edexcel

Mark Scheme (Results)

Summer 2015

Pearson Edexcel GCE in 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.

PEARSON 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)
   - d… or dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - $*$ The answer is printed on the paper or ag- answer given
   - $\sqsubset$ or d… 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.

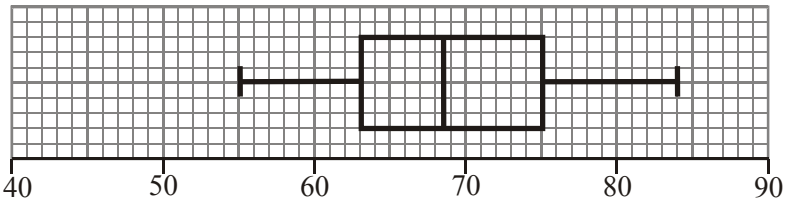
Special notes for marking statistics exams

(a) If a method leads to "probabilities" which are greater than 1 or less than zero then M0 should be awarded unless the mark scheme specifies otherwise.

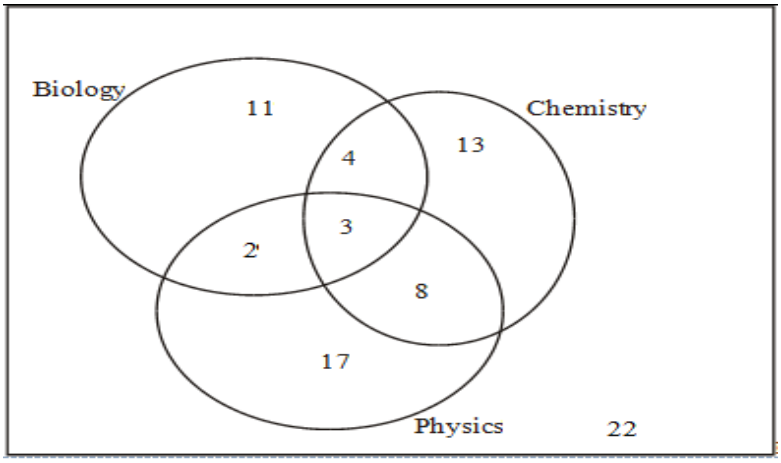
(b) Any correct method should gain credit.

(c) For method marks we generally allow or condone a slip or transcription error if these are seen in an expression. Typical examples on this paper are: Qu 4 where 225 is used instead of 255 or in Qu 5 where 255 is used instead of 225. Also in Question 5(e) and 5(f) 0.064 often becomes 0.64 and in 6(b) 0.625 becomes 0.0625

We do not condone or allow these errors in accuracy marks though.

Question	Scheme	Marks
1.		
(a)	[Range = 48 – 9] = **39**	B1 (1)
(b)	[IQR = 25 – 12]= **13**	B1 (1)
(c)	Median = $65+\frac{[9]}{13}\times 5 = \frac{890}{13}$ = awrt **68.5**° $\left[\text{Condone: } 65+\frac{[9.5]}{13}\times 5 = 68.7\right]$	M1 A1 (2)
(d)	Lower Quartile = $60+\frac{9}{15}\times 5 =$ **63** **(*)**	M1 A1cso (2)
(e)(i)	$63-1.5\times(75-63)=45$ $75+1.5\times(75-63)=93$ No data above 93 and no data below 45 or 55>45 etc or there are no outliers.	M1A1 A1
(ii)		M1 A1ft (5)
(f)	Median for the 70°angle is closer (to 70°)[than the 20° median is to 20°] The range/IQR for the 70° angle box plot is smaller/shorter Therefore, students were more accurate at drawing the 70° angle.	B1 B1 dB1 (3) (14 marks)
	Notes	
(c)	M1 for an attempt (should have 65 or 70, 13 and 5)NB working down: $70-\frac{[4]}{13}\times 5$ Allow any correct method leading to $\frac{890}{13}$, the "5" may be implied by 65 and 70 seen A1 awrt 68.5 (condone 68.7 if (n+1) is used). Ans only of 68.5 is 2/2 but 68.7 needs M1	
(d)	M1 for correct expression for the lower quartile (condone 9.25 if (n+1) used) Watch out for working down e.g. $65-\frac{6}{15}\times 5$ (M1) but e.g. $\frac{60+65}{2}=62.5=63$ is M0 A1 for correct solution with no incorrect working seen (condone (n+1) giving 63.08..)	
(e)(i)	M1 for either correct calculation (may be implied by one correct limit) A1 for either 45 or 93 A1 for 45 and 93 and conclusion	
(ii)	M1 for a box with 1 whisker drawn on each side (must see the line drawn) A1ft their median $63 < Q_2 < 75$ but quartiles (63 and 75), 55 and 84 must be correct.	
Accuracy	Use 0.5 sq. accuracy so condone median on 68 or 69 if 68.5 seen	
(f)	1st B1 for correct comparison of their **medians** (63 < (c) < 75) to true value 2nd B1 for correct comparison of their **range** or **IQR** ("spread" is B0) Allow saying IQRs of 12 and 13 are similar. Ignore mention of "skewness" or "outliers" 3rd dB1 dependent upon at least one previous B1 being scored for choosing 70°	

Question		Scheme	Marks
2.	**(a)**	$\frac{1840-a}{b}=4.0$ $\quad$ $\frac{1848-a}{b}=4.8$ $a=$ **<u>1800</u>** $\quad$ $b=$ **<u>10</u>**	M1 A1 (2)
	(b)	$r=\frac{-2.17}{\sqrt{1.02\times 8.22}}=-0.749417343....$ $\quad$ awrt $-$ **<u>0.749</u>**	M1A1 (2)
	(c)	-0.749	B1ft (1)
	(d)	House H: 156 400/85 = [£1840/m^2 or $q=4$] House J: 172 900/95 = [£1820/m^2 or $q=2$] Since ($r=-0.749$,) there is negative correlation. <u>or</u> The higher the price (per square metre), the lower the distance from the train station. Therefore…..House H is likely to be closer.	M1 dM1 A1 (3) (8 marks)
		Notes	
	(a)	M1 for setting up two suitable equations which could lead to a and b (may be implied by one correct answer) A1 for $a=1800$ <u>and</u> $b=10$ ($a=10$ and $b=1800$ is A0) Correct answer only is 2/2	
	(b)	M1 for a correct expression (condone missing $-$) A1 for awrt -0.749 (-0.75 <u>or</u> awrt 0.749 with no working scores M1 A0).	
	(c)	B1ft for -0.749 or ft their answer to (b) to at least 2sf. Must be in the range $-1<'(b)'<1$	
	(d)	M1 for calculating price/square metre for <u>both</u> H and J. Can be implied by sight of 1840 and 1820 (so OK if not labelled or mis-labelled) These may be seen in the table in the question. Allow comment like "H is £20/square metre more than J" dM1 dependent on 1st M1 for a statement that correlation is negative <u>or</u> a contextualised interpretation of the negative correlation. **$r>0$** If $r>0$ allow equivalent statements about positive correlation A1 (dependent on both Ms) for House H is likely to be closer (No ft if $r>0$)	

Question	Scheme	Marks
3. (a)		B1 M1 A1 A1 B1 (5)
(b)	$\frac{'13'}{80}$ or 0.1625	B1ft (1)
(c)	$\frac{28+30-11}{80}$ or $\frac{2+3+4+8+13+17}{80}$ or $1-\frac{(11+22)}{80}=\frac{47}{80}$ or 0.5875	M1 A1 (2)
(d)	$\frac{"17+8+13"}{"47"}$ or $\frac{\frac{"38"}{80}}{\frac{"47"}{80}}$ or $1-\frac{"2+3+4"}{"47"}=\frac{38}{47}$ (condone awrt 0.809)	M1 A1cao (2)
(e)	$P(B\|C)=\frac{7}{28}$, $P(B)=\frac{20}{80}$ $P(C\|B)=\frac{7}{20}$, $P(C)=\frac{28}{80}$ $P(B\cap C)=\frac{7}{80}$, $P(B)\ =\ \frac{20}{80}P(C)=\frac{28}{80}$ $P(B\|C)=P(B)$, $P(C\|B)=P(C)$ these may be implied by correct conclusion $P(B\cap C)=P(B)\times P(C)$ this approach requires the product to be seen So, they are independent.	M1 M1 A1 (3) (13 marks)
	Notes	
(a)	B1 for 3 intersecting circles with 3 in the centre. **Allow probs. or integers in diagram.** M1 for some correct subtraction e.g. at least one of 2, 4, 8 or for B: 20 – their(2+3+4) etc A1 for 2, 4 and 8 (ignore labels) A1 for 11, 13 and 17 (must be in compatible regions with 2, 4, 8 if no labels) B1 for correct labels and 22 and box (Do not treat "blank" as 0 so can't use 0 for ft in (c))	
(c)	M1 for a correct expression seen in (c) (or ft their diagram). Correct ans M1A1	
(d)	M1 for denominator of 47 or ft their numerator from part (c) and numerator of 38 or their (17 + 8 + 13) or (their 47) – their (2 + 3 + 4). Correct ans M1A1	
(e)	M1 for stating at least the required probs.& labelled for a correct test (can ft their diagram) M1 for use of a correct test with B and C Must see product attempted for $P(B\cap C)$ test. A1 for a correct test with all probabilities correct and a correct concluding statement. NB M0M1A0 should be possible but A1 requires both Ms	

Question	Scheme	Marks
4. (a)	To simplify (or represent) a real world problem (o.e.) To improve understanding (o.e.) To analyse a real world problem or can change variables/replicate easily (oe) To make predictions or find estimates (o.e.)	B1g B1h (2)
(b)	$\sum x = 12$ $S_{xy} = 283.8 - \frac{'12' \times 255}{10}$, $= -\underline{\mathbf{22.2}}$	B1 M1,A1cao (3)
(c)	$b = \frac{'-22.2'}{10.36} =, -2.142857....$ (A1 for awrt -2.1) $\left[a = \bar{y} - b\bar{x} \quad \Rightarrow\right] \; a = \frac{255}{10} - 'b' \times \frac{"12"}{10} = 28.07143$ $y = 28.1 - 2.14x$ $\left[\text{Condone: } y = 28.1 + -2.14x\right]$	M1A1 M1 A1 (4)
(d)	(28.1 kWh) of energy are used when the temperature is 0[°C]	B1 (1)
(e)	$y = 28.1 - 2.14(2) =$ awrt $\underline{\mathbf{23.8}}$	M1 A1 (2)
(f)	The regression model is based on temperatures from the winter, so not reliable in the summer. Stating it **is** reliable (whatever the reason) is B0B0	B1 dB1 (2) (14 marks)
	Notes	
(a)	Make sure reasons refer to **models** and not **tests** 1st B1g (be fairly generous) for a sensible reason not using "quick", "cheap" or "describe" 2nd B1h (be slightly harder) for two convincing reasons (both based on the list above) Use professional judgement and mark as B0B0 or B1B0 or B1B1 do **not** use B0B1	
(b)	B1 for $\sum x = 12$ (May be by the table) (Can be implied by 3060 seen or the next line) M1 for attempt at correct formula (ft their $\sum x$ where $10 < \sum x < 14$) A1 for -22.2 only	
(c)	M1 for a correct expression for b (ft their $S_{xy} \neq 283.8$) A1 for awrt -2.1 (allow $-15/7$) M1 for a correct expression for a and ft their 12 (allow use of a letter b) A1 for $y = 28.1 - 2.14x$ (awrt 28.1 and awrt -2.14) Must be y and x and no fractions	
(d)	B1 for a contextualised interpretation e.g. the amount of <u>energy</u> used when <u>temperature</u> is <u>0</u>[°C] **or** [28.1] <u>kWh</u> used when <u>temp. is 0</u>[°C] [Can ft their 28.1]Need <u>temp</u> or °<u>sign</u> [B0 for "value of y when $x = 0$" since no context in words]	
(e)	M1 for substituting $x = 2$ into their equation	
(f)	B1 for reasoning to suggest that temperatures are different in summer or the model was based only on data from the winter. Allow mention of <u>extrapolation</u> (o.e.) dB1 so not reliable.	

Question	Scheme	Marks
5. (a)	To score 15 points, 2 correct and 1 not correct $[0.6\times0.6\times0.4]+[0.6\times0.4\times0.6]+[0.4\times0.6\times0.6]$ <u>or</u> $3\times(0.6\times0.6\times0.4)$ $= 0.432$ **(*)**	M1 A1cso (2)
(b)	$1 - (0.216 + 0.432 + 0.064) =$ **<u>0.288</u>** or $3\times0.6\times(0.4)^2$	B1 (1)
(c)	[(30, 0), (0, 30) or (15, 15)] $0.216\times'0.288'+'0.288'\times0.216+0.432\times0.432$ **awrt <u>0.311</u>**	M1 A1ft A1 (3)
(d)	$E(X)=[30\times0.216]+[15\times0.432]+[0\times0.288]+[(-15)\times0.064]$ $E(X) = 12$ **<u>12</u>** (only)	M1 A1 (2)
(e)	$E(X^2)=30^2\times0.216+15^2\times0.432+0^2\times0.288+(-15)^2\times0.064\ (=306)$ $Var(X)=E(X^2)-[E(X)]^2$ $='306'-'12'^2=$, **<u>162</u>**	M1 M1, A1 (3)
(f)	Let Y = number of points scored in bonus round [y] | 60 | 35 | 10 | –15 [P($Y=y$)] | 0.216 | 0.432 | 0.288 | 0.064 $E(Y) = 60\times0.216+35\times0.432+10\times0.288+(-15)\times0.064$ $=$ **<u>30</u>**	M1 dM1 A1 (3) (14 marks)
	Notes	
(a)	M1 for $0.6^2\times0.4$ may be $\Rightarrow$ by tree diagram with 0.6 & 0.4 but just 3×0.144 or 2×0.216 is M0 A1 cso for $3\times0.6^2\times0.4$ (seen) and no incorrect working seen	
(b)	0.288 or $\frac{36}{125}$ answer may be seen in table. [NB Fractions: $\frac{27}{125},\frac{54}{125},\frac{36}{125}$ and $\frac{8}{125}$]	
	Correct answers to (c), (d) and (e) score full marks for these parts.	
(c)	M1 for either $0.216\times'0.288' = (0.062208)$ <u>or</u> $0.432\times0.432 = 0.186624$ (ft (b) provided their (b) is a probability) 1st A1ft for a fully correct expression 2nd A1 for awrt 0.311 or $\frac{972}{3125}$	
SC	**6 questions 4 correct** Award M1&1st A1 for $6C4\times0.6^4\times0.4^2$ or $15\times0.6^4\times0.4^2$	
(d)	M1 for a correct expression for E(X) (0 term not required, ft their (b)) NB alt: $3\times(10\times0.6+(-5)\times0.4)$. E($X$) = 12 scores M1A1 if (b) is a probability.	
(e)	1st M1 for correct expres' for $E(X^2)$ (0 term not required, ft their(b))Condone -15^2 Ignore label so Var(X) = [E(X^2)] = 306 can score M1M0A0 2nd M1 for correct expression for Var(X) (may follow through their values)	
ALT	1st M1 for $[10^2\times0.6+(-5)^2\times0.4 = 70]$ 2nd M1 for $3\times(70-4^2)=54$ and A1 for 162	
(f)	1st M1 for correct distribution for Y (ft(b)) <u>or</u> $20\times0.6+(-5)\times0.4$ <u>or</u> $Y=\frac{5}{3}X+10$ 2nd dM1 for correct expres' for E(Y) <u>or</u> $3\times(20\times0.6+(-5)\times0.4)$ <u>or</u> $E(Y)=\frac{5}{3}E(X)+10$ Dep. on 1st M1 but can ft their (b) or their E(X). Correct expres' (line 2) scores M1M1 A1 for 30 with at least 1 M mark scored. Answer only is 0/3 but 30 after M1 is 3/3	

Question	Scheme	Marks
6. (a)(i)	$P(A) = P(Z > 1.1) = 1 - 0.8643 =$ **0.1357** (accept awrt 0.136)	B1
(ii)	$P(B) = P(Z > -1.9) =$ **0.9713** (accept awrt 0.971)	B1
(iii)	$P(C) = [P(-1.5 < Z < 1.5)] = 0.9332 - (1 - 0.9332)$ or $(0.9332 - 0.5) \times 2$ $=$ **0.8664** (accept awrt 0.866)	M1 A1
(iv)	$P(A \cup C) = P(Z > -1.5)$ or $P(Z < 1.5)$ or $= P(A) + P(C) - P(A \cap C) = "0.1357" + "0.8664" - (0.9332 - 0.8643)$ $=$ **0.9332** (accept awrt 0.933)	M1 A1 (6)
(b)	$[P(X > w \mid X > 28) =] \dfrac{P(X > w)}{P(X > 28)} = [0.625]$	M1
	$P(X > 28) = P\left(Z > \dfrac{28-21}{5}\right) = P(Z > 1.4) = [0.0808$ calc: 0.80756..$]$	M1
	$P(X > w) = 0.0808 \times 0.625$ (= 0.0505) or ($P(X < w) = 0.9495$)	A1
	$\dfrac{w-21}{5} = 1.64$	M1 B1
	$w =$ awrt **29.2**	A1 (6) (12 marks)
	Notes	
	Mark final answer here so in (ii) 0.9713 followed by 1 – 0.9713 is B0 but for rounding errors e.g. 29.245 followed by 29.3 apply ISW and award for 29.245	
(a)(iii)	M1 for correct expression with probability values . Correct ans implies M1A1	
(iv)	M1 for a correct addition formula with some correct substitution (or correct ft) or $P(Z > -1.5)$ (o.e) or for a fully correct expression with correct probabilities A1 for 0.9332 (accept 0.933) Correct answer only is M1A1	
(b)	M1 for correct expression for conditional probability- must have $P(X > w)$ as num' May be implied by $P(X > w) = 0.625 \times$ (any probability) M1 for standardising 28 with 21 and 5 Allow $\pm$ (May be implied by 0.0808 [or awrt 0.081] seen in correct position) A1 for $P(X > w) = 0.0808 \times 0.625$ or $P(X > w) = 0.0505$ or $P(X < w) = 0.9495$) This A1 depends on both Ms but seeing $P(X > w) = 0.0808 \times 0.625$ scores M1M1A1	
1st 3 marks	Allow $P\left(Z > \dfrac{w-21}{5}\right)$ instead of $P(X > w)$ for these first 3 marks M1 for standardising w with 21 and 5 (allow $\pm$) and setting equal to a z-value $\lvert z \rvert > 1$ Allow any letter instead of w B1 for 1.64 (or better) used correctly. [Calculator gives: 1.6402851...] A1 allow awrt 29.2	

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