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Mark Scheme (Results)

January 2013

GCE Maths – Statistics S1 (6683/01)

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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.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Unless indicated in the mark scheme a correct answer with no working should gain full marks for that part of the question.

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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.

In some instances, the mark distributions (e.g. M1, B1 and A1) printed on the candidate's response may differ from the final mark scheme.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used.

- 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
- $*$ The answer is printed on the paper
- $\lfloor$ 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 incorrect 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.

8. The maximum mark allocation for each question/part question(item) is set out in the marking grid and you should allocate a score of '0' or '1' for each mark, or "trait", as shown:

	0	1
aM		●
aA	●	
bM1		●
bA1	●	
bB	●	
bM2		●
bA2		●

January 2013
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
1.		
(a)	$(S_{tt}) = 8702 - \frac{258^2}{10}$ or $(S_{gt}) = 1550.2 - \frac{258 \times 63.6}{10}$	M1
	$(S_{tt} =) 2045.6$, $(S_{gt} =) -90.68$ awrt (2046), awrt – 90.7	A1, A1
		(3)
(b)	$r = \frac{-90.68}{\sqrt{2045.6 \times 7.864}} = -0.714956...$ awrt -0.715	M1 A1
		(2)
(c)	Positive e.g. high *v* corresponds to low *t* and low *t* corresponds to high *g* so expect high *v* to corresponds to high *g* or expect more revision to result in a better grade	B1 B1 (2)
		7

	Notes
(a)	M1 for at least one correct expression 1st A1 for S_{tt} = awrt 2046 (Condone S_{xx} =… or even S_{yy} =…) 2nd A1 for S_{gt} = awrt -90.7 (Condone S_{xy} =…)
(b)	M1 for attempt at correct formula. Must have their S_{tt}, S_{gt} and given S_{gg} in the correct places. Condone missing "$-$" Award M1A0 for awrt -0.71 with no expression seen M0 for $\frac{1550.2}{\sqrt{8702 \times 7.864}}$ Correct answer only is 2/2
(c)	1st B1 for saying "positive". Ignore mention of skew. 2nd B1 for suitable reason that mentions at least *v* and *g* and supports positive correlation. e.g. "the less revision done the lower the grade" is B1 "should do better with more revision" is B0 since does not mention grades "both coefficients are similar" or two sketches of negative correlation with labelled axes is B1 since *v*, *t* and *g* are implied Allow use of letters *v* and *g* Allow equivalent terms e.g. "study" instead of "revision" or "score" instead of "grade"

Question Number	Scheme	Marks
2.		
(a)	F(3) = 1 gives $\frac{3^3+k}{40}=1$	M1
	So k = **<u>13</u>**	A1cso (2)
(b)	P(X = 1) = $\frac{14}{40}$ or 0.35 (o.e.)	B1
	Use of P(X = 2) = F(2) – F(1) <u>or</u> P(X = 3) = F(3) – F(2)	M1
	P(X = 2) = $\frac{7}{40}$ or 0.175 , P(X = 3) = $\frac{19}{40}$ or 0.475	A1, A1 (4)
(c)	Var(4X – 5) = 4^2 Var(X)	M1
	So Var(4X – 5) = $\frac{259}{20}$ or 12.95	A1 (2)
		8

Notes

(a)

M1 for use of F(3) = 1 Attempt at $\frac{3^3+k}{40}=1$ must be seen

$27+k = 40$ without reference to F(3) = 1 is M0

A1cso for no incorrect working seen and M1 scored.

<u>Verify</u>

Allow M1 for $\frac{3^3+13}{40}=1$ but the A1 requires an <u>explicit</u> comment such as "so k = 13"

(b)

If a table such as this is seen then award B1M1A1A1. Ignore labels on 2nd row

	1	2	3
	$\frac{7}{20}$ or 0.35	$\frac{7}{40}$ or 0.175	$\frac{19}{40}$ or 0.475

Otherwise apply the following:

B1 for $\frac{14}{40}$ or 0.35 or any exact equivalent. Can be labelled F(1), P(X = 1) or p(x) and associated with x = 1 or given in a table but must have <u>a</u> label.

M1 for clear method showing how to obtain P(X =...) from F(x)
M1 can be implied if either P(X = 2) <u>or</u> P(X =3) is correct

1st A1 for P(X = 2) = $\frac{7}{40}$ or 0.175 or exact equivalent

2nd A1 for P(X = 3) = $\frac{19}{40}$ or 0.475 or exact equivalent

(c)

M1 for correct use of the variance formula (4^2Var(X) alone secures M1)
A value for Var(X) is not required for this M1

A1 for any exact equivalent to 12.95 Correct answer only is 2/2

Question Number	Scheme	Marks
3.		
(a)	$\sum t = 140$ (or $\bar{t} = 17.5$) and $\sum m = 32$ (or $\bar{m} = 4$)	B1 B1
	$(S_{tm}) = 469.5 - \dfrac{"140" \times "32"}{8}$	M1
	$(S_{tm} =) -90.5$	A1cso
		(4)
(b)	$b = \dfrac{S_{tm}}{S_{tt}} = \dfrac{-90.5}{354}$	M1
	$b = -0.255649...$ (allow $\frac{181}{708}$) -0.25 or awrt -0.26	A1
	$a = \dfrac{"32"}{8} - b \times \dfrac{"140"}{8}$	M1
	So equation of the line is **$\underline{m = 8.47 - 0.256t}$** (allow $m = \frac{11999}{1416} - \frac{181}{708}t$)	A1
		(4)
(c)	$(8.47 - 0.256 \times 10 =) 5.9...$ awrt **$\underline{5.9}$**	B1 (1)
(d)	Should be reliable since 10 is in the range (of the data)	B1 (1)
		10

Notes

(a)
1st B1 for 140 seen in correct context or correctly labelled
2nd B1 for 32 seen in correct context or correctly labelled.
(allow a fully correct expression – not "...+...+...") 4480 used correctly is B1B1
M1 for attempting a correct expression. Follow through their 140 and their 32
You may see attempt at $\sum (t - \bar{t})(m - \bar{m})$. This must have all the products seen.
A1cso requires a correct expression seen and no incorrect working leading to -90.5

(b)
1st M1 for a correct expression for *b*. Follow through their S_{tm}. Condone missing "$-$"
1st A1 for awrt -0.26 or condone -0.25
2nd M1 for a correct method for *a*. Follow through their sums from part (a) and their value of *b*
2nd A1 for a correct equation for *m* and *t* with *a* = awrt 8.47 and *b* = awrt -0.256
Must be an equation in *m* and *t*, use of *x* or *y* scores A0 here.

(c)
B1 for awrt 5.9 Accept 6 if the correct expression (awrt $8.47 - 10 \times$ awrt 0.256) is seen

(d)
B1 for suggesting it is reliable and mentioning 10 within the range (of the data.)
or suggesting it is reliable since interpolating or not extrapolating

NB "it is reliable since it is in the range" is B0 since "it" is not explicit enough
Condone extra non-relevant comments but penalise contradictory comments.
e.g. "near the extreme so not reliable but not extrapolated so reliable" is B0 since contradicts
"reliable since 10 is within the range (of temps) and 5.9 within range of times" is B1 since irrelevant

Question Number	Scheme	Marks
4.		
(a)	$\frac{127-100}{15}$	M1
	So P(L > 127) = P(Z > 1.8) or $1-$P(Z < 1.8) o.e.	A1
	= 1 – 0.9641 = **0.0359** (awrt **0.0359**)	A1
		(3)
(b)	$\frac{d-100}{15} = -1.2816$ (Calculator gives $-1.2815515\ldots$)	M1, B1
	d = 80.776 (awrt **80.8**)	A1
		(3)
(c)	Require P(L > 133 | L > 127)	M1
	$= \left[\frac{\text{P}(L>133)}{\text{P}(L>127)}\right] = \frac{\text{P}(Z>2.2)}{\text{P}(L>127)}$	dM1
	$= \left[\frac{1-0.9861}{1-0.9641}\right] = \frac{0.0139}{[0.0359]}$	A1
	= 0.3871... = awrt **0.39**	A1
		(4)
S.C.	An attempt at P(L < 133| L > 127) that leads to awrt 0.61 (M0M1A0A0)	
		10

	Notes
(a)	M1 for attempting to standardise with 127, 100 and 15 . Allow $\pm$
	1st A1 for Z > 1.8. Allow a diagram but must have 1.8 and correct area indicated. Must have the Z so P(L > 127) with or without a diagram is insufficient. May be implied by 0.0359
	2nd A1 for awrt 0.0359 (calc. gives 0.035930266…). Correct ans only 3/3. M1A0A1 not poss.
(b)	M1 for an attempt to standardise with 100 and 15 and set = $\pm$ any z value ($\|z\|$ > 1)
	B1 for $z = \pm$ 1.2816 (or better) seen anywhere [May be implied by 80.776(72…) or better seen]
	A1 for awrt 80.8 (can be scored for using 1.28 but then they get M1B0A1) The 80.8 must follow from correct working.
Calc	If answer is awrt 80.8 **and** awrt 80.777 or 80.776… or better seen then award M1B1A1
	If answer is awrt 80.8 or 80.77 then award M1B0A1 (unless of course z = 1.2816 is seen)
(c)	1st M1 for clear indication of correct conditional probability or attempt at correct ratio
	So clear attempt at $\frac{\text{P}(L>133)}{\text{P}(L>127)}$ is sufficient for the 1st M1
	2nd dM1 dependent on 1st M1 for P(L > 133) leading to P(Z > 2.2).
	1st A1 for 0.0139 or better seen coming from P(Z > 2.20). Dependent on both Ms
	2nd A1 for awrt 0.39. Both Ms required
ALT	If they assume Alice did not check that the phone was working you may see: [P(L< 127).0] + P(L > 127).P(L > 133| L > 127) Provided the conditional probability is seen as part of this calculation the 1st M1 can be scored and their final answer will be 0.0139(4/4)
	An answer of 0.0139 without sight of the conditional probability is 0/4.

Question Number	Scheme	Marks
5. (a)	Width = 4 (cm)	B1
	Area of 14 cm^2 represents frequency 28 and area of 4*h* represents 18	M1
	Or $\frac{4h}{18}=\frac{14}{28}$ (o.e.) **h = <u>2.25</u>** (cm)	A1
		(3)
(b)	$m=(240)+\frac{10}{22}\times 80$ (o.e.)	M1
	= 276.36... ($\frac{3040}{11}$) ((£)**<u>276</u>** $\leq m <$ (£)276.5)	A1
		(2)
(c)	$\sum fy = 31600$ leading to $\underline{\bar{y}=316}$	M1A1
	$\sigma_y=\sqrt{\frac{12452800}{100}-\left(\bar{y}\right)^2}$ = 157 .07... (awrt **<u>157</u>**) Allow *s* = 157.86...	M1A1
		(4)
(d)	Skewness = 0.764... (awrt **<u>0.76</u>** or **<u>0.75</u>**)	B1
	[If *n*+1 used in (b) and *m* = £278 accept awrt 0.73 or 0.72]	
	<u>Positive</u> skew	B1ft
		(2)
(e)	$z=\pm\frac{80}{150}$	M1
	P(240< *X* < 400) = **<u>0.40 ~ 0.41</u>**	A1
		(2)
(f)	(e) suggests a reasonable fit for this range BUT	B2/1/0
	(d) since skew it will not be a good fit overall	(2)
		15
	Notes	
(a)	B1 for width (ignore units)	
	M1 for clear method using area and frequency <u>or</u> their width × their height = 9	
	e.g. seeing both fd of 0.7 and 0.225 (may see fd in the table) [Must use correct interval]	
(b)	M1 for $\frac{10}{22}\times 80$ or $\frac{10.5}{22}\times 80$ (o.e.). Allow use of (*n* + 1) leading to £278 .18... or [278, 278.5)	
	A1 Do not award if incorrect end-point seen but answer only is 2/2	
(c)	1st M1 attempt at $\sum fy$ with at least 3 correct products or ans. that rounds to 30 000 (to 1 sf) &/100	
	2nd M1 for correct expression including $\sqrt{\ }$. Follow through $\bar{y}$. Need $\sum fy^2$ correct but condone a minor transcription error e.g. 12458200.	
(d)	1st B1 for awrt 0.76/0.75 for *m* = £276 or awrt 0.73/0.72 for *m* = £278	
	2nd B1ft for a correct description of their skew based on their measure <u>or</u> if no measure given based on their values of mean and median. (correlation is B0)	
(e)	M1 for an attempt to standardise using the 320 and 150 and either 240 or 400 (implied by 0.53)	
	A1 for answer in range [0.40 , 0.41] (tables gives 0.4038, calculator 0.40619...) Ans only 2/2	
(f)	For B2 we need 2 comments that make reference to each of part (e) and part (d)	
	One comment should suggest it is <u>not</u> good since <u>skew</u>. The other it <u>is</u> since matches <u>range in (e)</u>	
	1st B1 for one relevant comment	
	2nd B1 for both comments NB Do not use B0B1	

Question Number	Scheme	Marks
6. (a)	b | 1 | 3 | 5 ; P($B = b$) | $\frac{1}{3}$ | $\frac{1}{3}$ | $\frac{1}{3}$ Also allow b values 1,1,3,3,5,5 and probabilities all $\frac{1}{6}$	B1 B1 (2)
(b)	Discrete Uniform {distribution}	B1 (1)
(c)	[E(B) =] 3 (by symmetry)	B1 (1)
(d)	[E(R) =] $2\times\frac{2}{3}+4\times\frac{1}{6}+6\times\frac{1}{6}$ = **3**	M1 A1 (2)
(e)	$[\mathrm{E}(R^2)=]\ 2^2\times\frac{2}{3}+4^2\times\frac{1}{6}+6^2\times\frac{1}{6} \quad \left[\ =\frac{34}{3}\ \right]$ [Var(R) =] $\frac{34}{3}-3^2=,\frac{7}{3}$ (or any exact equivalent. NB 2.33 is A0)	M1 dM1, A1 (3)
(f)	Coin lands on **2**, choose **blue** die; coin lands on **5** choose **red** die P(Avisha wins) = $\frac{1}{2}\times\left(\frac{1}{3}+\frac{1}{3}\right)+\frac{1}{2}\times\frac{1}{6}$ = $\frac{5}{12}$ (allow awrt 0.417)	B2/1/0 M1 A1 (4)
		13

Notes

(a) 1st B1 for correctly identifying values of b as 1, 3, 5 or 1,1,3,3,5,5

2nd B1 for probabilities all = $\frac{1}{3}$ or exact equivalent (or of course 6 cases of $\frac{1}{6}$)

Any correct probability distribution or probability function is 2/2. Must be in part (a)

(b) B1 for "Discrete Uniform" . Both words required.

(c) B1 for answer of 3 o.e. Accept E(X) = 3

(d) M1 for an attempt at correct formula. At least 2 correct products seen. If later divide by $n(\neq 1)$ M0

A1 for an answer of 3. Correct answer only scores both marks.

(e) 1st M1 for a correct attempt at $\mathrm{E}(R^2)$. At least 2 correct products seen. Condone Var(R) = etc

May be implied by sight of $\frac{34}{3}$ or 11.3 or better.

2nd dM1 Dep. on 1st M1 for clear attempt at $\mathrm{E}(R^2)-\left[\mathrm{E}(R)\right]^2$ Must see their values <u>used</u>.

NB Var(R) = $\mathrm{E}(R^2)-\left[\mathrm{E}(R)\right]^2$ = "$\frac{34}{3}$" − "3" is M1M0A0 since do not <u>use</u> their $\left[\mathrm{E}(R)\right]^2$

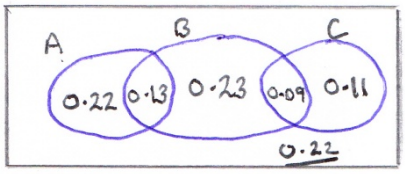
(f) B2/1/0 Both correct B1B1, one correct B1B0. Do not use B0B1[e.g. always red or RR is B1B0]

NB Allow other descriptions of the die e.g. 1st or fair for blue, 2nd for red if they are clear.

M1 for evaluating correct probabilities i.e. only $\frac{1}{3},\frac{1}{12}$ seen <u>or</u> if incorrect choice made:

M1 for an answer of : if choose RR ($\frac{1}{4}$), if choose BB ($\frac{1}{3}$), if choose RB ($\frac{1}{6}$)

NB $\frac{5}{12}$ as answer scores M1A1. Need to see choices of die stated for B marks.

Question Number	Scheme	Marks
7.		
(a)	$P(A \cup B) = 0.35 + 0.45 - 0.13$ or $0.22 + 0.13 + 0.32$ $= \underline{\mathbf{0.67}}$	M1 A1 (2)
(b)	$P(A' \mid B') = \dfrac{P(A' \cap B')}{P(B')}$ or $\dfrac{0.33}{0.55}$ $= \dfrac{3}{5}$ or 0.6	M1 A1 (2)
(c)	$P(B \cap C) = 0.45 \times 0.2$ $= \underline{\mathbf{0.09}}$	M1 A1 (2)
(d)	 Allow 1st B1 for 3 intersecting circles in a box with zeros in the regions for $A \cap C$ Do not accept "blank" for zero	B1 B1ft B1 B1 (4)
(e)	$P(B \cup C)' = 0.22 + \underline{0.22}$ or $1 - [0.56]$ or $1 - [0.13 + 0.23 + 0.09 + 0.11]$ o.e. $= \underline{\mathbf{0.44}}$	M1 A1 (2) **12**
	Notes	
	NB May see Venn diagram for *A* and *B* only used for (a) and (b) but M marks are awarded for <u>correct expressions only</u>. No ft from an incorrect diagram for M marks.	
(a)	M1 for attempt to use the addition rule. Correct substitution i.e. correct expression seen A1 for 0.67 only. Correct answer only scores 2/2	
(b)	M1 for a correct ratio of probabilities or a correct formula and at least one correct prob For a correct formula allow "1 − their (a)" instead of 0.33 but not for correct ratio case. Do not award for assuming independence i.e. $\frac{P(A' \cap B')}{P(B')} = \frac{0.65 \times 0.55}{0.55}$ is M0. M0 if num>denom A1 for 3/5 or any exact equivalent.	
(c)	M1 for correct expression. Need correct values for P(*B*) and P(*C*) seen. A1 for 0.09 or any exact equivalent. Correct answer only is 2/2	
(d)	**No labels *A*, *B*, *C* in (d) loses 1st B1 but can score the other 3 by implication** B1 for box with *B* intersecting *A* and *C* but *C* not intersecting *A*. No box is B0 B1ft for 0.13 and their 0.09 in correct places. [ft $P(B \cap C)$ from (c)] B1 for any 2 of 0.22, <u>0.22</u>, 0.11 and 0.23 correct B1 for all 4 values correct	
(e)	M1 for a correct expression or follow through from their Venn diagram NB $P(B') \times P(C') = 0.55 \times 0.8$ is OK. Do not ft "blank" for zero and M0 for negative probs. A1 for 0.44 only. Correct answer only is 2/2	

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