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Mark Scheme (Results)

Summer 2014

Pearson Edexcel GCE in Statistics S1R (6683/01R)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

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EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes.

- bod – benefit of doubt
- ft – follow through
- the symbol $\surd$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- $\ast$ The answer is printed on the paper
- $\underline{}$ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

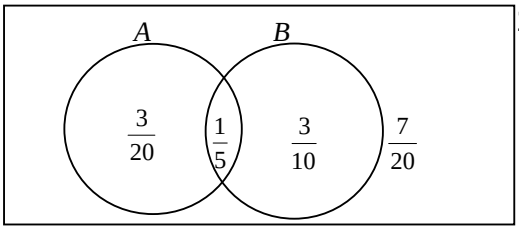
Question Number	Scheme		Marks
1. (a)	$0.4+p+0.05+0.15+p=1$ $2p=0.4$ $p=0.2$	or verify $0.4+0.2+0.05+0.15+0.2=1$ conclusion $p=0.2$ must be stated	M1 A1cso **(2)**
(b)	$\mathrm{E}(X)=0.4\times-4+0.2\times-2+0.05\times1+0.15\times3+0.2\times5=-0.5$		M1 A1 **(2)**
(c)	$\left[\mathrm{F}(0)=\mathrm{P}(X=-2)+\mathrm{P}(X=-4)=0.2+0.4\right]=0.6$		B1 **(1)**
(d)	$\mathrm{P}(3X+2>5)=\mathrm{P}(X>1)$ $\mathrm{P}(3X+2>5)=\mathrm{P}(X=3)+\mathrm{P}(X=5)$ $\mathrm{P}(3X+2>5)=0.35$		M1 A1 **(2)**
(e)	$\mathrm{Var}(aX+3)=a^2\,\mathrm{Var}(X)$ $53.4=a^2 13.35$ $a=\pm 2$		M1 A1 **(2)** **[Total 9]**

	Notes
(a)	M1 for equating sum of all probabilities to 1 The minimum working required is: $0.6 + 2p = 1$ but $2p = 1 - 0.6$ or $2p = 0.4$ is M0 BUT allow $1 - 0.4 - 0.05 - 0.15 = 0.4$ followed by $2p = 0.4$ or $1 - 0.4 - 0.05 - 0.15 = 2p$ Since all of the probabilities are seen. A1cso for a correct solution with no incorrect working seen (For verify method, they must conclude that $p = 0.2$)
(b)	M1 for a correct expression with at least 3 correct terms May be: $-1.6-0.4+0.05+0.45+1$ A1 for -0.5
(c)	B1 for 0.6
(d)	M1 for identifying $X=3$ and $X=5$ only ($X > 1$ is not sufficient) A1 for 0.35
(e)	M1 for $\mathrm{Var}(aX+3)=a^2\,\mathrm{Var}(X)$ but this may be implied by seeing $a = 2$ or $a = -2$ A1 for both correct values + 2 and -2

Question Number	Scheme	Marks
2. (a)	(Discrete) Uniform	B1 **(1)**
(b)	(i) $P(X = 10) = \frac{1}{10}$	B1
	(ii) $P(X < 10) = \frac{9}{10}$	B1 **(2)**
(c)	(i) $P(Y = 10) = 0$	B1
	(ii) $P(Y < 10) = \frac{1}{2}$	B1 **(2)** **[Total 5]**
	Notes	
(a)	B1 for seeing the word **uniform** Condone "continuous" uniform	

Question Number	Scheme	Marks
3. (a)	$\sum x = 88$	B1
	$S_{pp} = 11422 - \frac{299.2^2}{8} = [231.92]$ **(*)**	B1cso
	$S_{xx} = 1160 - \frac{'88'^2}{8} = 192$	M1 A1
	$S_{xp} = 3449.5 - \frac{'88' \times 299.2}{8} = 158.3$ **awrt** 158	A1 **(5)**
(b)	$r = \left[\frac{S_{xp}}{\sqrt{S_{xx}S_{pp}}} = \right] \frac{'158.3'}{\sqrt{'192' \times 231.92}}$	M1
	$r = 0.7501726031\ldots$ **awrt** 0.750	A1 **(2)**
(c)	$b = \left[\frac{S_{xp}}{S_{xx}} = \right] \frac{'158.3'}{'192'} = 0.824(479166....)$ **(*)**	M1 A1cso
	$a = \bar{p} - b\bar{x} = \frac{299.2}{8} - 0.824... \times \frac{"88"}{8} = 28.330729...$ **awrt** 28.3	M1 A1 **(4)**
(d)	$p = 28.3.... + 0.824.... \times 10 = 36.57552\ldots$ **awrt** £3700	M1 A1 **(2)**
(e)	Goes up £82.40	B1 **(1)**
(f)	(i) $r = 0.750$ (ii) $b = 0.412$	B1ft B1 **(2)** **[Total 16]**

	Notes
(a)	1st B1 for $\sum x = 88$ seen. May be in a correct formula or implied by 192 or 158.3
	2nd B1cso for a correct expression for S_{pp}
	M1 for a correct expression for S_{xx} or S_{xp} (ft their Σx). If we don't see an explicit $\Sigma x = k$ but consistent use of k instead of 88 in S_{xp} and S_{xx} then award M1
	1st A1 for $S_{xx} = 192$ 2nd A1 for S_{xp} = awrt 158
(b)	M1 for correct expression for r ft their 192 and 158.3 May be implied by $r = 0.75$
	A1 for awrt 0.750 Allow A1 for $r = 0.75$ if a correct expr' is seen (since 3rd sf is 0)
(c)	1st M1 for a correct expression for b using their values NB. use of 158 gives 0.8229
	1st A1 cso for b = awrt 0.824
SC	If there is no expression but 0.8244...or better is seen award 1 mark as M0A1
	2nd M1 for a correct expression for a ft their Σx
(d)	2nd A1 for a = awrt 28.3
	M1 for substituting $x = 10$ into their equation
(e)	A1 for awrt £3700 (£ 36.58 or £36.58 (hundreds) is A0)
(f)(i)	B1 for goes up £82.40 (for each additional employee) (£0.824 hundreds is B0)
(ii)	B1ft for r = their answer to (b) . Allow recalculation. Condone $\|r\| > 1$
	B1 for 0.412 only

Question Number	Scheme	Marks
4. (a)	$P(A \cap B) = P(A\|B) \times P(B)$ $P(A \cap B) = \frac{2}{5} \times \frac{1}{2} = \frac{1}{5}$	M1 A1 **(2)**
(b)	 2 intersecting circles and 'P($A \cap B$)' $\frac{3}{20}$ and $\frac{3}{10}$ Box and $\frac{7}{20}$	B1ft B1 B1 **(3)**
(c)	$\left[P(A) = \frac{3}{20} + \frac{1}{5} \right] = \frac{7}{20}$ or 0.35	B1ft **(1)**
(d)	$P(B \mid A) = \frac{P(A \cap B)}{P(A)} = \frac{\frac{1}{5}}{\frac{7}{20}}$ $= \frac{4}{7}$	M1 A1 cao **(2)**
(e)	0.3	B1ft **(1)** **[Total 9]**
	Notes	
(a)	M1 for $\frac{2}{5} \times \frac{1}{2}$ or a correct probability product expression and one correct prob. Ans only 2/2	
(b)	1st B1 for 2 intersecting circles labelled *A* and *B* and ft their prob. for intersection Condone missing labels for 2nd and 3rd B marks	
(c)	B1ft for 0.35 (o.e.) if no Venn diagram or correct follow through from their diagram or allow 0.35 (or correct ft) from correct working e.g. 0.65 – 0.5 + (a) B0 for 0.35 if their diagram does not give 0.35 unless it comes from correct work Don't insist on P(*A*) =... but do not award for $P(A' \cap B') = \frac{7}{20}$	
(d)	M1 for $\frac{\text{their (a)}}{\text{their (c)}}$ or a correct ratio of probabilities from their diagram NB incorrect use of $P(A' \cap B') = \frac{7}{20}$ scores M0 and num $\geq$ denom scores M0 A1 for $\frac{4}{7}$ only	
(e)	B1ft for 0.3 or correct ft from their Venn diagram or ft from $\frac{13}{20}$ – their (c)	

Question Number		Scheme	Marks
5.	(a)	4.5	B1 **(1)**
	(b)	<table><tr><th>Time</th><th>Frequency density</th></tr><tr><td>2-4</td><td>5</td></tr><tr><td>5-6</td><td>4.5</td></tr><tr><td>7</td><td>6</td></tr><tr><td>8</td><td>24</td></tr><tr><td>9-10</td><td>7</td></tr><tr><td>11-15</td><td>2.4</td></tr></table> f.d = 24 is represented as 6cm, so f.d. = 7 is represented as **1.75(cm)**	M1 A1 A1 **(3)**
	(c)	$\frac{1}{3}\times 15+9+\frac{1}{2}\times 6,=17$	M1, A1 **(2)**
	(d)	$\text{Median} = 7.5+\frac{40-30}{24}\times 1 = 7.91666.....$ **awrt** 7.92 or 7.93(75)	M1 A1
		$Q_1 = 4.5+\frac{20-15}{9}\times 2 = 5.6111111...$ **awrt** 5.61 or 5.66(666…)	A1
		$Q_3 = 8.5+\frac{60-54}{14}\times 2 = 9.357142.....$ **awrt** 9.36 or 9.46(4285….)	A1 **(4)**
	(e)	$Q_3 - Q_2 (=1.4 \text{ or } 1.5) < Q_2 - Q_1 (=2.3)$ <u>or</u> (Mean) < Median < Mode Therefore negative skew	B1ft dB1cao **(2)** **[Total 12]**

	Notes
(a)	B1 for 4.5 (o.e.) only. NB 1.5~4.5 is B0
(b)	M1 for evidence of f/w (at least 3 f.d. found). May be implied by a correct answer. A1 for identifying 9-10 as 2nd highest bar from correct working e.g. $24x = 6\times 7$ A1 for 1.75(cm). Correct answer only 3/3
(c)	M1 for a correct expression. May interpolate e.g. $\left[24+\frac{1}{2}\times 6-\frac{2}{3}\times 15\right]$ or (27 – 10) A1 for 17
(d)	M1 for one correct fraction in an expression for Q_1, Q_2 or Q_3 1st A1 for Q_2 **awrt** 7.92 (or 7.94 if (n +1) used – look for 40.5 instead of 40) 2nd A1 for Q_1 **awrt** 5.61 (or 5.67 if (n +1) used – look for 20.25 instead of 20) 3rd A1 for Q_3 **awrt** 9.36 (or 9.46 if (n +1) used – look for 60.75 instead of 60) NB watch out for working down e.g. $8.5-\frac{14}{24}\times 1$ for Q_2
(e)	1st B1ft for a correct comparison of their quartiles e.g. Q_2 closer to Q_3 or using at least two of Mean < Median < Mode (must state mean or mode if using this method). N.B. Mean = 7.71875, mode = 8 2nd B1cao dependent on 1st B1 being awarded for **negative skew** only (no ft)

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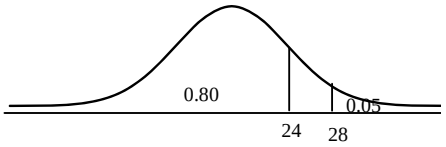
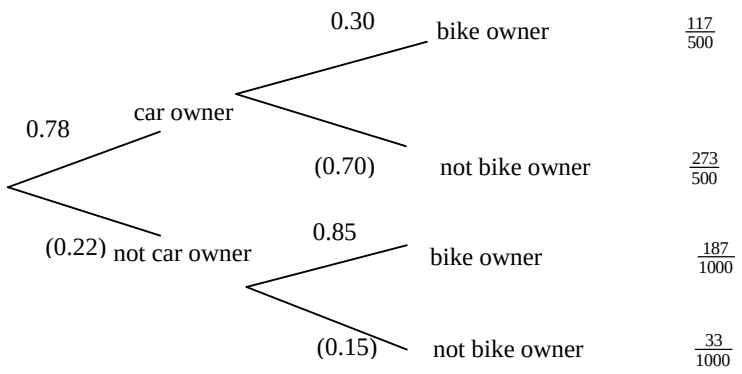
Question Number	Scheme	Marks
6. (a)	 24 and 28 (above the mean) For 0.80 and 0.05 (clearly indicated)	B1 B1 **(2)**
(b)	15%	B1 **(1)**
(c)(i)	$\frac{(28-\mu)}{\sigma}=1.64(49)$ or $\frac{(24-\mu)}{\sigma}=0.84(16)$	M1
	0.8416 and 1.6449 seen	B1
	$\mu=28-1.64(49)\sigma$, $\mu=24-0.84(16)\sigma$	A1,A1
(ii)	$24-0.8416\sigma=28-1.6449\sigma$ eliminating μ or σ	M1
	$\sigma=4.9794597...$ **awrt** 4.98	A1
	$\mu=19.809286...$ **awrt** 19.8	A1 **(7)**
(d)	$z=\frac{(12-'19.8...')}{'4.97...'}$	M1
	$P(Z<-1.57)=1-P(Z<1.57)$	dM1
	$1-0.9418=0.0582$ **awrt** 0.06	A1 **(3)**
		[Total 13]

	Notes
(a)	1st B1 24 and 28 labelled on the horizontal axis above the mean in the correct order. They must clearly indicate where 24 and 28 are on the horizontal axis.
(b)	2nd B1 for clear, correct labelling of probabilities. Must be associated with correct <u>area</u>.
(c)	B1 for 15% or 0.15 NB 0.15% is B0
	1st M1 for $\frac{\pm(28-\mu)}{\sigma}=z_1$ <u>or</u> $\frac{\pm(24-\mu)}{\sigma}=z_2$ where $\lvert z_1\rvert > 1.5$ and $\lvert z_2\rvert < 1$ Condone $z_2=0.8$
	B1 for both values 0.8416 <u>and</u> 1.6449 or better seen. Calc: 0.8416212.., 1.644853..
	1st A1 for $\mu=28-1.64(49)\sigma$ or any correct arrangement (allow 1.64 ~1.65 inclusive)
	2nd A1 for $\mu=24-0.84(16)\sigma$ or any correct arrangement (allow 0.84 or better)
	2nd M1 for an attempt to solve simultaneous equations by eliminating μ or σ
	3rd A1 for **awrt** 4.98 (Condone $\sigma=5$ or awrt 5.0 if B0 scored)
	4th A1 for **awrt** 19.8
SC	For use of 0.84 and 1.64 giving $\sigma=5$ and $\mu=$ awrt 19.8 score M1B0A1A1M1A1A1
(d)	<u>or</u> 0.84 and 1.65 giving $\sigma=$ awrt 4.94 and $\mu=$ awrt 19.9 score M1B0A1A1M1A1A1
	1st M1 for standardising with 12, their μ and σ provided $\sigma>0$ If $\sigma<0$ from their equations in (c) allow M1 if they use $\lvert\sigma\rvert$
	2nd dM1 for $1-P(Z<'1.57')$ dependent on the 1st M1 being scored i.e. leads to prob < 0.5
	A1 for awrt 0.06 from correct working

Question Number	Scheme	Marks
7. (a)		B1 B1 B1 **(3)**
(b)	P(car or bike but not both)$= 0.78\times0.70+0.22\times0.85=0.733$	M1 A1 **(2)**
(c)	$[\text{P(car}\mid\text{bike)}] = \dfrac{\text{P(car}\cap\text{bike)}}{\text{P(bike)}} = \dfrac{0.78\times0.30}{0.78\times0.30+0.22\times0.85}, = 0.555819....$ **awrt** 0.556	M1A1 A1 **(3)**
(d)	$\text{P(bike)} = 0.78\times0.30+0.22\times0.85=0.421$, P(not bike) = 1 – 0.421 $0.421\times0.579+0.579\times0.421$ = 0.487518 **awrt** 0.488	M1 dM1 A1 **(3)** **[Total 11]**
	Notes	
(a)	1st B1 for a (2+4) tree with 6 branches 2nd B1 for 0.78 with label 3rd B1 for 0.30 and 0.85 with label	
(b)	M1 for correct expression of follow through their correct tree branches A1 for 0.733 or exact equivalent e.g. $\frac{733}{1000}$ and allow 73.3%	
(c)	M1 for a correct expression correct ft or correct formula and $\dfrac{\text{1 product}}{\text{sum of 2 products}}$ With at least 2 products correct or correct ft. Ratio must be smaller than 1 1st A1 for finding the denominator correctly. Fully correct expression or = 0.421 (oe) 2nd A1 for awrt 0.556 or exact equivalent e.g. $\frac{234}{421}$ and allow 55.6%	
(d)	M1 for their $\text{P(bike)}\times(1-\text{P(bike)})$ dM1 for $\times 2$ A1 for awrt 0.488	

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