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Mark Scheme (Results)

Summer 2013

GCE Statistics 1 (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.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

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
- $*$ The answer is printed on the paper
- ⌐ 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.

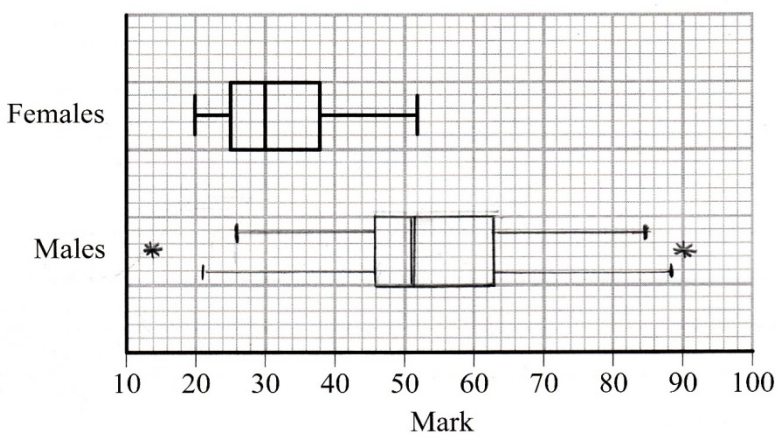
6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

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

8. 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.

Question	Scheme	Marks
1. (a)	$(S_{th}) = 64980 - \frac{7150\times110}{9} = -22408.9\ldots$ $\quad -\underline{\mathbf{22\ 400}}$	M1 A1
	$(S_{hh}) = 7171500 - \frac{7150^2}{9} = 1491222.2\ldots$ $\quad \underline{\mathbf{1\ 490\ 000}}$	A1
		(3)
(b)	$r = \frac{-22408.9}{\sqrt{1491222\times371.56}} = -0.95200068\ldots$ $\quad$ awrt $\underline{\mathbf{-0.952}}$	M1A1
		(2)
(c)	Yes as r is close to -1 (if $-1 < r < -0.5$) or Yes as r is close to 1 (if $1 > r > 0.5$) [If $-0.5 \leq r \leq 0.5$ allow "no since r is close to 0"] [If $\lvert r\rvert > 1$ award B0]	B1ft
		(1)
(d)	$b = \frac{-22408.9}{1491222.2} = -0.015027...$ $\quad (\text{allow } \frac{-56}{3725})$ $\quad$ awrt -0.015	M1 A1
	$a = \frac{110}{9} - \text{"their } b\text{"}\times\frac{7150}{9} = (12.2 - -0.015\times794.4), = 24.1604...$ so $\boldsymbol{t = 24.2 - 0.015h}$	M1, A1
		(4)
(e)	0.015 is the drop in temp, (in ^{0}C), for every 1(m) increase in height above sea level.	B1
		(1)
(f)	Change = ("24.2 – 0.015"$\times$500) – ("24.2 – 0.015"$\times$1000) or 500 $\times$"0.015" $= \pm 7.5$ (awrt $\pm$ 7.5) (only ft a value < 100)	M1 A1ft **(2)**
		(13 marks)

	Notes
(a)	M1 for at least one correct expression (condone transcription error) 1st A1 for S_{hh} = awrt 1 490 000 or S_{th} = awrt $-22\ 400$ (Condone S_{xx} or S_{xy} =… or even S_{yy} =...) 2nd A1 for S_{th} = $-22\ 400$ and S_{hh} = 1 490 000 only. [This mark is assessing correct rounding] (Allow no labels but mis-labelling S_{th} as S_{hh} etc loses the final A1)
(b)	M1 for attempt at correct formula. Allow minor transcription errors of 2 or 3 digits. Must have their S_{hh}, S_{th} and given S_{tt} (3sf or better) in the correct places. Condone missing "$-$" Award M1A0 for awrt -0.95 with no expression seen. M0 for $\frac{64980}{\sqrt{7171500\times7.864}}$
(c)	B1ft must comment on supporting **and** state: high/strong/clear (negative or positive) correlation "points lie close to a straight line" is B0 since there is no evidence of this.
(d)	1st M1 for a correct expression for b. Follow through their S_{hh} & S_{th}. Condone missing "$-$" 1st A1 for awrt -0.015 or allow exact fraction from rounded values. 2nd M1 for a correct method for a. Follow through their value of b 2nd A1 for a correct equation for t and h with a = awrt 24.2 and b = awrt -0.015 No fractions
(e)	B1 Must mention h (or height) and t (or temperature) and their (1 sf) value of b in a correct comment
(f)	M1 for a correct expression seen based on their equation. Allow transcription error of 1 digit. If answer is 500$\times$ their b to 2sf and < 100 (M1A1), If answer is 500$\times$ their b to 2sf and $\geq$100 (M1A0)

Question	Scheme	Marks
2. (a)	25 (allow any x where $24 < x < 26$)	B1 **(1)**
(b)	**Q_2** (or median or m) = **51**	B1
	IQR = 63 – 46 ,= **17** (or $Q_3 - Q_1 = 17$)	M1, A1 **(3)**
(c)	Outliers given by $46 - 1.5 \times 17 = 20.5$ or $63 + 1.5 \times 17 = 88.5$	M1
	Outliers limits are **20.5** and **88.5**	A1
	 Allow lower whisker to 20.5 and upper whisker to 88.5 Do **not** allow a mix of whiskers e.g 20.5 and 85 Do **not** allow both sets of whiskers	M1 A1ft B1 **(5)**
(d)	**Medians:** Median for females lower than males	
	IQR: IQR for females smaller than males. Allow "lower/higher" but not "wider"	B1ft
	Range: Range of females is less than males	B1ft
	Skewness: Male and female marks are both positively skew	**(2)**
	Ignore other statements about average, spread, mean, st. Dev, variation, outliers etc	**(11 marks)**

Notes

Mark (b) and (c) together BUT must see clear statement that median (or m or Q_2) = 51 and IQR = 17

(b)
M1 for 2 quartiles (at least one correct) and attempt to find the difference. Must see their 63 – their 46
A1 for 17 only. [Answer only of IQR= 17 scores M1A1]

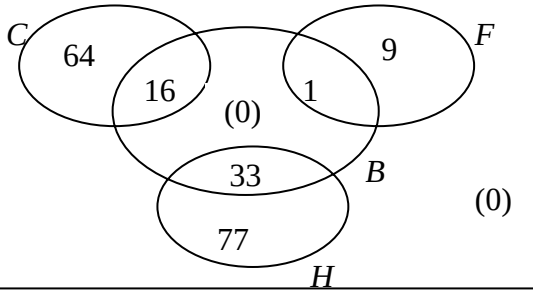
(c)
A fully correct box-plot (either version) with no supporting work scores 5/5. Otherwise:
1st M1 for correct attempt to calc' at least one limit for outliers, ft their quartiles or IQR
or award for sight of 20.5 or 88.5
1st A1 for identifying both limits of 20.5 and 88.5
2nd M1 for a box with an upper and a lower whisker(s) with at least 2 correct values (or correct ft)
(condone no median marked) (condone 2 upper or 2 lower whiskers)
2nd A1ft for their 20.5 or 26 ,46, 51, 63 and 85 or their 88.5 in appropriate places and readable off their scale. Follow through their 20.5 and their 88.5 only, other values need to be correct
If there are 2 upper or 2 lower whiskers A0
B1 for only 2 outliers appropriately marked at 14 and 90 Do not award if whiskers go beyond these values.

Apply ± 0.5 square accuracy for diagram

A box plot not on the graph paper can only score the 1st M1A1

In (d) ft from their diagrams (if no diagram then use their values)

(d)
1st B1ft for one correct comment comparing median, IQR , range or skewness
2nd B1ft for a second correct comment comparing median, IQR, range or skewness
Do not allow contradictory statements

Question	Scheme	Marks
3. (a)	$\frac{35+75}{200}=0.55$	M1 A1 **(2)**
(b)	$\frac{200-2}{200}=0.99$	M1 A1 **(2)**
(c)	$\left[\mathrm{P}(W \mid C)\right]=\frac{\mathrm{P}(W \cap C)}{\mathrm{P}(C)}=\frac{30/200}{80/200}=\frac{30}{80}=0.375$	M1 A1 **(2)**
(d)	 Allow diagrams with intersections between *F*, *C* and *H* provided these are marked with 0. If their diagram indicates extra empty regions do not treat a blank as 0.	M1 B1 for 9, 1 B1 for 77,33 B1 for 64,16 **(4)**
(e)	$\frac{1+16+33}{200}=0.25$	M1 A1 **(2)**
		(12 marks)

	Notes
	Correct answers only score full marks for each part **If a probability is not in [0, 1] award M0**
(a)	M1 for denominator of 200 and attempt to add 2 + 8 or 35 + 75 or 30 + 50 A1 for 0.55 or exact equivalent fraction e.g. $\frac{11}{20}$
(b)	M1 for a fully correct expression (e.g. $1-0.01$) A1 for 0.99 or an exact equivalent fraction
(c)	M1 for a correct ratio or a correct formula and at least one correct prob (i.e. a correct num or denom). BUT award M0 if num is $\mathrm{P}(W)\times\mathrm{P}(C)=\frac{67}{200}\times\frac{80}{200}$ or if num>denom A1 for 0.375 or 3/8 or any exact equivalent.
(d)	M1 for a box and the 3 regions *F, C* and *H* labelled or <u>implied</u> and single set *B* labelled. There should be no intersections between *F, C* and *H* unless marked by zeros. They may have 3 circles for *F, C* and *B* with $H=F'\cap C'$ etc. Condone lack of zero in the <u>given</u> diagram. *F* 1st B1 for the 9 and 1 <u>or</u> 0.045 and 0.005 (o.e.) in the correct regions *H* 2nd B1 for the 77 and 33 <u>or</u> 0.385 and 0.165 (o.e.) in the correct regions *C* 3rd B1 for the 64 and 16 <u>or</u> 0.32 and 0.08 (o.e.) in the correct regions. May have *B* in 3 bits that are disconnected.
(e)	M1 for a numerator made up of their 1 + their 16 + their 33 and a denom of 200 and num < 200 Also allow sum of their probabilities (provided sum < 1) A1 for 0.25 or any exact equivalent

Question	Scheme	Marks
4. (a)	$\sum ft = 4837.5$ (allow 4838 or 4840)	B1
	Mean = $\frac{"4837.5"}{200} = 24.1875$ awrt **24.2** or $\frac{387}{16}$	M1 A1
	$\sigma = \sqrt{\frac{134281.25}{200} - \left(\frac{4837.5}{200}\right)^2}$	M1
	= 9.293 …..... (accept s =9.32) awrt **9.29**	A1 **(5)**
(b)	$Q_2 = [20.5] + \frac{(100/100.5 - 62)}{88} \times 5 = 22.659...$ awrt **22.7**	M1 A1 **(2)**
(c)	$Q_1 = 10.5 + \frac{(50/50.25)}{62} \times 10 [= 18.56]$ **(*)** (n + 1 gives 18.604…)	B1 cso **(1)**
(d)	Q_3= 25.5 (Use of n + 1 gives 25.734…)	B1
	IQR = 6.9 (Use of n + 1 gives 7.1)	B1 ft **(2)**
(e)	The data is skewed (condone "negative skew")	B1 **(1)**
(f)	Mean decreases and st. dev. remains the same. [Must mention mean and st. dev.] (from(a))	B1
	The median and quartiles would decrease. [Must refer to median and at least Q_1.] ((b)(c))	B1
	The IQR would remain unchanged (from (d))	B1 **(3)** **(14 marks)**

	Notes
	Correct answers only score full marks in each part except (c)
(a)	B1 for 4837.5 or 4838 or 4840 seen.
	If no $\sum ft$ seen (or attempt at $\sum ft$ seen), B1 can be implied by a correct mean of awrt 24.2
	1st M1 for attempt at their $\frac{\sum ft}{\sum f}$ allow 1sf so $\sum f$ = awrt 200 and $\sum ft$ = awrt 5000.
	Or award M1 for a clear attempt at mean where at least 4 correct products of $\sum ft$ are seen
	2nd M1 for correct expression including square root seen. Follow through their mean. Allow a transcription error in 134281.25 but not an incorrect re-calculation.
(b)	M1 for a correct fraction ×5 . Ignore end point but must be +. Allow use of (n + 1) giving 100.5…
(c)	B1cso for a fully correct expression including end point. NB Answer is given. Allow use of (n + 1) giving 50.25…but use of 50.5 scores B0
(d)	1st B1 for 25.5 (or awrt 25.7 using n + 1)
	2nd B1ft for their Q_3 – their Q_1 (or 18.6) (provided > 0) Accept awrt 2sf . Correct ans. only scores 2/2
(e)	B1 Must mention that the data is skewed or not symmetrical. Do not award for "outliers"
(f)	1st B1 for one correct comment from the above. May refer to parts (a), (b), (c) or (d)
	2nd B1 for two correct comments from the above
	3rd B1 for all 3 correct comments from the above

Question	Scheme	Marks
5. (a)	$3a + 2b = 0.7$	M1
	$a + 2a + 3a + 4b + 5b + 1.8 = 4.2$ or $6a + 9b = 2.4$	M1
	$5b = 1$ Attempt to solve	M1
	$b =$ **0.2** cao	B1
	$a =$ **0.1** cao	B1
		(5)
(b)	$E(X^2) = 1\times0.1 + 2^2\times0.1 + 3^2\times0.1 + 4^2\times0.2 + 5^2\times0.2 + 6^2\times0.3$ (= 20.4) (*)	B1cso
		(1)
(c)	[Var (X) =] $20.4 - 4.2^2$ [= 2.76]	M1
	Var$(5 - 3X)$ = 9 Var (X)	M1
	= **24.84** or **24.8** (allow $\frac{621}{25}$) cao	A1
		(3)
(d)	[$5k = 1$ so] $k =$ **0.2**	B1
		(1)
(e)	P($Y = 1$) = 0.1	B1
	e.g. P($Y = 2$) = F(2) – F(1) = 0.1	M1
	y | 1 | 2 | 3 | 4 | 5 P($Y = y$) | 0.1 | 0.1 | 0.4 | 0.2 | 0.2 Condone use of $X(x)$ instead of $Y(y)$ Ignore incorrect or no label if table fully correct	A1
		(3)
(f)	P($X = 1$) × P($Y = 1$) ,= **0.01** cao	M1, A1 **(2)**
		(15 marks)

	Notes
	Probabilities outside [0, 1] should be awarded M0
(a)	1st M1 for an attempt at a linear equation in a and b based on sum of probs. = 1
	2nd M1 for an attempt at a second linear equation in a and b based on E(X) = 4.2 Allow one slip.
	3rd M1 for an attempt to solve their 2 linear equations based on sum of probs and E(X) . Must reduce to a linear equation in one variable. 1st B1 for b and 2nd B1 for a. Answers only score B1B1 only
	The 3rd M1 may be implied if M2 is scored and both correct answers are given.
ALT	B1B1 for stating b and a.
	1st M1 for showing that sum of probs. = 1
	2nd M1 for showing that E(X) = 4.2
	3rd M1 for an overall comment "(therefore) a = …and b = …" No comment loses this mark.
(b)	B1cso for a fully correct expression (no incorrect work seen). E.g. allow $14\times0.1 + 41\times0.2 + 36\times0.3$
	Or $0.1 + 0.4 + 0.9 + 3.2 + 5 + 10.8$. Allow in a table (with 20.4) but without "+" explicitly seen.
(c)	1st M1 for a correct expression for Var(X). Must see -4.2^2
	2nd M1 for $(-3)^2$ Var(X) or better, no need for a value. Accept -3^2 if it clearly is used as +9 later.
(e)	B1 for P($Y = 1$) = 0.1
	M1 for correct use of F(y) to find one other prob. Can ft their k if finding P($Y = y$) for y >2
	Can be implied by one other prob. correct or correct ft Look out for P(3) = $3k$ – 0.2 or P(4) = P(5) = k.
	A1 for a fully correct probability distribution. Correct table only is 3/3
(f)	M1 for a correct expression or answer ft their P($Y = 1$) and their P($X = 1$)
	A1 for 0.01 or exact equivalent only
	Don't ISW here e.g. $0.1\times0.1 + 0.1\times0.1$ or $2\times0.1\times0.1$ are M0A0

Question	Scheme	Marks
6. (a)	[Let X be the amount of beans in a tin. P(X < 200) = 0.1]	
	$\frac{200-\mu}{7.8} = -1.2816$ [calc gives 1.28155156…]	M1 B1
	μ = 209.996…. awrt 210	A1
		(3)
(b)	$P(X > 225) = P\left(Z > \frac{225-"210"}{7.8}\right)$	M1
	$= P(Z > 1.92)$ or $1 - P(Z < 1.92)$ (allow 1.93)	A1
	= 1 – 0.9726 = 0.0274 (or better) [calc gives 0.0272037…]	
	= 0.0274	
	= awrt **2.7%** allow **0.027**	A1
		(3)
(c)	[Let Y be the new amount of beans in a tin]	
	$\frac{210-205}{\sigma} = 2.3263$ or $\frac{200-205}{\sigma} = -2.3263$ [calc gives 2.3263478…]	M1 B1
	$\sigma = \frac{5}{2.3263}$	dM1
	$\sigma = 2.15$ (2.14933…)	A1
		(4)
		(10 marks)

	Notes
	Condone poor handling of notation if answers are correct but A marks must have correct working.
(a)	M1 for an attempt to standardise (allow ±) with 200 and 7.8 and set = ± any z value ($\|z\| > 1$) B1 for z = ± 1.2816 (or better used as a z)[May be implied by 209.996(102…) or better seen] A1 for awrt 210 (can be scored for using 1.28 but then they get M1B0A1) The 210 must follow from correct working – sign scores A0 If answer is awrt 210 **and** 209.996… or better seen then award M1B1A1 z = 1.28 gives 209.984 and z = 1.282 gives 209.9996 and both score M1B0A1 If answer is awrt 210 or awrt 209.996 then award M1B0A1 (unless of course z = 1.2816 is seen)
(b)	M1 for attempting to standardise with 225, their mean and 7.8 . Allow ± 1st A1 for Z > awrt 1.92/3. Allow a diagram but must have 1.92/3 and correct area indicated. Must have the Z so P(X > 225) with or without a diagram is not sufficient. Award for 1 – 0.9726 or 1 – 0.9732 2nd A1 for 2.7 % or better (calculator gives 2.72…) Allow awrt 0.027. Correct ans scores 3/3
(c)	1st M1 for an attempt to standardise with 200 or 210, 205 and σ and set = ± any z value ($\|z\| > 2$) B1 for z = 2.3263 (or better) **and** compatible signs. If B0 in (a) for using a value in [1.28, 1.29) but not using 1.2816: allow awrt 2.33 here 2nd dM1 **Dependent on the first M1** for correctly rearranging to make σ = ... May be implied e.g. $\frac{5}{\sigma} = 2.32 \rightarrow \sigma = 2.16$ (M1A0) BUT must have $\sigma > 0$ A1 for awrt 2.15 . Must follow from correct working but a range of possible z values will do. NB $2.320 < z \leq 2.331$ will give an answer of awrt 2.15

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