

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.

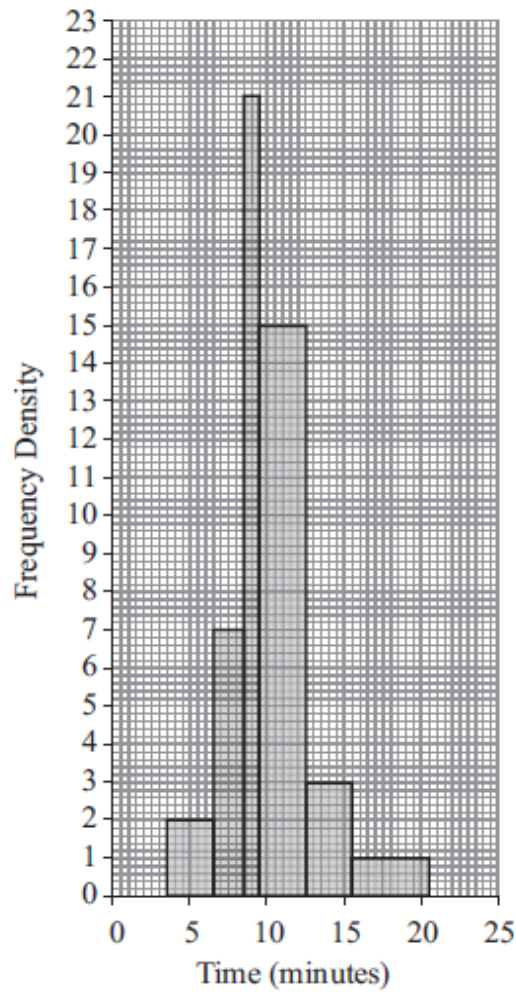


Figure 1

- (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)
-

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)
-

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	Key
3	6 9 9	(3 6 means 36)
4	0 1 2 2 3 4	
4	5 6 6 6 8	
5	0 2 3 3 4 4	
5	5 5 6 7 7 9	
6	0 0 0 0 1 3 4 4 4	
6	5 5 6 7 8 9	
7	1 2 3 3	
	(3)	
	(6)	
	(5)	
	(6)	
	(6)	
	(9)	
	(6)	
	(4)	

- (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)
-

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

**January 2012
6683 Statistics S1
Mark Scheme**

Question Number	Scheme	Marks
1 (a)	14, 5	M1 A1 (2)
(b)	$21 + 45 + 3 = 69$	M1 A1 (2) Total 4
NOTES		
(a)	M1 for 2×7 or 14 or 5×1 or 5 A1 for both 14 and 5	
(b)	M1 for $21 + 45 + (0 < \text{frequency} < 9)$ A1 for 69 only. 69 no working, award M1A1 Incorrect answer with no working M0A0	

Question Number	Scheme	Marks
<p>2 (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	<p>(<i>R</i> and <i>S</i> are mutually) exclusive.</p> $\frac{2}{3} = \frac{1}{4} + P(B) - P(A \cap B)$ <p style="text-align: right;">use of Addition Rule</p> $\frac{2}{3} = \frac{1}{4} + P(B) - \frac{1}{4} \times P(B)$ <p style="text-align: right;">use of independence</p> $\frac{5}{12} = \frac{3}{4} P(B)$ $P(B) = \frac{5}{9}$ $P(A' \cap B) = \frac{3}{4} \times \frac{5}{9} = \frac{15}{36} = \frac{5}{12}$ $P(B' A) = \frac{(1 - (b)) \times 0.25}{0.25} \quad \text{or } P(B') \text{ or } \frac{1}{\frac{1}{4}}$ $= \frac{4}{9}$	<p>B1 (1)</p> <p>M1</p> <p>M1 A1</p> <p>A1 (4)</p> <p>M1A1ft (2)</p> <p>M1</p> <p>A1 (2)</p> <p>Total 9</p>
<p>NOTES</p> <p>(a)</p> <p>(b)</p> <p>(c)</p>	<p>B1 for '(mutually) exclusive' or 'cannot occur at the same time' seen or equivalent. 'Intersection is zero' or 'no overlaps' without further explanation is B0.</p> <p>M1 for use of Addition Formula, including an intersection, with at least one probability substituted. Intersection must be explicitly considered for this mark.</p> <p>Accept $\frac{2}{3} = \frac{1}{4} + P(B) - 0$ for M1.</p> <p>M1 for $P(A \cap B) = \frac{1}{4} P(B)$</p> <p>A1 for completely correct equation or equivalent.</p> <p>A1 for $\frac{5}{9}$ or exact equivalent..</p> <p>Venn Diagram with 2 overlapping closed curves and correct values possibly without $\frac{1}{3}$, award M1M1A1.</p> <p>M1 for $\frac{3}{4}$ x 'their $P(B)$' or 'their $P(B) - P(A \cap B)$' or $P(A \cup B) - P(B) = \frac{2}{3} - \frac{1}{4}$</p> <p>Or $P(A' \cap B) = P(A') + \text{'their } P(B) - P(A' \cup B) = \frac{3}{4} + \frac{5}{9} - \frac{8}{9}$</p> <p>A1 for $\frac{5}{12}$ or follow through from their method. Accept exact equivalent.</p> <p>Correct answer only with no working M1A1 but must be clearly labelled (c).</p>	

(d)

M1 for using $1 - \text{their } P(B)$ or $(P(A \cup B) - P(A))/P(A)$ or $(P(A) - P(A \cap B))/P(A)$ with a correct attempt at the numerator and denominator. If mutually exclusive is

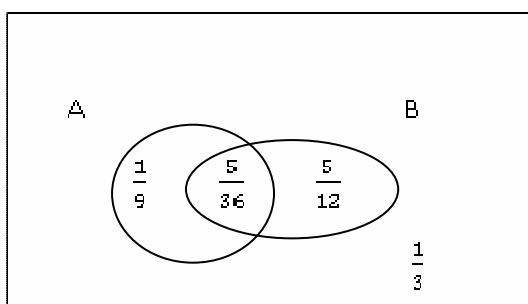
assumed then the last option gives $\frac{1}{4}$ for M1.

A1 for $\frac{4}{9}$ or exact equivalent.

For part (c) follow through their stated values; **do not** follow through incorrectly labelled regions on a Venn Diagram.

Throughout the question we require probabilities between 0 and 1 for method marks.

Venn Diagram:

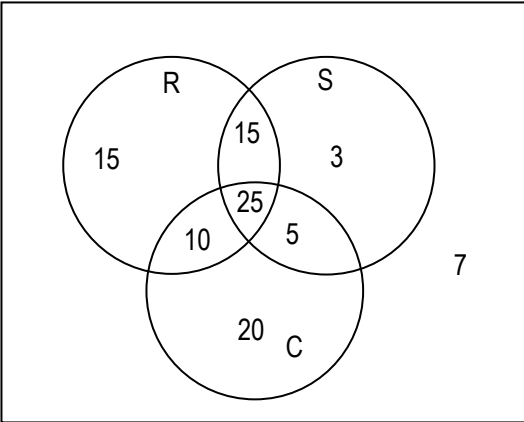


Question Number	Scheme	Marks
<p>3 (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p>	$\frac{5}{21} + \frac{2k}{21} + \frac{7}{21} + \frac{k}{21} = 1$ $\frac{12 + 3k}{21} = 1$ $k = 3 \quad * \text{ AG}$ <p style="text-align: right;">required for both methods</p> $\frac{11}{21}$ $E(X) = 2 \times \frac{5}{21} + 3 \times \frac{6}{21} + 4 \times \frac{7}{21} + 6 \times \frac{1}{7}$ $= 3 \frac{11}{21} \text{ or } \frac{74}{21} \text{ or awrt } 3.52$ $E(X^2) = 2^2 \times \frac{5}{21} + 3^2 \times \frac{6}{21} + 4^2 \times \frac{7}{21} + 6^2 \times \frac{1}{7}$ $= 14$ $\text{Var}(X) = 14 - \left(3 \frac{11}{21}\right)^2$ $= 1 \frac{257}{441} \text{ or } \frac{698}{441} \text{ or awrt } 1.6$ $\text{Var}(7X - 5) = 7^2 \text{Var}(X)$ $= 77 \frac{5}{9} \text{ or } \frac{698}{9} \text{ or awrt } 77.6$	<p>M1</p> <p>A1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>(2)</p> <p>(1)</p> <p>(2)</p> <p>(2)</p> <p>(4)</p> <p>Total 11</p>
<p>NOTES</p> <p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p>	<p>M1 Award for verification. Sub in k=3 and show $\sum x P(X = x) = 1$. Require at least three correct terms seen or line 2 of scheme.</p> <p>A1 Correct solution only including verification.</p> <p>B1 Award for exact equivalent.</p> <p>M1 At least two correct terms required for method, follow through 'their k' for method. Correct answer only, award M1 A1.</p> <p>M1 At least two correct terms required for method. M0 if probability is squared. Correct answer only, award M1 A1. Accept exact equivalent of 14 for A1.</p> <p>M1 for use of correct formula in both. 1.6 can be implied by correct final answer. Working needs to be clearly labelled to award first method mark without second stage of calculation.</p> <p>If a new table for values of $7X - 5$ is used, so $Y = 7X - 5$</p> $E(Y^2) = \frac{9751}{21}; \text{Var}(Y) = 77 \frac{5}{9} \text{ or } \frac{698}{9} \text{ or awrt } 77.6 \text{ Award M1A1; M1A1}$ <p>If any attempt to divide by 4 seen as part of working award M0 for that part.</p>	

Question Number	Scheme	Marks
<p>4 (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p>	<p>60</p> <p>$Q_1 = 46$ $Q_2 = 56$ $Q_3 = 64$</p> <p>mean = 55.48.... or $\frac{2497}{45}$ awrt 55.5</p> <p>$sd = \sqrt{\frac{143369}{45} - \left(\frac{2497}{45}\right)^2}$ = 10.342... (s = 10.459..) anything which rounds to 10.3 (or s = 10.5)</p> <p>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;</p> <p>mean = $(55 - 5) \times 0.9$ = 45 sd = 10×0.9 = 9</p>	<p>B1 (1)</p> <p>B1 B1 B1 (3)</p> <p>B1 awrt 55.5</p> <p>M1</p> <p>A1 (3)</p> <p>B1</p> <p>B1dep (2)</p> <p>M1 A1 M1 A1 (4)</p> <p>Total 13</p>
<p>NOTES</p> <p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p>	<p>B1 60 only</p> <p>Award each B1 for correct answer only in this order.</p> <p>M1 for use of correct formula, including square root. Correct answers with no working B1M1A1.</p> <p>B1 any correct comparison of a pair of mean, median and mode using their values. B1 for 'negative skew' or allow (almost) symmetrical dependent upon correct reason.</p> <p>M1 for $(55 \text{ or } 55.5 - 5) \times 0.9$ A1 for the correct answer only. M1 for $(10 \text{ or } 10.3 \text{ or } 10.5) \times 0.9$ A1 for the correct answer only.</p>	

Question Number	Scheme	Marks
5 (a)	$S_{tt} = 2688 - \frac{158^2}{10} = 191.6$ $S_{tw} = 1760.62 - \frac{158 \times 111.75}{10} = -5.03$	awrt 192 awrt -5.03 (3)
(b)	$r = \frac{-5.03}{\sqrt{191.6 \times 0.16}} = -0.908469\dots$	awrt -0.908(5) (2)
(c)	$b = \frac{-5.03}{191.6} = -0.0263$ $a = 11.175 + 0.0263 \times 15.8$ $= 11.59$ $w = 11.6 - 0.0263t$	awrt -0.026 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)
Total 15		
NOTES	<p>(a) M1 for correct attempt at either method, A1 awrt 192 A1 awrt -5.03</p> <p>(b) M1 for correct attempt at use of formula, square root required. A1 awrt -0.908(5)</p> <p>(c) M1 require 'their -5.03' as numerator and /their 191.6' as denominator. A1 awrt -0.026 M1 for use of correct formula with b or 'their b'; require -- or + and values in the correct place. A1 for equation as written with values awrt 3 sf. with w and t. Accept fractional answers that are accurate to 3sf when evaluated as decimals</p> <p>(d) B1 for 'Age' or t or 'years' B1 for 'you use age / t to predict w' or 'you can control t/ age' or 'weight depends on age' or similar</p> <p>(e) B1 awrt 11.5 B1 awrt -0.1 but 'decrease of -0.1' is B0.</p> <p>(f) B1 for Decrease only but 'mod r increases' explicitly stated in words or symbols award B1. B1 accept 'stronger correlation' or 'increase in correlation' or 'better linear fit' or 'r closer to -1' or 'points are closer to a straight line' or 'point is an outlier' or equivalent</p>	

Special Case 1	<p>Attempt to calculate S_{tw}</p> $\sum tw = 1669.62, \sum t = 153, \sum w = 91.75 \text{ or } S_{tw} = 1660.62 - \frac{153 \times 91.75}{9} \text{ or awrt } 101$ <p>or $S_{tw} > 0$ with some calculation “(Increase)”</p>	<p>B1 B1</p>	(2)
Special Case 2	<p>Attempt to calculate S_{ww}</p> $\sum w^2 = 1248.96625 - 400 = 848.96625 \text{ or awrt } 849 \text{ or } S_{ww} = 848.96625 - \frac{91.75^2}{9}$ <p>or awrt -86.4 or $S_{ww} < 0$</p>	<p>B2</p>	(2)
Special Case 3	<p>Argument based on standard deviation.</p> <p>e.g. $\sigma_w \approx 0.126$ and $\bar{w} = 11.175$ so fake coin is over 69 sds away from the mean “(very) unlikely” or “impossible”</p>	<p>B1 B1</p>	(2)

Question Number	Scheme	Marks
<p>6 (a)</p>	<div style="display: flex; align-items: flex-start;"> <div style="flex: 1;">  </div> <div style="flex: 2; padding-left: 10px;"> <p>3 closed curves and 25 in correct place</p> <p style="text-align: right;">15,10,5 15,3,20</p> <p>Labels R, S, C and box</p> </div> </div>	<p>M1 A1 A1 B1</p>
<p>(b)</p>	<p>All values/100 or equivalent fractions award accuracy marks. 7/100 or 0.07</p>	<p>(4) M1 A1</p>
<p>(c)</p>	<p>(3+5)/100 = 2/25 or 0.08</p>	<p>(2) M1A1</p>
<p>(d)</p>	<p>(25+15+10+5)/100 = 11/20 or 0.55</p>	<p>(2) M1 A1</p>
<p>(e)</p>	<p> $P(S \cap C' R) = \frac{P(S \cap C' \cap R)}{P(R)}$ $= \frac{15}{65}$ $= \frac{3}{13}$ </p> <p>Require denominator to be 'their 65' or 'their $\frac{65}{100}$', require 'their 15' and correct denominator of 65 or exact equivalents.</p>	<p>(3) M1 A1 A1 Total 13</p>
<p>NOTES</p>	<p>(b) M1 for 'their 7'/100 seen. A1 Correct answer only In parts (c) and (d) we require "/100" for methods to be awarded. Also check their values and award correct method if they follow from their Venn Diagram.</p> <p>(c) M1 For ('their 3'+ 'their 5')/100. $\frac{8}{48}$ award M0. A1 Correct answer only or equivalent.</p> <p>(d) M1 Accept sum of their 4 values from the Venn diagram /100. A1 Correct answer only or equivalent</p> <p>(e) M1 Attempt to use correct formula for conditional probability. Award for correct formula and a denominator of 'their 65' or 'their 65/100'. A1 for 'their 15'/65 only. A1 for exact equivalent answers, including 15/65. In all parts correct answers with no working award full marks.</p>	

Question Number	Scheme	Marks
<p>7 (a)</p> <p>(b)</p> <p>(c)</p>	$P(W < 224) = P\left(z < \frac{224 - 232}{5}\right)$ $= P(z < -1.6)$ $= 1 - 0.9452$ $= 0.0548$ $0.5 - 0.2 = 0.3$ $\frac{w - 232}{5} = 0.5244$ $w = 234.622$ $0.2 \times (1 - 0.2)$ $2 \times 0.8 \times (1 - 0.8) = 0.32$	<p>M1</p> <p>M1</p> <p>A1</p> <p>(3)</p> <p>M1</p> <p>0.3 or 0.7 seen</p> <p>M1</p> <p>0.5244 seen</p> <p>B1; M1</p> <p>A1</p> <p>(4)</p> <p>M1</p> <p>M1 A1</p> <p>(3)</p> <p>Total 10</p>
<p>NOTES</p> <p>(a)</p> <p>(b)</p> <p>(c)</p>	<p>M1 for standardising with 232 and 5. (i.e. not 5^2 or $\sqrt{5}$). Accept $\pm \frac{w - 232}{5}$.</p> <p>M1 for finding (1 - a probability > 0.5)</p> <p>A1 awrt 0.0548</p> <p>M1 Can be implied by use of ± 0.5244 or $\pm (0.52 \text{ to } 0.53)$</p> <p>B1 for ± 0.5244 only.</p> <p>Second M1 standardise with 232 and 5 and equate to z value of (0.52 to 0.53) or (0.84 to 0.85)</p> <p>1 - z used award second M0.</p> <p>Require consistent signs i.e. $\frac{232 - w}{5} = -0.5244$ or negative z value for M1.</p> <p>A1 dependent upon second M mark for awrt 235 but see note below.</p> <p>Common errors involving probabilities and not z values:</p> <p>$P(Z < 0.2) = 0.5793$ used instead of z value gives awrt 235 but award M0B0M0A0</p> <p>$P(Z < 0.8) = 0.7881$ used instead of z value award M0B0M0A0.</p> <p>M1B0M0A0 for 0.6179, M1B0M0A0 for 0.7580</p> <p>M1 for 0.16 seen</p> <p>M1 for '$2 \times p(1 - p)$'</p> <p>A1 0.32 correct answer only</p>	