AS
STATISTICS
Unit Statistics 1B

Wednesday 25 May 2016   Morning   Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
• the blue AQA booklet of formulae and statistical tables.
You may use a graphics calculator.

Instructions
• Use black ink or black ball-point pen. Pencil should only be used for drawing.
• Fill in the boxes at the top of this page.
• Answer **all** questions.
• Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
• You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
• Do not write outside the box around each page.
• Show all necessary working; otherwise marks for method may be lost.
• Do all rough work in this book. Cross through any work that you do not want to be marked.
• The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information
• The marks for questions are shown in brackets.
• The maximum mark for this paper is 75.
• Unit Statistics 1B has a **written paper only**.

Advice
• Unless stated otherwise, you may quote formulae, without proof, from the booklet.
• You do not necessarily need to use all the space provided.

Answer **all** questions.

Answer each question in the space provided for that question.

1 The table shows the trunk length, x metres, and the tail length, y metres, for each of a sample of 10 male African elephants.

x	2.06	2.07	2.11	1.94	1.96	2.10	2.02	1.92	2.05	2.02
y	1.16	1.19	1.11	1.06	1.13	1.19	1.08	1.10	1.13	1.15

(a) Calculate the value of the product moment correlation coefficient between x and y.

[3 marks]

(b) Assuming that the 10 elephants are a random sample, interpret your value in the context of this question.

[2 marks]

QUESTION PART REFERENCE | **Answer space for question 1**

QUESTION PART REFERENCE	Answer space for question 1

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2   Jeremy records the specified petrol consumptions, in miles per gallon (mpg), of 10 vehicles with similar-sized petrol engines as follows.

45.6   48.9   51.3   48.1   47.0   46.7   50.5   49.6   47.2   46.1

(a)   Calculate values for the mean and the variance of these 10 petrol consumptions.

[3 marks]

(b)   Richard asks Jeremy to find the values in part **(a)** based upon equivalent petrol consumptions measured in kilometres per litre (km/l).

Given that 1 mpg is approximately 0.354 km/l, find the equivalent values to those found in part **(a)** in the units asked for by Richard.

[4 marks]

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3   Shower-cleaner liquid is sold in spray bottles. The volume of liquid in a bottle may be modelled by a normal distribution with mean 955 millilitres and standard deviation 5 millilitres.

(a)   Determine the probability that the volume of liquid in a particular bottle is:

(i)   at most 960 millilitres;

(ii)   more than 946 millilitres;

(iii)   exactly 950 millilitres;

(iv)   between 946 millilitres and 960 millilitres.

[7 marks]

(b)   A customer buys 10 of these bottles that may be regarded as a random sample.

Determine the probability that:

(i)   all 10 of the bottles each contains more than 946 millilitres;

(ii)   the **mean** content of the 10 bottles is less than 952.5 millilitres.

[6 marks]

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4 A café serves four types of bread roll, and each roll contains one of four fillings. The combinations offered, together with the number of each combination chosen by 400 customers who purchased rolls, are shown in the table.

		Filling				
		Ham	**Chicken**	**Egg**	**Cheese**	**Total**
Type of bread roll	**Soft white**	56	45	32	17	150
	Crusty white	50	25	21	14	110
	Soft brown	30	24	17	9	80
	Crusty brown	24	26	10	0	60
	Total	160	120	80	40	400

(a) A customer is selected at random from these 400 customers. Calculate the probability that this customer chose:

(i) a crusty white roll;

(ii) a soft white roll with ham filling;

(iii) a brown roll with either ham or chicken filling;

(iv) a soft white roll, given that the customer chose chicken filling;

(v) either egg or cheese filling, given that the customer chose a white roll.

[9 marks]

(b) You may assume that the 400 customers represent a random sample of all customers purchasing rolls at this café.

Four customers, **not** included in the above 400 customers, were selected at random from those customers purchasing rolls at the café.

Estimate, **to five decimal places**, the probability that two of them chose white rolls with chicken filling and two of them chose brown rolls with ham filling.

[5 marks]

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5 The table shows the ground temperature, $x\,°C$, at 6 pm and the number of wing vibrations per second, y, made by a particular type of insect, called a striped ground cricket.

x	31.4	25.0	34.1	30.7	27.1	24.3	20.6	21.8	28.9	26.9	28.6	24.6
y	19.0	16.0	19.8	18.0	17.3	15.5	14.7	15.4	18.1	16.8	17.0	16.4

(a) (i) Calculate the equation of the least squares regression line in the form $y = a + bx$.

[4 marks]

(ii) Interpret your value for b in the context of the question.

[2 marks]

(iii) Given that the wings of striped ground crickets do not vibrate at temperatures below $15\,°C$, explain why your value for a has no practical interpretation.

[2 marks]

(b) Estimate the number of wing vibrations of a striped ground cricket when the ground temperature at 6 pm is $23\,°C$.

[1 mark]

(c) (i) Calculate the value of the residual for the point $(28.6\,,\,17.0)$.

[2 marks]

(ii) State why the sum of the residuals for the 12 points gives no useful information about the strength of the linear relationship between y and x.

[1 mark]

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6 A record was kept of the different types of vehicle caught speeding by a speed camera. An analysis revealed that, for those vehicles caught speeding by the camera, the percentage of each type of vehicle was as shown in the table.

Type of vehicle caught speeding	Motorbike	Car	Van	Heavy goods vehicle
Percentage	15	45	28	12

A random sample of 30 vehicles caught speeding by this camera is selected.

Use a binomial distribution with $n = 30$, together with relevant information from the table, to determine the probability that this sample contains:

(a) exactly 3 vans;

[3 marks]

(b) fewer than 15 cars;

[2 marks]

(c) at least 10 vans or heavy goods vehicles;

[3 marks]

(d) more than 20 but at most 25 vehicles that are **not** motorbikes.

[4 marks]

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7   *Bharat's Bakery* produces 400-gram unwrapped loaves of bread. As part of a check on the quality of the loaves, random samples of 30 loaves are regularly selected. The ordered weights, x grams, of the most recent sample and its summary information are as follows.

$$
\begin{array}{cccccccccc}
383 & 385 & 385 & 387 & 394 & 397 & 398 & 402 & 405 & 406 \\
406 & 408 & 409 & 410 & 411 & 412 & 413 & 413 & 414 & 415 \\
415 & 416 & 416 & 417 & 418 & 419 & 420 & 421 & 422 & 423
\end{array}
$$

$$\sum x = 12\,240 \quad \text{and} \quad \sum (x - \bar{x})^2 = 3972$$

(a) (i)   Construct a 98% confidence interval for the mean weight of 400-gram loaves produced by *Bharat's Bakery*.

[6 marks]

(ii)   A local regulation requires that the mean weight of unwrapped loaves of bread should be at least 0.5 per cent above their advertised nominal weight.

Do the 400-gram loaves produced by *Bharat's Bakery* meet this requirement? Justify your answer.

[3 marks]

(b)   Bharat, the bakery's owner, had previously decided that, in every random sample of 30 of the bakery's 400-gram loaves, no more than 10 per cent should weigh less than 388 grams.

State, with justification, whether or not the above sample of 400-gram loaves meets this requirement.

[2 marks]

(c)   State where in this question, if anywhere, you made use of the Central Limit Theorem.

[1 mark]

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