 marks]

(b) With $k = 8$, which heads appear in the sample? Explain your answer. [3 marks]

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(c) Find every value of k from 5 to 12 for which the sample contains bottles from all six heads. [2 marks]

Answer .....

(d) With $k = 8$, find the probability that the sample contains bottles from head 4. [2 marks]

Answer .....

Total for X7: 9 marks

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X8 A club's 350 members are numbered 001 to 350. A random number generator gives whole numbers from 000 to 999, each equally likely. Numbers are generated until a simple random sample of members has been chosen.

(a) Ravi uses only the numbers 001 to 350 and ignores the others. Find the probability that a generated number can be used. [2 marks]

Answer .....

(b) Sita also uses the numbers 501 to 850, taking away 500 from each. Find the probability that a generated number can be used, and show that each member is still equally likely to be chosen by each number. [3 marks]

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(c) Tom uses every number: he divides it by 350 and uses the remainder, with a remainder of 0 meaning member 350. Show that this does not give every member the same chance of being chosen. [3 marks]

Total for X8: 8 marks

F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can work backwards from a stratified sample, including the effect of rounding.	○	○	○
I can find probabilities for simple random samples and explain how stratified sampling differs.	○	○	○
I can work with tr and n/a in the large data set, giving bounds and deciding whether a claim can be checked.	○	○	○
I can decide whether a systematic sample or a random-number method gives every member the same chance.	○	○	○

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Hints

Use one hint at a time. Cover the ones below it with a sheet of paper.

X1

Hint 1 Write the number of juniors in the sample, before rounding, in terms of x.

Hint 2 A number rounds to 12 when it is at least 11.5 and less than 12.5. Multiply through by $x + 500$, which is positive.

Hint 3 x is a whole number. Check that the adults and seniors still round so that the total is 40.

X2

Hint 1 Take the six people one at a time: the first is an office worker with probability $\dfrac{35}{42}$, and so on.

Hint 2 Work out P(no drivers) for a general n and try values of n near where it falls below 0.1.

Hint 3 Compare the chance of one particular driver being chosen, and then the chance that the sample has no driver at all.

X3

Hint 1 What fraction of the school is in the lower school? What fraction of Mia's 80 values comes from it?

Hint 2 A fair estimate gives each part's mean a weight equal to that part's share of the school.

Hint 3 In a proportional stratified sample the plain mean of all the values is already a weighted mean. Look at the effect of rounding.

X4

Hint 1 The class 0.5–2.0 holds the recorded values $0.5, 1.0, 1.5, 2.0$. A value recorded as 0.5 to the nearest 0.5 is at least 0.25.

Hint 2 Use the midpoint of each class between its boundaries, not between the recorded values.

Hint 3 If 0.5 now means from 0.5 up to 1, where are the new boundaries? How far has each midpoint moved?

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X5

Hint 1 A tr value is a real amount of rain between 0 and 0.05 mm. Where do the tr values go when the data are put in order?

Hint 2 Find the mean twice: with every tr as 0, and with every tr as 0.05.

Hint 3 Is 0.95 inside or outside the interval for the mean? What would the tr values have to add up to?

X6

Hint 1 Put the 12 descriptions in order. Which two values are in the middle?

Hint 2 Is a description a measurement? Look at how many knots each band covers.

Hint 3 A recorded value of 11 knots, to the nearest knot, is at least 10.5 knots.

X7

Hint 1 Which head fills bottle $s + 12$? Bottle $s + 8$?

Hint 2 List the heads reached when you keep moving on by k, counting round $1, 2, \ldots, 6, 1, 2, \ldots$.

Hint 3 For $k = 8$, list the head that fills bottle s for each start s from 1 to 8.

X8

Hint 1 Count how many of the 1000 numbers can be used in each method.

Hint 2 For Sita's method, which numbers give member m?

Hint 3 For Tom's method, list the numbers from 000 to 999 that leave remainder m when divided by 350. How many are there when $m = 10$? When $m = 320$?

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