Paper Reference(s)

6683/01

Edexcel GCE

Statistics S1

Advanced Level

Tuesday 17 January 2012 – Morning

Time: 1 hour 30 minutes

Materials required for examination
Mathematical Formulae (Pink)

Items included with question papers
Nil

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulas stored in them.

Instructions to Candidates

In the boxes on the answer book, write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Statistics S1), the paper reference (6683), your surname, other name and signature.
Values from the statistical tables should be quoted in full. When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
This paper has 7 questions.
The total mark for this paper is 75.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

1. The histogram in Figure 1 shows the time, to the nearest minute, that a random sample of 100 motorists were delayed by roadworks on a stretch of motorway.

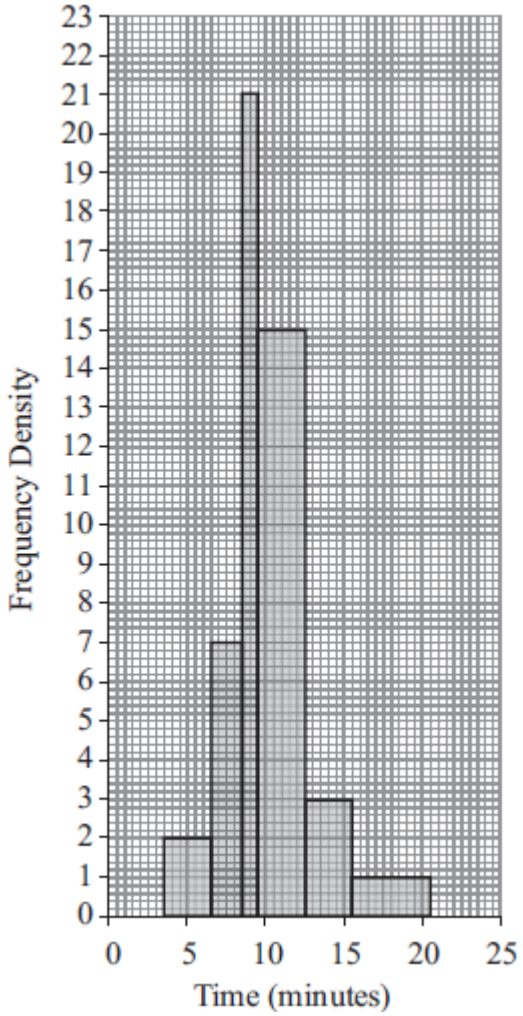

Figure 1

(a) Complete the table.

Delay (minutes)	Number of motorists
4 – 6	6
7 – 8	
9	21
10 – 12	45
13 – 15	9
16 – 20	

(2)

(*b*) Estimate the number of motorists who were delayed between 8.5 and 13.5 minutes by the roadworks.

(2)

2. (a) State in words the relationship between two events R and S when $P(R \cap S) = 0$.

(1)

The events A and B are independent with $P(A) = \frac{1}{4}$ and $P(A \cup B) = \frac{2}{3}$.

Find

(b) $P(B)$,

(4)

(c) $P(A' \cap B)$,

(2)

(d) $P(B' | A)$.

(2)

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3. The discrete random variable X can take only the values 2, 3, 4 or 6. For these values the probability distribution function is given by

x	2	3	4	6
$P(X = x)$	$\frac{5}{21}$	$\frac{2k}{21}$	$\frac{7}{21}$	$\frac{k}{21}$

where k is a positive integer.

(a) Show that $k = 3$.

(2)

Find

(b) $F(3)$,

(1)

(c) $E(X)$,

(2)

(d) $E(X^2)$,

(2)

(e) $\text{Var}(7X - 5)$.

(4)

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4. The marks, x, of 45 students randomly selected from those students who sat a mathematics examination are shown in the stem and leaf diagram below.

Mark										Totals
3	6	9	9							(3)
4	0	1	2	2	3	4				(6)
4	5	6	6	6	8					(5)
5	0	2	3	3	4	4				(6)
5	5	5	6	7	7	9				(6)
6	0	0	0	0	1	3	4	4	4	(9)
6	5	5	6	7	8	9				(6)
7	1	2	3	3						(4)

Key	(3 | 6 means 36)

(*a*) Write down the modal mark of these students.

(1)

(*b*) Find the values of the lower quartile, the median and the upper quartile.

(3)

For these students $\sum x = 2497$ and $\sum x^2 = 143\,369$.

(*c*) Find the mean and the standard deviation of the marks of these students.

(3)

(*d*) Describe the skewness of the marks of these students, giving a reason for your answer.

(2)

The mean and standard deviation of the marks of all the students who sat the examination were 55 and 10 respectively. The examiners decided that the total mark of each student should be scaled by subtracting 5 marks and then reducing the mark by a further 10 %.

(*e*) Find the mean and standard deviation of the scaled marks of all the students.

(4)

5. The age, t years, and weight, w grams, of each of 10 coins were recorded. These data are summarised below.

$$\sum t^2 = 2688 \quad \sum tw = 1760.62 \quad \sum t = 158 \quad \sum w = 111.75 \quad S_{ww} = 0.16$$

(*a*) Find S_{tt} and S_{tw} for these data.

(3)

(*b*) Calculate, to 3 significant figures, the product moment correlation coefficient between t and w.

(2)

(*c*) Find the equation of the regression line of w on t in the form $w = a + bt$.

(4)

(*d*) State, with a reason, which variable is the explanatory variable.

(2)

(*e*) Using this model, estimate

(i) the weight of a coin which is 5 years old,

(ii) the effect of an increase of 4 years in age on the weight of a coin.

(2)

It was discovered that a coin in the original sample, which was 5 years old and weighed 20 grams, was a fake.

(*f*) State, without any further calculations, whether the exclusion of this coin would increase or decrease the value of the product moment correlation coefficient. Give a reason for your answer.

(2)

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6. The following shows the results of a survey on the types of exercise taken by a group of 100 people.

65 run
48 swim
60 cycle
40 run and swim
30 swim and cycle
35 run and cycle
25 do all three

(*a*) Draw a Venn Diagram to represent these data.

(4)

Find the probability that a randomly selected person from the survey

(*b*) takes none of these types of exercise,

(2)

(*c*) swims but does not run,

(2)

(*d*) takes at least two of these types of exercise.

(2)

Jason is one of the above group.

Given that Jason runs,

(*e*) find the probability that he swims but does not cycle.

(3)

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7. A manufacturer fills jars with coffee. The weight of coffee, W grams, in a jar can be modelled by a normal distribution with mean 232 grams and standard deviation 5 grams.

(*a*) Find $P(W < 224)$.

(3)

(*b*) Find the value of w such that $P(232 < W < w) = 0.20$.

(4)

Two jars of coffee are selected at random.

(*c*) Find the probability that only one of the jars contains between 232 grams and w grams of coffee.

(3)

TOTAL FOR PAPER: 75 MARKS

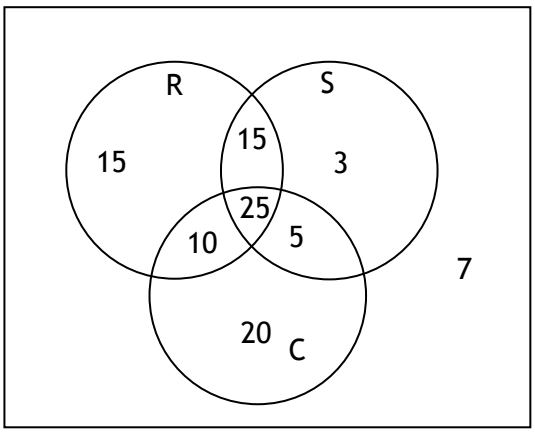
END

Question Number	Scheme	Marks
1 (a)	14, 5	M1 A1 **(2)**
(b)	21 + 45 + 3 = 69	M1 A1 **(2)**
		(4 marks)
2 (a)	*(R* and *S* are mutually) exclusive.	B1 (1)
(b)	$\frac{2}{3} = \frac{1}{4} + \mathrm{P}(B) - \mathrm{P}(A \cap B)$ use of Addition Rule	M1
	$\frac{2}{3} = \frac{1}{4} + \mathrm{P}(B) - \frac{1}{4} \times \mathrm{P}(B)$ use of independence	M1 A1
	$\frac{5}{12} = \frac{3}{4}\,\mathrm{P}(B)$	
	$\mathrm{P}(B) = \frac{5}{9}$	A1
		(4)
(c)	$\mathrm{P}(A' \cap B) = \frac{3}{4} \times \frac{5}{9} = \frac{15}{36} = \frac{5}{12}$	M1A1ft
		(2)
(d)	$\mathrm{P}(B' \mid A) = \frac{(1 - (b)) \times 0.25}{0.25}$ or $\mathrm{P}(B')$ or $\frac{\frac{1}{9}}{\frac{1}{4}}$	M1
	$= \frac{4}{9}$	A1
		(2)
		(9 marks)

Question Number	Scheme	Marks
3 (a)	$\frac{5}{21}+\frac{2k}{21}+\frac{7}{21}+\frac{k}{21}=1$	M1
	$\frac{12+3k}{21}=1$	
	$k=3$ ***** AG required for both methods	A1
		(2)
(b)	$\frac{11}{21}$	B1
		(1)
(c)	$\mathrm{E}(X)=2\times\frac{5}{21}+3\times\frac{6}{21}+4\times\frac{7}{21}+6\times\frac{1}{7}$	M1
	$=3\frac{11}{21}$ or $\frac{74}{21}$ or awrt 3.52	A1
		(2)
(d)	$\mathrm{E}(X^2)=2^2\times\frac{5}{21}+3^2\times\frac{6}{21}+4^2\times\frac{7}{21}+6^2\times\frac{1}{7}$	M1
	$=14$	A1
		(2)
(e)	$\mathrm{Var}(X)=14-\left(3\frac{11}{21}\right)^2$	M1
	$=1\frac{257}{441}$ or $\frac{698}{441}$ or awrt 1.6	A1
	$\mathrm{Var}(7X-5)=49\,\mathrm{Var}(X)$	M1
	$=77\frac{5}{9}$ or $\frac{698}{9}$ or awrt 77.6	A1
		(4)
		(11 marks)

Question Number	Scheme	Marks
4 (a)	60	B1 (1)
(b)	$Q_1 = 46$ $Q_2 = 56$ $Q_3 = 64$	B1 B1 B1 (3)
(c)	mean = 55.48…. or $\frac{2497}{45}$ awrt 55.5	B1
	sd = $\sqrt{\frac{143369}{45} - \left(\frac{2497}{45}\right)^2}$	M1
	= 10.342… (s = 10.459..) anything which rounds to 10.3 (or s = 10.5)	A1 (3)
(d)	Mean < median < mode or $Q_2 - Q_1 > Q_3 - Q_2$ with or without their numbers or median closer to upper quartile (than lower quartile) or (mean-median)/sd <0; negative skew;	B1 B1dep (2)
(e)	mean = $(5 - 5) \times 0.9$ = 45 sd = 10×0.9 = 9	M1 A1 M1 A1 (4) **(13 marks)**

Question Number	Scheme	Marks
5 (a)	$S_{tt} = 2688 - \frac{158^2}{10} = 191.6$ awrt 191.6 $S_{tw} = 1760.62 - \frac{158 \times 111.75}{10} = -5.03$ awrt -5.03	M1 A1 A1 (3)
(b)	$r = \frac{-5.03}{\sqrt{191.6 \times 0.16}} = -0.908469\ldots$ awrt -0.908(5)	M1A1 (2)
(c)	$b = \frac{-5.03}{191.6} = -0.0263$ awrt -0.026 $a = 11.175 + 0.0263 \times 15.8$ $= 11.59$ $w = 11.6 - 0.0263t$	M1 A1 M1 A1 (4)
(d)	The explanatory variable is the age of each coin. This is because the age is set and the weight varies.	B1 B1 (2)
(e) (i)	awrt 11.5	B1
(ii)	Decrease(in weight of coin of 0.1052 g) = 0.1 or –0.1 or increase of –0.1 awrt (–0.1)	B1 (2)
(f)	Decrease; removing the fake will result in a better linear fit so *r* will be closer to -1	B1;B1 (2) **(15 marks)**

Question Number	Scheme	Marks
6 (a)	 3 closed curves and 25 in correct place 15,10,5 15,3,20 Labels *R*, *S* ,*C* and box	M1 A1 A1 B1
	All values/100 or equivalent fractions award accuracy marks.	(4)
(b)	7/100 or 0.07 M1 for ('their 7'in diagram or here)/100	M1 A1
		(2)
(c)	(3+5)/100 = 2/25 or 0.08	M1A1
		(2)
(d)	(25+15+10+5)/100 = 11/20 or 0.55	M1 A1
		(2)
(e)	P $S \cap C' \mid R = \dfrac{P\ S \cap C' \cap R}{P(R)}$ Require denominator to be 'their 65' or 'their $\frac{65}{100}$'	M1
	$= \dfrac{15}{65}$ require 'their 15' and correct denominator of 65	A1
	$= \dfrac{3}{13}$ or exact equivalents.	A1 (3)
		(13 marks)
7. (a)	P(W < 224) $= \mathrm{P}\left(z < \dfrac{224-232}{5}\right)$	M1
	= P (z < -1.6)	
	= 1 - 0.9452	M1
	= 0.0548 awrt 0.0548	A1
		(3)
(b)	0.5 – 0.2 = 0.3 0.3 or 0.7 seen	M1
	$\dfrac{w-232}{5} = 0.5244$ 0.5244 seen; any z	B1; M1
	w = 234.622 awrt 235	A1
		(4)
(c)	$0.2 \times (1-0.2)$	M1
	$2 \times 0.8 \times (1-0.8) = 0.32$	M1 A1
		(3)
		(10 marks)