

Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
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2	
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TOTAL	



General Certificate of Education  
Advanced Subsidiary Examination  
June 2014

## Mathematics

## MS1B

### Unit Statistics 1B

Friday 6 June 2014 1.30 pm to 3.00 pm

**For this paper you must have:**

- the blue AQA booklet of formulae and statistical tables.
- You may use a graphics calculator.

**Time allowed**

- 1 hour 30 minutes

**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.



J U N 1 4 M S 1 B 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

- 1** Henrietta lives on a small farm where she keeps some hens.

For a period of 35 weeks during the hens' first laying season, she records, **each week**, the total number of eggs laid by the hens.

Her records are shown in the table.

Total number of eggs laid in a week ( $x$ )	Number of weeks ( $f$ )
66	1
67	2
68	3
69	5
70	7
71	8
72	4
73	2
74	2
75	1
<b>Total</b>	<b>35</b>

- (a) For these data:
- (i) state values for the mode and the range; **[2 marks]**
  - (ii) find values for the median and the interquartile range; **[3 marks]**
  - (iii) calculate values for the mean and the standard deviation. **[4 marks]**
- (b) Each week, for the 35 weeks, Henrietta sells 60 eggs to a local shop, keeping the remainder for her own use.
- State values for the mean and the standard deviation of the number of eggs that she keeps. **[2 marks]**



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**2** A garden centre sells bamboo canes of nominal length 1.8 metres. The length,  $X$  metres, of the canes can be modelled by a normal distribution with mean 1.86 and standard deviation  $\sigma$ .

**(a)** Assuming that  $\sigma = 0.04$ , determine:

- (i)**  $P(X < 1.90)$ ;
- (ii)**  $P(X > 1.80)$ ;
- (iii)**  $P(1.80 < X < 1.90)$ ;
- (iv)**  $P(X \neq 1.86)$ .

**[7 marks]**

**(b)** It is subsequently found that  $P(X > 1.80) = 0.98$ .

Determine the value of  $\sigma$ .

**[3 marks]**

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3 The table shows the colour of hair and the colour of eyes of a sample of 750 people from a particular population.

		Colour of hair					Total
		Black	Dark	Medium	Fair	Auburn	
Colour of eyes	Blue	6	51	68	66	24	215
	Brown	14	92	97	90	47	340
	Green	0	37	55	64	39	195
Total		20	180	220	220	110	750

(a) Calculate, **to three decimal places**, the probability that a person, selected at random from this sample, has:

- (i) fair hair;
- (ii) auburn hair and blue eyes;
- (iii) either auburn hair or blue eyes but not both;
- (iv) green eyes, given that the person has fair hair;
- (v) fair hair, given that the person has green eyes.

[8 marks]

(b) Three people are selected at random from the sample.

Calculate, **to three significant figures**, the probability that two of them have dark hair and brown eyes and the other has medium hair and green eyes.

[4 marks]

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- 4** Every year, usually during early June, the Isle of Man hosts motorbike races. Each race consists of three consecutive laps of the island's course. To compete in a race, a rider must first complete at least one qualifying lap.

The data refer to the lightweight motorbike class in 2012 and show, for each of a random sample of 10 riders, values of

$$u = x - 100 \quad \text{and} \quad v = y - 100$$

where

$x$  denotes the average speed, in mph, for the rider's fastest qualifying lap  
and

$y$  denotes the average speed, in mph, for the rider's three laps of the race.

		Rider									
		A	B	C	D	E	F	G	H	I	J
$u$		7.88	13.02	4.29	2.88	6.26	7.03	3.60	11.78	13.15	11.69
$v$		6.63	10.16	3.63	0.47	5.70	8.01	3.30	7.31	13.08	11.82

- (a) (i) Calculate the value of  $r_{uv}$ , the product moment correlation coefficient between  $u$  and  $v$ . **[3 marks]**
- (ii) Hence state the value of  $r_{xy}$ , giving a reason for your answer. **[2 marks]**
- (b) Interpret your value of  $r_{xy}$  in the context of this question. **[2 marks]**

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5 An analysis of the number of vehicles registered by each household within a city resulted in the following information.

<b>Number of vehicles registered</b>	0	1	2	$\geq 3$
<b>Percentage of households</b>	18	47	25	10

(a) A random sample of 30 households within the city is selected.

Use a binomial distribution with  $n = 30$ , together with relevant information from the table in each case, to find the probability that the sample contains:

(i) exactly 3 households with **no** registered vehicles; [3 marks]

(ii) at most 5 households with **three or more** registered vehicles; [2 marks]

(iii) more than 10 households with **at least two** registered vehicles; [3 marks]

(iv) more than 5 households but fewer than 10 households with **exactly two** registered vehicles. [3 marks]

(b) If a random sample of **150** households within the city were to be selected, estimate the mean and the variance for the number of households in the sample that would have **either one or two** registered vehicles. [2 marks]

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- 6** A rubber seal is fitted to the bottom of a flood barrier. When no pressure is applied, the depth of the seal is 15 cm. When pressure is applied, a watertight seal is created between the flood barrier and the ground.

The table shows the pressure,  $x$  kilopascals (kPa), applied to the seal and the resultant depth,  $y$  centimetres, of the seal.

$x$	25	50	75	100	125	150	175	200	250	300
$y$	14.7	13.4	12.8	11.9	11.0	10.3	9.7	9.0	7.5	6.7

- (a) (i) State the value that you would **expect** for  $a$  in the equation of the least squares regression line,  $y = a + bx$ . **[1 mark]**
- (ii) Calculate the equation of the least squares regression line,  $y = a + bx$ . **[4 marks]**
- (iii) Interpret, in context, your value for  $b$ . **[2 marks]**
- (b) Calculate an estimate of the depth of the seal when it is subjected to a pressure of 225 kPa. **[2 marks]**
- (c) (i) Give a statistical reason as to why your equation is unlikely to give a realistic estimate of the depth of the seal if it were to be subjected to a pressure of 400 kPa.
- (ii) Give a reason based on the context of this question as to why your equation will not give a realistic estimate of the depth of the seal if it were to be subjected to a pressure of 525 kPa. **[3 marks]**

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- 7** The volume of water,  $V$ , used by a guest in an en suite shower room at a small guest house may be modelled by a random variable with mean  $\mu$  litres and standard deviation 65 litres.
- A random sample of 80 guests using this shower room showed a mean usage of 118 litres of water.
- (a) (i)** Give a numerical justification as to why  $V$  is unlikely to be normally distributed. **[2 marks]**
- (ii)** Explain why  $\bar{V}$ , the mean of a random sample of 80 observations of  $V$ , may be assumed to be approximately normally distributed. **[2 marks]**
- (b) (i)** Construct a 98% confidence interval for  $\mu$ . **[4 marks]**
- (ii)** Hence comment on a claim that  $\mu$  is 140. **[2 marks]**

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