Paper Reference(s)

6683/01

Edexcel GCE

Statistics S1

Advanced/Advanced Subsidiary

Wednesday 20 May 2009 – Afternoon

Time: 1 hour 30 minutes

Materials required for examination	**Items included with question papers**
Mathematical Formulae (Orange Green)	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 formulae stored in them.

Instructions to Candidates

Write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Statistics S1), the paper reference (6683), your surname, initials and signature.
Answer ALL questions.
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.
There are 8 questions in this question paper. 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 volume of a sample of gas is kept constant. The gas is heated and the pressure, p, is measured at 10 different temperatures, t. The results are summarised below.

$$\Sigma p = 445 \qquad \Sigma p^2 = 38\,125 \qquad \Sigma t = 240 \qquad \Sigma t^2 = 27\,520 \qquad \Sigma pt = 26\,830$$

(a) Find S_{pp} and S_{pt} .

(3)

Given that $S_{tt} = 21\,760$,

(b) calculate the product moment correlation coefficient.

(2)

(c) Give an interpretation of your answer to part (b).

(1)

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2. On a randomly chosen day the probability that Bill travels to school by car, by bicycle or on foot is $\frac{1}{2}$, $\frac{1}{6}$ and $\frac{1}{3}$ respectively. The probability of being late when using these methods of travel is $\frac{1}{5}$, $\frac{2}{5}$ and $\frac{1}{10}$ respectively.

(a) Draw a tree diagram to represent this information.

(3)

(b) Find the probability that on a randomly chosen day

(i) Bill travels by foot and is late,

(ii) Bill is not late.

(4)

(c) Given that Bill is late, find the probability that he did not travel on foot.

(4)

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3. The variable x was measured to the nearest whole number. Forty observations are given in the table below.

x	10 – 15	16 – 18	19 –
Frequency	15	9	16

A histogram was drawn and the bar representing the 10 – 15 class has a width of 2 cm and a height of 5 cm. For the 16 – 18 class find

(*a*) the width,

(1)

(*b*) the height

(2)

of the bar representing this class.

4. A researcher measured the foot lengths of a random sample of 120 ten-year-old children. The lengths are summarised in the table below.

Foot length, *l*, (cm)	**Number of children**
$10 \leq l < 12$	5
$12 \leq l < 17$	53
$17 \leq l < 19$	29
$19 \leq l < 21$	15
$21 \leq l < 23$	11
$23 \leq l < 25$	7

(*a*) Use interpolation to estimate the median of this distribution.

(2)

(*b*) Calculate estimates for the mean and the standard deviation of these data.

(6)

One measure of skewness is given by

$$\text{Coefficient of skewness} = \frac{3(\text{mean} - \text{median})}{\text{standard deviation}}$$

(*c*) Evaluate this coefficient and comment on the skewness of these data.

(3)

Greg suggests that a normal distribution is a suitable model for the foot lengths of ten-year-old children.

(*d*) Using the value found in part (*c*), comment on Greg's suggestion, giving a reason for your answer.

(2)

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5. The weight, w grams, and the length, l mm, of 10 randomly selected newborn turtles are given in the table below.

l	49.0	52.0	53.0	54.5	54.1	53.4	50.0	51.6	49.5	51.2
w	29	32	34	39	38	35	30	31	29	30

(You may use $S_{ll} = 33.381$ $S_{wl} = 59.99$ $S_{ww} = 120.1$)

(a) Find the equation of the regression line of w on l in the form $w = a + bl$.

(5)

(b) Use your regression line to estimate the weight of a newborn turtle of length 60 mm.

(2)

(c) Comment on the reliability of your estimate giving a reason for your answer.

(2)

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6. The discrete random variable X has probability function

$$P(X = x) = \begin{cases} a(3-x) & x = 0, 1, 2 \\ b & x = 3 \end{cases}$$

(a) Find $P(X = 2)$ and copy and complete the table below.

x	0	1	2	3
$P(X=x)$	$3a$	$2a$		b

(1)

Given that $E(X) = 1.6$,

(b) find the value of a and the value of b.

(5)

Find

(c) $P(0.5 < X < 3)$,

(2)

(d) $E(3X - 2)$.

(2)

(e) Show that the $Var(X) = 1.64$

(3)

(f) Calculate $Var(3X - 2)$.

(2)

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7. (*a*) Given that P(*A*) = *a* and P(*B*) = *b* express P(*A* ∪ *B*) in terms of *a* and *b* when

(i) *A* and *B* are mutually exclusive,

(ii) *A* and *B* are independent.

(2)

Two events *R* and *Q* are such that

$$P(R \cap Q \square) = 0.15, \quad P(Q) = 0.35 \quad \text{and} \quad P(R \mid Q) = 0.1$$

Find the value of

(*b*) P(*R* ∪ *Q*),

(1)

(*c*) P(*R* ∩ *Q*),

(2)

(*d*) P(*R*).

(2)

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8. The lifetimes of bulbs used in a lamp are normally distributed.

A company *X* sells bulbs with a mean lifetime of 850 hours and a standard deviation of 50 hours.

(*a*) Find the probability of a bulb, from company *X*, having a lifetime of less than 830 hours.

(3)

(*b*) In a box of 500 bulbs, from company *X*, find the expected number having a lifetime of less than 830 hours.

(2)

A rival company *Y* sells bulbs with a mean lifetime of 860 hours and 20% of these bulbs have a lifetime of less than 818 hours.

(*c*) Find the standard deviation of the lifetimes of bulbs from company *Y*.

(4)

Both companies sell the bulbs for the same price.

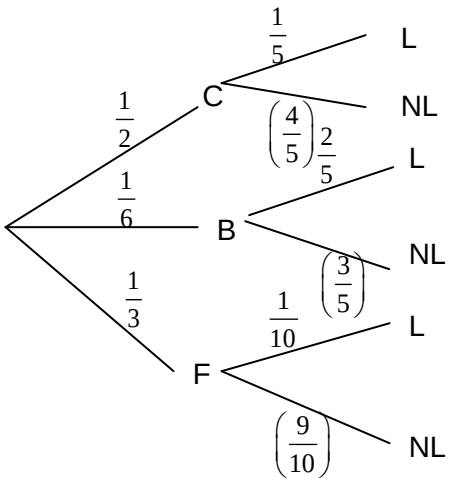
(*d*) State which company you would recommend. Give reasons for your answer.

(2)

TOTAL FOR PAPER: 75 MARKS

END

Question Number		Scheme		Marks
1.	(a)	$(S_{pp} =)\ 38125 - \frac{445^2}{10}$		M1
		$= 18322.5$	awrt 18300	A1
		$(S_{pt} =)\ 26830 - \frac{445 \times 240}{10}$		
		$= 16150$	awrt 16200	A1 (3)
	(b)	$r = \frac{"16150"}{\sqrt{"18322.5" \times 21760}}$	Using their values for method	M1
		$= 0.8088...$	awrt 0.809	A1 2)
	(c)	As the temperature increases the pressure increases.		B1 (1)
				(6 marks)

Question Number	Scheme	Marks
2. (a)	 Correct tree All labels Probabilities on correct branches	B1 B1 B1 (3)
(b)(i)	$\frac{1}{3}\times\frac{1}{10}=\frac{1}{30}$ or equivalent	M1 A1 (2)
(ii)	CNL + BNL + FNL $=\frac{1}{2}\times\frac{4}{5}+\frac{1}{6}\times\frac{3}{5}+\frac{1}{3}\times\frac{9}{10}$	M1
	$=\frac{4}{5}$ or equivalent	A1 (2)
(c)	$P(F'/L)=\frac{P(F'\cap L)}{P(L)}$ Attempt correct conditional probability	M1
	$=\frac{\frac{1}{6}\times\frac{2}{5}+\frac{1}{2}\times\frac{1}{5}}{1-(ii)}$ $\frac{\text{numerator}}{\text{denominator}}$	$\frac{\text{A1}}{\text{A1ft}}$
	$=\frac{\frac{5}{30}}{\frac{1}{5}}=\frac{5}{6}$ or equivalent cao	A1 (4)
		(11 marks)
3. (a)	1(cm) cao	B1
(b)	10 cm^2 represents 15 10/15 cm^2 represents 1 or 1 cm^2 represents 1.5	M1
	Therefore frequency of 9 is $\frac{10}{15}\times 9$ or $\frac{9}{1.5}$ Require $\times\frac{2}{3}$ or $\div 1.5$	M1
	height = 6 (cm)	A1 **(3 marks)**

Question Number		Scheme		Marks
4.	(a)	$Q_2 = 17 + \left(\frac{60-58}{29}\right) \times 2$		M1
		= 17.1 (17.2 if use 60.5)	awrt 17.1 (or17.2)	A1 (2)
	(b)	$\sum fx = 2055.5$ $\sum fx^2 = 36500.25$		B1 B1
		Evidence of attempt to use midpoints with at least one correct		M1
		Mean = 17.129…	awrt 17.1	B1
		$\sigma = \sqrt{\frac{36500.25}{120} - \left(\frac{2055.5}{120}\right)^2}$		M1
		= 3.28 (s = 3.294)	awrt 3.3	A1 (6)
	(c)	$\frac{3(17.129 - 17.1379...)}{3.28}$ = -0.00802	Accept 0 or awrt 0.0	M1 A1
		No skew/ slight skew		B1 (3)
	(d)	The skewness is very small. Possible.		B1 B1 (2)
				(13 marks)
5.	(a)	$b = \frac{59.99}{33.381}$		M1
		= 1.79713…..	1.8 or awrt 1.80	A1
		a = 32.7 – 1.79713… × 51.83		M1
		= – 60.44525…	awrt –60	A1
		w = - 60.445251…+ 1.79713…l	l and w required and awrt 2sf	A1ft (5)
	(b)	w = - 60.445251…+ 1.79713… × 60		M1
		= 47.3825…	In range 47.3 – 47.6 inclusive	A1 (2)
	(c)	It is extrapolating so (may be) unreliable.		B1 B1 (2)
				(9 marks)

Question Number		Scheme		Marks	
6.	(a)	$\begin{array}{\|c\|c\|c\|c\|}\hline 0 & 1 & 2 & 3 \\ \hline 3a & 2a & a & b \\ \hline \end{array}$		B1	(1)
	(b)	$3a + 2a + a + b = 1$	or equivalent, using Sum of probabilities =1	M1	
		$2a + 2a + 3b = 1.6$	or equivalent, using E(X)=1.6	M1	
		$14a = 1.4$	Attempt to solve	M1	
		$a = 0.1$	cao	B1	
		$b = 0.4$	cao	B1	(5)
	(c)	$P(0.5 < x < 3) = P(1) + P(2)$	3a or their $2a$+their a	M1	
		$= 0.2 + 0.1$			
		$= 0.3$	Require $0<3a<1$ to award follow through	A1 ft	(2)
	(d)	$E(3X - 2) = 3E(X) - 2$		M1	
		$= 3 \times 1.6 - 2$			
		$= 2.8$	cao	A1	(2)
	(e)	$E(X^2) = 1\times0.2 + 4 \times0.1 + 9 \times0.4$ (= 4.2)		M1	
		Var (X) = "4.2" – 1.6^2		M1	
		$= 1.64$ **given answer**	cso	A1	(3)
	(f)	$\text{Var}(3X - 2) = 9\ \text{Var}(X)$		M1	
		$= 14.76$	awrt 14.8	A1	(2)
					(15 marks)

Question Number	Scheme	Marks
7. (a) (i)	$P(A \cup B) = a + b$ cao	B1
(ii)	$P(A \cup B) = a + b - ab$ or equivalent	B1 (2)
(b)	$P(R \cup Q) = 0.15 + 0.35$ $= 0.5$ 0.5	B1 (1)
(c)	$P(R \cap Q) = P(R\|Q) \times P(Q)$ $= 0.1 \times 0.35$ $= 0.035$	M1 A1 (2)
(d)	$P(R \cup Q) = P(R) + P(Q) - P(R \cap Q)$ OR $P(R) = P(R \cap Q') + P(R \cap Q)$ $0.5 = P(R) + 0.35 - 0.035$ $= 0.15 + 0.035$ $P(R) = 0.185$ $= 0.185$ 0.185	M1 A1 (2)
		(7 marks)
8. (a)	Let the random variable X be the lifetime in hours of bulb	
	$P(X < 830) = P(Z < \frac{\pm(830-850)}{50})$ Standardising with 850 and 50	M1
	$= P(Z < -0.4)$	
	$= 1 - P(Z < 0.4)$ Using 1-(probability>0.5)	M1
	$= 1 - 0.6554$	
	$= 0.3446$ or 0.344578 by calculator awrt 0.345	A1 (3)
(b)	0.3446×500 Their (a) x 500	M1
	$= 172.3$ Accept 172.3 or 172 or 173	A1 (2)
(c)	Standardise with 860 and σ and equate to z value $\frac{\pm(818-860)}{\sigma} = z$ value	M1
	$\frac{818-860}{\sigma} = -0.84(16)$ or $\frac{860-818}{\sigma} = 0.84(16)$ or $\frac{902-860}{\sigma} = 0.84(16)$ or equiv.	A1
	$\pm 0.8416(2)$	B1
	$\sigma = 49.9$hours 50 or awrt 49.9	A1 (4)
(d)	Company Y as the ***mean*** is greater for Y. both	B1
	They have (approximately) the same ***standard deviation*** or ***sd***	B1 (2)
		(11 marks)