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Mark Scheme (Results)

June 2011

GCE Statistics S1 (6683) Paper 1

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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 and can be used if you are using the annotation facility on ePEN.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol 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

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June 2011
Statistics S1 6683
Mark Scheme

Question Number	Scheme	Marks
1. **(a)**	$S_{yy} = 4305 - \frac{181^2}{8}$ = <u>209.875</u> **(awrt 210)**	M1 A1 (2)
(b)	$r = \frac{(-)23726.25}{\sqrt{3535237.5 \times "209.875"}}$ = $-$<u>0.87104…</u> **(awrt $-$0.871)**	M1 A1 (2)
(c)	Higher towns have lower temperature or temp. decreases as height increases	B1 (1)
(d)	$S_{hh} = 3.5352375$ (**awrt 3.54**) (condone 3.53)	B1 (1)
(e)	r = $-$<u>0.87104…</u> **(awrt $-$0.871)**	B1ft (1) **(7 marks)**
	Notes	
(a)	M1 for a correct expression. Allow one slip e.g. 4350 for 4305	
(b)	M1 for a correct expression for r, follow through their answer to (a). Condone no "_ " Allow M1 for <u>+</u> 0.87 with no working. (-0.871 is M1A1)	
(c)	B1 Must mention <u>temperature</u> (o.e.) and <u>height</u> (above sea level) and interpret the relationship between them. Must be a correct <u>and sensible</u> comment. e.g. "As temperature increases the height <u>of the sea</u> decreases" is B0. BUT simply stating "As temperature increases the height decreases" is B1 although "As height increases the temperature decreases" would be better. Treat mention of 0.87... as ISW "strong negative correlation between height and temp" is B0 (no interpretation) " as x increases y decreases" is B0 (no mention of height and temperature)	

Question Number	Scheme	Marks
(d)	B1 accept awrt 3.54 and condone 3.53 (i.e truncation)	
(e)	B1ft for awrt -0.871 or ft their final answer to part (b) to the same accuracy (or 3 sf) provided $-1 < r < 1$ Answer to part (e) must be a number "it's the same" is B0	
2.		
(a)	awrt ± 1.40 $\frac{23-\mu}{5} = "1.40"$ (o.e) $\mu = 16$ (or awrt 16.0)	B1 M1A1ft A1 (4)
(b)	0.4192	B1 (1) **5**

Notes

(a)

B1 for awrt $\pm$ 1.40 or better seen anywhere. Condone 1.4 instead of 1.40

M1 for attempting to standardise with 23 and 5 and μ, accept $\pm$

e.g. $\frac{23-\mu}{25} = 1.40$ can score B1M0 (since using 25 not 5 for standardising)

$\frac{23-\mu}{5} = 0.9192$ can score B0M1 (since have correct standardisation)

Can accept equivalent equations e.g. $23-\mu = 5\times "1.40"$

1st A1ft for standardised expression = to a z value ($|z| > 1$). Signs must be compatible.

Follow through their z

e.g. $\frac{23-\mu}{5}$ = their z where $z > 1$ or $\frac{\mu-23}{5}$ = their z where $z < -1$

2nd A1 for 16 or awrt 16.0 if they are using a more accurate z

Correct answer only scores 4/4 but if any working is seen apply scheme

(b)

B1 for 0.4192 (but accept 3sf accuracy if 0.9192 – 0.5 is seen)

Question Number	Scheme	Marks
3. **(a)**	$a = \underline{0.1}$ [F(3) = F(2) + P(Y =3) =(0.5 + 0.3)] $d = \underline{0.8}$ b = F(2) - a = 0.5 - 0.1 or $a + b = 0.5$ $b = \underline{0.4}$ c = 1 - F(3) or 1 - ($a + b$ + 0.3) or $a + b + c = 0.7$ c = $\underline{0.2}$	B1 B1 M1 A1 A1 (5)
(b)	P(3Y + 2 $\geq$ 8) = P($Y \geq$ 2) or 1 - P($Y \leq$ 1) = b + 0.3 + c or 1 - a = $\underline{0.9}$	M1 A1ft (2) **7**
	Notes	
(a)	**Correct answers with no (or irrelevant) working score full marks** 1st B1 for a = 0.1 2nd B1 for F(3) = 0.8 or d = 0.8 M1 for a method for b or c. E.g. sight of $a + b = 0.5$ or $a + b + c = 0.7$ If their values satisfy one of these equations then score M1 provided their values are genuine probabilities (i.e. $0 < p < 1$) This M1 may be implied by a correct answer for b or c 1st A1 for b or P(2) = 0.4 2nd A1 for c or P(3) = 0.2	
(b)	M1 for rearranging to P($Y \geq$ 2) or 1 - P($Y \leq$ 1) or selecting cases Y = 2, 3 and 4 A1ft for 0.3 + their b + their c or 1 - their a, provided final answer < 1 and their values are probabilities.	

Question Number	Scheme	Marks
4. **(a)**	$(z = \pm)\dfrac{15-16.12}{1.6}(=-0.70)$	M1
	P(Z < -0.70) = 1 - 0.7580	M1
	= 0.2420 **(awrt 0.242)**	A1 (3)
(b)	[P(T < t)=0.30 implies] $z = \dfrac{t-16.12}{1.6} = -0.5244$	M1 A1
	$\dfrac{t-16.12}{1.6} = -0.5244 \Rightarrow t = 16.12 - 1.6\times"0.5244"$	M1
	t = awrt 15.28 (allow awrt 15.28/9)	A1 (4)
		7

	Notes
	Allow slips e.g. 16.2 for 16.12 for 1st M1 in (a) and (b)
(a)	1st M1 for standardising expression with 15, 16.12 and 1.6 - allow ±
	2nd M1 for 1 - a probability (> 0.5) from tables or calculator based on their standardised value
	Correct answer only scores 3/3
	In part (b) they can use any letter or symbol instead of *t*
(b)	1st M1 for standardising with t (o.e.), 16.12 and 1.6, allow ±, and setting equal to a z value
	1st A1 for an equation with z = ± 0.5244 or better
	e.g. $\dfrac{t-16.12}{1.6} = \pm 0.52$ (or 0.525) scores M1 (but A0)
	2nd M1 for solving their linear equation as far as $t = a \pm b\times 1.6$. Not dependent on 1st M1
	e.g. solving $\dfrac{t-16.12}{1.6} = 0.3$ to give $t = 16.12 + 1.6\times 0.3$ scores this M1
	Allow $\dfrac{t-16.12}{1.6^2} = 0.3$ to give $t = 16.12 + 1.6^2\times 0.3$ to score M1 too
	2nd A1 dependent on both M marks. Allow awrt 15.28 or awrt 15.29
	Condone awrt 15.3 if a correct expression for t = ... is seen.
	Answers with no working:
	15.28 is M1A1M1A1, 15.29 is M1A0M1A1, 15.3 is M1A0M1A0

Question Number	Scheme	Marks
5.		
(a)	10.5	B1 (1)
(b)	$(Q_2 =)\ (15.5+)\ \frac{\frac{1}{2}\times 30-14}{8}\times 3$ or $\frac{\frac{1}{2}\times 31-14}{8}\times 3$	M1
	= 15.875 or 16.0625	A1 (2)
(c)	$\bar{x} = \frac{477.5}{30}$ = 15.9 (15.916) [Accept $\frac{191}{12}$ or $15\frac{11}{12}$]	M1, A1
	$\sigma = \sqrt{\frac{8603.75}{30} - \bar{x}^2}$,= 5.78 (accept s = 5.88)	M1A1ft, A1 (5)
(d)	Since mean and median are similar (or equal or very close) a normal distribution may be suitable. [Allow mean or median close to mode/modal class]	B1 (1)
(e)	$Q_3 - Q_2 (=8) > (4.5 =) Q_2 - Q_1$	M1
	Therefore positive skew	A1 (2)
		(11 marks)

Notes

In parts (a) to (c) a correct answer with no working scores full marks for that value.

(a) B1 for 10.5 which may be in the table

(b) M1 for a correct ratio and times 3, ignore the lower boundary for this mark
A1 for awrt 15.9 (if n =30 used) or awrt 16.1 (if n+1 = 31 is used)

(c) 1st M1 for attempt at $\sum fx$ (this may be seen in the table as fx: 10, 73.5, 70, 136, 82, 106 [condone 1 slip] or awrt 500) and use of $\frac{\sum fx}{\sum f}$ or a correct expression for mean.

1st A1 for awrt 15.9

2nd M1 for an attempt at σ or σ^2, can ft their mean, condone mis-labelling $\sigma^2 = \sqrt{...}$ etc
Allow use of their $\sum fx^2$ (awrt 9000)

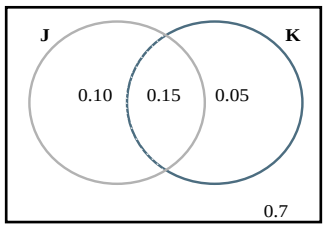
2nd A1ft for a correct expression including square root, ft their mean but not their $\sum fx^2$.
No label or correct label is OK but wrong label (e.g. $\sigma^2 = \sqrt{...}$) is A0

3rd A1 for awrt 5.78, allow s = awrt 5.88. **SC** Allow M1A1A0 for awrt 5.79 if $\bar{x}$ correct

(d) B1 for a reason implying or stating symmetry. "Time is continuous" or "evenly distributed" is B0

Question Number	Scheme	Marks
(e)	M1 for a clear reason or comparison, values not essential but comparison implying they have been found is required. A1 for stating "positive skew". Condone just "positive" but "positive correlation" is A0 **Do not allow arguments based on mean and median since this part relates to a different set of data.**	
6.		
(a)	$P(J \cup K) = 1 - 0.7$ or $0.1 + 0.15 + 0.05 =$ $\underline{0.3}$	B1 (1)
(b)	$P(K) = 0.05 + 0.15$ or "0.3" – 0.25 + 0.15 or "0.3" = 0.25 + $P(K)$ – 0.15	M1
	May be seen on Venn diagram $= \underline{0.2}$	A1 (2)
(c)	$\left[P(K \mid J)\right] = \dfrac{P(K \cap J)}{P(J)}$	M1
	$= \dfrac{0.15}{0.25}$	A1
	$= \underline{\dfrac{3}{5} \text{ or } 0.6}$	A1 (3)
(d)	$P(J) \times P(K) = 0.25 \times 0.2 (= 0.05)$, $P(J \cap K) = 0.15$ $\underline{\text{or}}$ $P(K \mid J) = 0.6$, $P(K) = 0.2$ $\underline{\text{or}}$ may see $P(J \mid K) = 0.75$ and $P(J) = 0.25$	M1
	not equal therefore not independent	A1ft (2)
(e)	Not independent so confirms the teacher's suspicion $\underline{\text{or}}$ they are linked (This requires a statement about independence in (d) or in (e))	B1ft (1) **(9 marks)**

Question Number	Scheme	Marks
	Notes	
(b)	M1 for a complete method, follow through their 0.3, leading to a linear equation for P(*K*) NB You may see this Venn diagram. A correct diagram (Venn or table) implies M1 in (b) Need not include box or 0.7 **Correct answer only is 2/2**	
(c)	**In parts (c) and (d) they must have defined *A* and *B*** M1 for a correct expression (including ratio) in symbols. 1st A1 for a correct ratio of probabilities (if this is seen the M1 is awarded by implication) Must be in (c). Condone no LHS but wrong LHS (e.g. P(*K*) or P(*J*|*K*)) is M0A0 2nd A1 for correct answer as printed only. **Correct answer only 3/3**	
(d)	**Mark (d) and (e) together** M1 for a correct comparison of known probabilities for an independence test - ft their values. E.g. $P(J)\times P(K)$ with $P(J\cap K)$ <u>or</u> P(*K*|*J*) with P(*K*) [Must have expressions] The values of these probabilities should be given unless they are in the question or stated elsewhere. A1ft for correct calculations and correct comment for their probabilities	
(e)	B1ft ft their conclusion on independence so not independent confirms teacher…independent contradicts teacher. **Methods leading to negative probabilities should score M0**	



Question Number	Scheme	Marks
7.		
(a)	$\left(S_{fh} =\right) 25291 - \frac{186 \times 1085}{8}$	M1
	$= \underline{64.75}$ (accept 64.8)	A1
		(2)
(b)	$b = \frac{"64.75"}{39.5}$, $= \underline{1.6392\ldots}$ (awrt 1.6)	M1, A1
	$a = \frac{1085}{8} - b \times \frac{186}{8}$, $= \underline{97.512\ldots}$ (awrt 97.5)	M1, A1
	$\underline{h = 97.5 + 1.64f}$	A1ft (dep on M1M1)
		(5)
(c)	$h = 97.5 + 1.64 \times 25$, $= \underline{138 \sim 139}$ (final answer in [138, 139])	M1, A1
		(2)
(d)	Should be reliable, since 25 cm(or *f* or footlength) is within the range of the data	B1, B1
		(2)
(e)	Line is for children – a different equation would apply to adults or Children are still growing, height will increase more than foot length	B1
		(1)
		12

Notes

[NB $r = 0.871$ so do not confuse this with question 1]

(a) M1 for attempting a correct expression [allow a copying slip e.g. 25921]

(b) 1st M1 for a correct expression for *b*, ft their part (a) but not $S_{fh} = 25291$

1st A1 for awrt 1.6

2nd M1 for use of $a = \bar{h} - b \times \bar{f}$, ft their value for *b*. Must use $\bar{h}$ and $\bar{f}$ not values from table.

2nd A1 for awrt 97.5 [NB $a = 135 - 1.63 \times 23 = 97.51$ but M0A0 since not using $\bar{h}$ and $\bar{f}$]

3rd A1ft for an equation for *h* and *f* with their coefficients to 3sf. **Dependent on both Ms**

Must be 3sf not awrt. Give this mark if seen in (c). Equation must be in *h* and *f* not *y* and *x*.

(c) M1 for using their equation and $f = 25$ to find *h*

A1 for their final answer in [138, 139]. Can give if they have 137.7... but round to 138

(d) 1st B1 for suggesting it is reliable

2nd B1 for mentioning that 25 cm is within range of data. "interpolation"or"not extrapol'B1

Use of "it" or a comment that height is in range is B0 but apply ISW

(e) B1 for some comment that states a difference between children and teachers(adults)

Must mention teacher/adults and children

e.g. ".teacher is not in same age group as the children", "equation is for children not adults"

"children and adults are different populations"

"teacher will be taller" is B0 since no mention of children.

"equation is only valid for children" is OK since "only" implies not suitable for adults

Or Reference to different growth rates

Question Number	Scheme	Marks
8.		
(a)	$1 = p + (0.25 + 0.25 + 0.2 + 0.2)$, $\Rightarrow p$ = $\frac{1}{10}$ or 0.1	M1, A1 (2)
(b)	E(S) = $\frac{1}{4} + 2\times\frac{1}{4} + 4\times\frac{1}{5} + 5\times\frac{1}{5}$, (or equiv. in decimals) = 2.55	M1, A1 (2)
(c)	E $\left(S^2\right) = \frac{1}{4} + \frac{2^2}{4} + \frac{4^2}{5} + \frac{5^2}{5}$ or 0.25 + 1 + 3.2 + 5 = 9.45 (*)	M1, A1cso (2)
(d)	Var(S) = 9.45 $-(\text{E}(S))^2$, = 2.9475 or $\frac{1179}{400}$ (accept awrt 2.95)	M1, A1 (2)
(e)	P(5 and 5) = $\left(\frac{1}{5}\right)^2$, = $\frac{1}{25}$ or 0.04	M1, A1 (2)
(f)	P(4, 4, 2) = $\left(\frac{1}{5}\right)^2 \times \frac{1}{4} \times 3$ (= 0.03 or $\frac{3}{100}$)	M1, M1
	P(4, 4, 4) = $\left(\frac{1}{5}\right)^3$ (= 0.008 or $\frac{1}{125}$)	B1
	P(Tom wins in 3 spins) = 0.038	A1 (4)
(g)	P $\left(\overline{5} \cap 5 \cap 5\right) + \text{P}(5 \cap \overline{5} \cap 5) = \frac{4}{5} \times \left(\frac{1}{5}\right)^2 \times 2$ = 0.064 or $\frac{8}{125}$	M1, M1, A1 (3)
		17

	Notes
(a)	M1 for clear attempt to use sum of probabilities = 1 (fractions or decimals) Ans only 2/2
(b)	M1 for at least 2 correct terms ($\neq 0$) of the expression. 2.55 with no working scores M1A1 **Any division by *k* (usually 5) in (b) or (c) or (d) scores M0**
(c)	M1 for at least 3 correct, non-zero terms of the expression seen, allow decimals. A1cso for the full expression (with 9.45) seen. Must be cso but can ignore wrong p.
(d)	M1 for a correct expression (9.45 seen), can ft their E(S). May see $\sum (x - \text{"2.55"})^2 \times \text{P}(X = x)$ A1 accept awrt 2.95 Answer only can score M1 for correct ft and A1 for awrt 2.95 **Answer only in (e) and (f) is full marks, in (g) is no marks**
(e)	M1 for $\left(\frac{1}{5}\right)^2$ Condone $\text{P}(5) \times \text{P}(5) = 0.25 \times 0.25$. [Beware 0.4 is A0]
(f)	1st M1 for $\left(\frac{1}{5}\right)^2 \times \frac{1}{4}$ or 0.01 seen 2nd M1 for multiplying a $p^2 q$ probability by 3($p, q \in (0,1)$). B1 for $(0.2)^3$ or better seen
(g)	1st M1 for $\frac{4}{5} \times \left(\frac{1}{5}\right)^2$ or all cases considered and correct attempt at probabilities. 2nd M1 for multiplying a $p^2(1-p)$ probability by 2. **Beware $(0.4)^3$ = 0.064 is M0M0A0**

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