edexcel

Mark Scheme (Results)

Summer 2015

Pearson Edexcel International A Level in Statistics 1 (WST01/01)

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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
   - $\lfloor$ 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.

June 2015
WST01 STATISTICS 1
Mark Scheme

Question	Scheme	Marks
1. (a)	$F(4)=1$	M1
	$4^2k=1\Rightarrow k=\frac{1}{16}$	A1
		(2)
(b)	e.g. $P(X=2)=F(2)-F(1)=\frac{4}{16}-\frac{1}{16}=\frac{3}{16}$	M1
	$[x]$: 1 | 2 | 3 | 4 $[P(X=x)]$: $\frac{1}{16}$ (0.0625) | $\frac{3}{16}$ (0.1875) | $\frac{5}{16}$ (0.3125) | $\frac{7}{16}$ (0.4375)	A1
		(2)
		Total 4
	Notes	
(a)	M1 for writing or using F(4)=1 A1 for $\frac{1}{16}$ or 0.0625 (Answer only scores 2 out of 2)	
(b)	M1 for correct use of F(x) to find P(X = 2, 3, or 4) (can follow through their k, $3k$, $5k$, $7k$). May be implied by at least two correct probabilities or correct follow through. A1 for a fully correct probability distribution. Allow exact decimals. Ignore incorrect or missing labels if table is all correct.	

Question	Scheme	Marks
2. (a)	$S_{xy} = 1474.1 - \frac{441.5 \times 59.8}{20} = 154.015$ awrt **154**	M1A1
	$S_{xx} = 11261.25 - \frac{441.5^2}{20} = 1515.1375$ awrt **1520**	A1
		(3)
(b)	$b = \left[\frac{S_{xy}}{S_{xx}}\right] = \frac{"154.015"}{"1515.1375"} = [0.10165084]$	M1
	$[a = \bar{y} - b\bar{x} \rightarrow]$ $a = \frac{59.8}{20} - 'b' \times \frac{441.5}{20} = [0.7460577...]$	M1
	$y = 0.746 + 0.102x$	A1
		(3)
(c)	$\frac{v}{100000} = '0.746' + '0.102'\left(\frac{s-50}{10}\right)$	M1
	$v = 23780.34997 + 1016.508403s$	
	c = awrt **23600-23800**	A1
	d = awrt **1020****	A1
		(3)
(d)	$v = 23780.34997 + 1016.508403 \times 130 = 155926.44236$ awrt **156000**	M1A1
		(2)
(e)	For each (additional) 1 m^2 in floor size, the value of the house increases by '£1020'	B1
		(1)
(f)	[31d=] £31511.76 awrt (£)**32000**	B1
		(1)
		Total 13

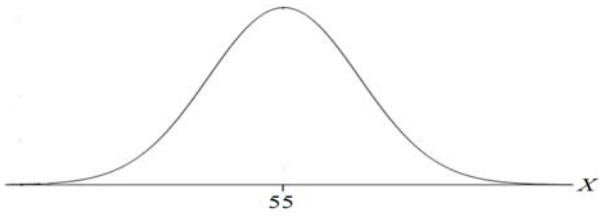
	Notes
(a)	M1 for one correct expression for S_{xy} or S_{xx}
	1st A1 for either S_{xy} = awrt 154 or S_{xx} = awrt 1520
	2nd A1 for both
(b)	1st M1 for a correct expression for b (ft their $S_{xy} \neq 1474.1$)
	2nd M1 for a correct expression for a (allow use of the letter b)
	A1 for $y = 0.746 + 0.102x$ (a = awrt 0.746 and b = awrt 0.102) Must be in y and x and no fractions.
(c)	M1 for substituting $y = \frac{v}{100000}$ and $x = \left(\frac{s-50}{10}\right)$ into their equation in (b)
	1st A1 c = awrt 23600-23800
	2nd A1 d = 1020** answer given so must come from correct working
Alt	Using $S_{sv} = 1\,000\,000 S_{xy}$ and $S_{ss} = 100 S_{xx}$ to find d and using $\bar{v} = 100000\bar{y}$ and $\bar{s} = 10\bar{x} + 50$ to find c can score M1 provided fully correct.
(d)	M1 for substituting s = 130 into their (c) or substituting x = 8 into their (b)
	A1 awrt 156 000
(e)	B1 A correct contextualised interpretation of the numerical value of the gradient which must mention m^2 or floor size **and** £ or value. Allow follow through from their regression equation in (c)
(f)	B1 awrt (£)32 000

Question	Scheme	Marks
3(a)	$[\text{P(Female)} =] \frac{30}{90}$ oe	B1 (1)
(b)	$[\text{P(Male} \mid < 4 \text{ years}) =] \frac{\text{P(Male} \cap < 4 \text{ years)}}{\text{P}(< 4 \text{ years})} = \frac{\frac{16}{(90)}}{\frac{16+9}{(90)}} = \frac{16}{25}$ oe	M1A1 (2)
(c)	$[\text{P(Male} \mid < 10 \text{ years}) =] \frac{\text{P(Male} \cap < 10 \text{ years)}}{\text{P}(< 10 \text{ years})} = \frac{\frac{20+16}{(90)}}{\frac{9+16+14+20}{(90)}} = \frac{36}{59}$	M1A1 (2)
(d)	$\text{P(Male} \mid < 4 \text{ years}) = '\frac{16}{25}', \quad \text{P(Male)} = \frac{60}{90}$ or $\text{P}(< 4 \text{ years} \mid \text{Male}) = \frac{16}{60}, \quad \text{P}(< 4 \text{ years}) = \frac{25}{90}$ or $\text{P(Male} \cap < 4 \text{ years}) = \frac{16}{90}, \quad \text{P(Male)} = \frac{60}{90}, \quad \text{P}(< 4 \text{ years}) = \frac{25}{90}$ $\text{P}(\text{M} \mid < 4) \neq \text{P(M)}$ or $\text{P}(< 4 \mid \text{M}) \neq \text{P}(<4)$ or $\text{P(Male} \cap < 4 \text{ years}) \neq \text{P(M)} \times \text{P}(< 4)$ so not independent.	M1 M1 A1 (3)
		Total 8

	Notes
(a)	B1 for $\frac{30}{90}$ or exact equivalent
(b)	M1 for a correct ratio expression with at least one correct probability substituted or for a correct ratio of probabilities. num>denom is M0 A1 $\frac{16}{25}$ or 0.64 (Correct answer scores 2 out of 2).
(c)	M1 for a correct ratio expression with at least one correct probability substituted or for a correct ratio of probabilities. num>denom is M0. A1 $\frac{36}{59}$ or condone awrt 0.610 (must be 3sf) (Correct answer gets 2 out of 2).
(d)	1st M1 for stating all of the required numerical probabilities for a correct test which must be labelled. The probabilities must be correct or correct ft from (b) (If attempting the first test, $\text{P(Male} \mid < 4 \text{ years}) = '\frac{16}{25}'$ was found in part(b) and need not be fully restated here). 2nd M1 for use of a correct test. Must see the product if attempting the 3rd test. A1 for correct test with all probabilities correct and a correct conclusion. NB Use of A and B throughout scores M0M0A0 unless A and B are explicitly defined.

Question	Scheme	Marks
4.(a)	[P(both blue) $= \frac{1}{20} \times \frac{1}{20} =] \frac{1}{400}$ oe	B1
		(1)
(b)	P(exactly 1 red) $= 2 \times \frac{1}{20} \times \frac{19}{20}, = \frac{19}{200}$ oe	M1, A1
		(2)
(c)	P(2 yellow and 1 green)$=3 \times \frac{4}{9} \times \frac{5}{8} \times \frac{4}{7} = \frac{10}{21}$ oe	B1 M1 A1
		(3)
(d)	P(All beads are yellow) $= \frac{5}{9} \times \frac{4}{8} \times \frac{3}{7} \times \frac{2}{6}$	M1
	P(At least 1 bead is green) = 1 – P(All beads are yellow)	
	$1 - \frac{5}{9} \times \frac{4}{8} \times \frac{3}{7} \times \frac{2}{6} = \frac{121}{126}$	M1A1
		(3)
		Total 9

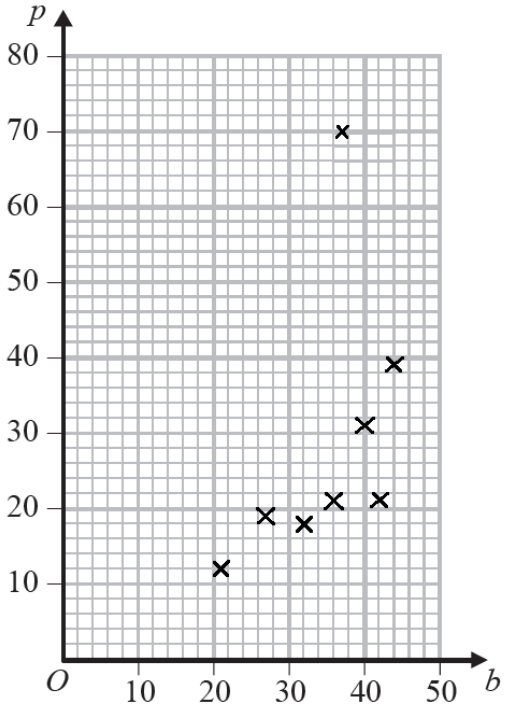
	Notes
(a)	B1 $\frac{1}{400}$ or 0.0025
(b)	M1 for a correct equivalent expression $\frac{1}{20} \times \frac{19}{20} + \frac{19}{20} \times \frac{1}{20}$
	A1 $\frac{19}{200}$ or 0.095
(c)	B1 for 3 × … or for the sum of exactly 3 identical products attempted M1 for any one product correct
	A1 $\frac{10}{21}$ (allow awrt 0.476 from correct working)
(d)	1st M1 $\frac{5}{9} \times \frac{4}{8} \times \frac{3}{7} \times \frac{2}{6}$
	2nd M1 Use of $1 - p$ (where p is a product of 4 probabilities)
	A1 $\frac{121}{126}$ (condone awrt 0.960 must be at least 3sf from correct working)
	OR
	1st M1 List **all** 15 favourable outcomes and at least one correct product (YYYG)×4 [(YYGY), (YGYY), (GYYY)] (YYGG)×6 [(YGYG), (YGGY), (GYYG), (GYGY), (GGYY)] (GGYG)×4 [(GGGY), (YGGG), (GYGG)] (GGGG)
	2nd M1 Sum all 15 correct probabilities
	A1 $\frac{121}{126}$ (condone awrt 0.960 must be at least 3sf from correct working)

Question	Scheme	Marks
5.(a)		B1 dB1 (2)
(b)	$P(X > 70) = P\left(Z > \frac{70-55}{20}\right)$ $= P(Z > 0.75)$ $= 1 - 0.7734 = 0.2266$ awrt **0.227/22.7%**	M1 M1A1 (3)
(c)	$P(X > b) = 0.01$ $\frac{b-55}{20} = 2.3263$ $b = 101.526$ **Given answer 102**	M1B1 A1 (3)
(d)	$P(70 < X < m) = 0.1315$ $P(X < m) - P(X < 70) = 0.1315$ $P\left(Z < \frac{m-55}{20}\right) = 0.9049$ $\frac{m-55}{20} = 1.31$ $m = 81.2$	M1 M1B1 A1 (4) **Total 12**

	Notes
(a)	1st B1 for a reasonable sketch of a symmetric, bell shaped curve which does not cross the *x*-axis (ignore any vertical axis drawn) 2nd B1 dependent on previous B1 for 55 labelled at the centre of the *x*-axis
(b)	1st M1 for standardising with 70, 55 , 20 (allow +/–) 2nd M1 Use of $1 - p$ (must be a probability so 1 – 0.67 is M0) A1 awrt 0.227 or 22.7%
(c)	M1 for standardising with 55, 20 and equating to *z*-value $\lvert z\rvert > 2$ B1 for 2.3263 (or better) used and compatible sign with their standardisation. A1 for awrt 102 which must come from a *z*-value in the range $2.32 \leq z \leq 2.34$
(d)	1st M1 for a correct expression for $P(X < m)$ (e.g. 0.1315 + '0.7734') or $P(X > m) = 0.0951$ or sight of 0.9049 (may be implied by sight of 1.31) 2nd M1 for standardising with 55, 20 and equating to a *z*-value $\lvert z\rvert > 1$ B1 1.31 (1.31018…from calc) used and compatible sign with their standardisation. A1 awrt 81.2

Question	Scheme	Marks
6(a)	$F(3) = \frac{3}{4}$	B1 (1)
(b)	$E(X) = 2.5$	B1 (1)
(c)	$E(X^2) = 1^2 \times \frac{1}{4} + 2^2 \times \frac{1}{4} + 3^2 \times \frac{1}{4} + 4^2 \times \frac{1}{4} \left[= \frac{15}{2} \right]$	M1
	$\text{Var}(X) = '\frac{15}{2}' - \left('\frac{5}{2}'\right)^2 = \frac{5}{4}$ **	M1A1 cso (3)
(d)	$P(Y = y) = \frac{1}{4}$	B1 (1)
(e)	$\text{Var}(Y) = \text{Var}(kX + c) =$ $k^2\text{Var}(X)$	M1
	$= \frac{5}{4}k^2$	A1 (2)
(f)	$c = 3 - k$	B1 (1)
		Total 9

	Notes
(a)	B1 $\frac{3}{4}$ oe
(b)	B1 2.5 oe
(c)	1st M1 for correct expression for E(X^2). $\frac{15}{2}$ on its own does not imply this mark
	2nd M1 for correct expression for Var(X) (follow through their E(X^2) and E(X))
	A1 for $\frac{5}{4}$ cso
Alt (c)	1st M1 for writing or using Var(X) = $\frac{n^2 - 1}{12}$ (may be implied by 2nd M1)
	2nd M1 for $\frac{4^2 - 1}{12}$ or $\frac{(4+1)(4-1)}{12}$ (15/12 on its own does not score this mark)
	A1 $\frac{5}{4}$ cso (dependent on both M marks and no incorrect working seen)
(d)	B1 $\frac{1}{4}$ may be in a table, but must be $\frac{1}{4}$ for each probability.
(e)	M1 for $k^2\text{Var}(X)$
	A1 oe
	Note: Var(Y) = $\frac{3^2 + (3+k)^2 + (3+2k)^2 + (3+3k)^2}{4} - \left(\frac{(3+(3+3k)}{2}\right)^2$ oe scores M1A1 (if the correct expression is seen, we can isw)

Question	Scheme	Marks
7.(a)		B1B1 (-1ee) (2)
(b)	For any sensible comment about H being far away from the other points. e.g. 'H is an outlier/anomaly', 'The blood protein/p/70 for H is much higher than the other patients', 'H does not follow the (linear) pattern', 'Data collected for H may be incorrect', etc.	B1 (1)
(c)	$r = \dfrac{369}{\sqrt{423\frac{5}{7} \times 490}} = 0.809826106$	M1A1 (2)
(d)	r would be closer to 0	B1 (1) **Total 6**
	Notes	
(a)	**USING OVERLAY** B1B1 all 8 points correctly plotted ½ small square tolerance. 7 points correct B1B0	
(b)	Do not allow 'H is not in range' on its own	
(c)	M1 for a correct expression A1 awrt 0.810 (Accept 0.81 if a fully correct expression is seen)	
(d)	B1 allow r would be smaller/weaker correlation	

Question	Scheme	Marks
8.(a)	(Time is) <u>continuous</u>	B1 (1)
(b)	40 people = 8 large squares/200 small squares 200 people = 40 large squares/1000 small squares 40/(21 – 11) or correct scale on f.d. axis	B1
	$\frac{x}{40}=\frac{180}{200}$ or $\frac{x}{40}=\frac{7.2}{8}$ or $(21-18)\times 4+(25-21)\times 6$	M1
	36 people (spent between 18 and 25 minutes shopping in the supermarket)	A1 (3)
(c)	$\text{Median}=26+\frac{[30]}{36}\times 5=$ awrt **<u>30.2</u>**	M1A1 (2)
(d)	$\sum fx = 16\times 40+23.5\times 30+28.5\times 36+33.5\times 40+38.5\times 14+46\times 20+61\times 20$ $=6390$ **	M1 A1cso (2)
(e)	i $\bar{x}=\frac{6390}{200}=31.95$	B1
	ii $\sigma=\sqrt{\frac{238430}{200}-31.95^2}=\sqrt{171.3475}=13.09\,(\text{or } s=13.122)$ awrt **<u>13.1</u>**	M1A1 (3)
(f)	0.409... awrt **<u>0.4</u>**	B1 (1)
(g)	Method 1: (positive) skew or median ≠ mean oe; not a good decision Method 2 (see note): (almost) symmetric oe; a good decision	B1 dB1 (2)
		Total 14

	Notes
(a)	Allow not discrete. Condone misspellings if intention of 'continuous' is clear.
(b)	B1 for establishing a ratio (usually 5 or 1/5) between people and area <u>or</u> calculating f.d. (may be implied by M1) M1 for a correct ratio <u>or</u> expression using areas for the people from 18 to 25 A1 36 cao (Answer of 36 scores 3 out of 3).
(c)	M1 for an attempt at the medians (should have 26, 36 and 5). If working down $31-\frac{[6]}{36}\times 5$ A1 awrt 30.2 (can come from using (n+1))
(d)	M1 for a correct expression for $\sum fx$ condone one incorrect product A1cso for 6390 and all correct
(e)(i)	B1 31.95 or equivalent fraction
(ii)	M1 for correct expression for standard deviation including root A1 awrt 13.1 (answer of awrt 13.1 scores 2 out of 2) [NB (s = 13.122)]
(g)	1st B1 for comment on skew (may be seen in part (f)). Method 1: skew or median ≠ mean Only allow method 2 if |their(f)| < 0.45. Method 2: ~symmetric (any mention of correlation is B0) 2nd dB1 for a correct compatible comment about the manager's decision

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