Mark Scheme (Results)

Summer 2016

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.

- 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.

PEARSON EDEXCEL IAL 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 $\sqrt{}$ 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

   - ⌐ 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.

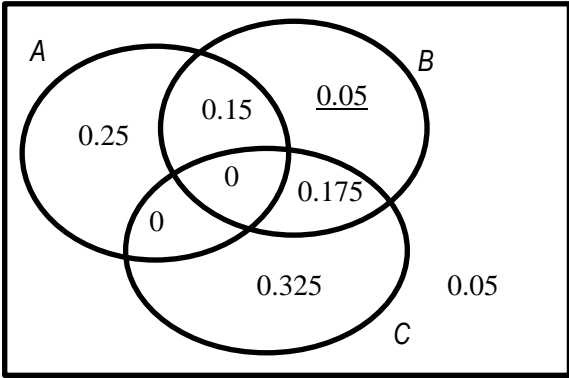| Question Number	Scheme	Marks
1. **(a)**	$S_{ww} = 41252 - \dfrac{640^2}{10} =$ **292**	M1A1
	$S_{wp} = 27557.8 - \dfrac{640 \times 431}{10} =$ **−26.2**	A1
		(3)
(b)	$r = \dfrac{-26.2}{\sqrt{292 \times 2.72}}$	M1
	$= -0.9297$ awrt **−0.930**	A1
		(2)
(c)	As <u>weight</u> increases the percentage of <u>oil</u> content decreases o.e.	B1
		(1)
(d)	$b = \dfrac{-26.2}{292} = -0.0897...$ awrt **−0.09**	M1 A1
	$a = \dfrac{431}{10} - \left(\dfrac{-26.2}{292}\right) \times \left(\dfrac{640}{10}\right) = 48.842...$	M1
	$\underline{\mathbf{p = 48.8 - 0.0897w}}$	A1
		(4)
(e)	$p = 48.8 - 0.0897 \times 60$	M1
	$= 43.4/43.5$ awrt **43.4/43.5**	A1
		(2)
		Total 12
	Notes	
(a)	M1 for a correct expression for S_{ww} or S_{wp} (may be implied by one correct answer) 1st A1 for either $S_{ww} = 292$ or $S_{wp} = -26.2$ 2nd A1 for **both** $S_{ww} = 292$ <u>and</u> $S_{wp} = -26.2$	
(b)	M1 for a correct expression (Allow ft of their S_{ww} or S_{wp} provided $S_{ww} \neq 41252$ and $S_{wp} \neq 27557.8$). Condone missing "−" A1 for awrt −0.930 (Condone −0.93 for M1A1 if correct expression is seen) (Answer only awrt −0.930 scores 2/2 but answer only −0.93 is M1A0)	
(c)	B1 For a correct contextual description of negative correlation which must include <u>weight</u> and <u>oil</u> (but w increases as p decreases is not sufficient)	
(d)	1st M1 for a correct expression for b (Allow ft) 1st A1 for awrt −0.09 2nd M1 for a correct method for a ft their value of b (Allow $a = 43.1 + b \times 64$) 2nd A1 for a correct equation for p and w with $a =$ awrt 48.8 and $b =$ awrt −0.0897 No fractions. Equation in x and y is A0	
(e)	M1 substituting $w = 60$ into their equation A1 awrt 43.4 or 43.5 (Answer only scores 2/2)	

Question Number	Scheme	Marks
2.	$1.5 \times 12 = 18$ 20 people represented by 18 (cm^2) or 1 person is represented by 0.9 (cm^2) $x = \dfrac{20 \times 94.5}{18}$ oe $= 105$ (people)	M1 M1 A1cao (3) **Total 3**
	Notes	
	1st M1 for an attempt to relate area to frequency (e.g. $\frac{20}{18}$ or $\frac{18}{20}$ seen) 2nd M1 for a correct expression/equation for total frequency e.g. $\frac{18}{20} = \frac{94.5}{x}$ A1 for 105cao	

Question Number	Scheme	Marks
3.(a)	(Discrete) **Uniform**	B1 (1)
(b)	$P(X = 4) = \dfrac{1}{5}$ oe	B1 (1)
(c)	$F(3) = \dfrac{3}{5}$ oe	B1 (1)
(d)	$P(3X - 3 > X + 4) = P(X > 3.5)$	M1
	$\qquad\qquad = \dfrac{2}{5}$ oe	A1 (2)
(e)	$E(X) = \underline{\mathbf{3}}$	B1 (1)
(f)	$E(X^2) = \dfrac{1}{5}\left(1^2 + 2^2 + 3^2 + 4^2 + 5^2\right)$	M1
	$\qquad = \underline{\mathbf{11}}$	A1 (2)
(g)	$\text{Var}(X) = 11 - 3^2 \qquad$ or $\qquad \dfrac{(5+1)(5-1)}{12}$	M1
	$\qquad = \underline{\mathbf{2}}$	A1 (2)
(h)	$11.4 = aE(X) - 3$ **or** $11.4 = 3a - 3$	M1
	$\quad a = 4.8$	A1
	$\text{Var}(4.8X - 3) = \text{'}4.8\text{'}^2 \times \text{'}2\text{'}$	M1
	$\qquad\qquad = 46.08 \qquad\qquad\qquad$ awrt **46.1**	A1 (4)
		Total 14

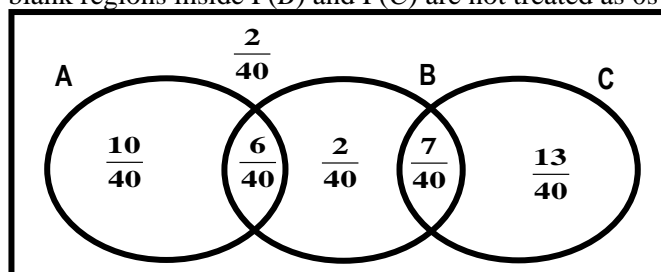|	**Notes**	
(a)	B1 for uniform	
(d)	M1 for identifying the correct probabilities i.e. $P(X > 3.5)$ <u>or</u> $P(X = 4) + P(X = 5)$	
(f)	M1 for a correct expression	
(g)	M1 for either 'their (f)' – 'their (e)'^{2} <u>or</u> for a correct expression $\dfrac{(5+1)(5-1)}{12}$	
(h)	1st M1 for setting up a correct linear equation using $aE(X) - 3 = 11.4$	
	1st A1 may be implied by a correct answer	
	2nd M1 for "their a^2"×"their $\text{Var}(X)$" (must see values substituted) (may be implied by a correct answer or correct ft answer) NB 'their $\text{Var}(X)$' < 0 is M0 here.	

Question Number	Scheme	Marks
4.(a)	7.5 <u>and</u> 25	B1 (1)
(b)	Mean = 10.3125 awrt **10.3**	B1 (1)
(c)	$\sigma = \sqrt{\dfrac{120125}{80} - '10.3125^2}$ $= 6.6188..$ $(s = 6.6605\ldots)$ awrt **6.62**	M1 A1 (2)
(d)	Median $= \{5\} + \dfrac{20}{24} \times 5$ or $\{10\} - \dfrac{4}{24} \times 5$ $= 9.16666$ awrt **9.17**	M1 A1 (2)
(e)	Mean > median $\therefore$ positive skew	M1A1 (2)
(f)	$t = 10v + 5$ Mean $= 10 \times 10.3125 + 5$ $= 108.125$ awrt **108** $\sigma = 10 \times 6.6188$ $= 66.188..$ (66.605 from s) awrt **66.2**	 M1 A1 M1 A1 (4)
		Total 12

	Notes	
(a)	B1 both values correct (may be seen in table)	
(b)	B1 for awrt 10.3 (Do not allow improper fractions).	
(c)	M1 for a correct expression including the square root (allow ft from their mean) A1 for awrt 6.62 (Allow $s =$ awrt 6.66)	
(d)	M1 for a correct fraction: $\dfrac{20}{24} \times 5$ <u>or</u> if using $n + 1$ for $\dfrac{20.5}{24} \times 5$ may be scored from working down $-\dfrac{4}{24} \times 5$ A1 for awrt 9.17 or (if using $n + 1$) for awrt 9.27	
(e)	M1 for a correct comparison of 'their b' and 'their d' (must have an answer to both (b) and (d)) Comparison may be part of bigger expression e.g. 3(mean – median)/s.d. Allow use of $Q_3 - Q_2 > Q_2 - Q_1$ only if $Q_1 = 5$ and $Q_3 = 15$ are both seen A1 for positive skew (which must follow from their values)	
(f)	1st M1 for $10 \times$ "their mean" $+ 5$ 2nd M1 for $10 \times$ "their sd" Use of decoded data to find mean must be fully correct, i.e. 8650/80 = awrt 108 (M1A1) Use of decoded data to find s.d. must be fully correct, i.e. $\sqrt{\dfrac{1285750}{80} - \left(\dfrac{8650}{80}\right)^2}$ = awrt 66.2 (M1A1)	

Question Number	Scheme	Marks
5. (a)	$P(T=2) = 3 \times \dfrac{1}{6} \times \dfrac{1}{6} = \dfrac{1}{12}$ oe	M1 A1 (2)
(b)	$P(T=3) = [P(0, 3) + P(1, 2) + P(2, 1)] + P(3)$	
	$= \left(\dfrac{1}{6} \times \dfrac{1}{2}\right) + \left(\dfrac{1}{6} \times \dfrac{1}{6}\right) + \left(\dfrac{1}{6} \times \dfrac{1}{6}\right) + \dfrac{1}{2}$	M1 M1
	$= \dfrac{23}{36}$ oe	A1 (3)
(c)	$P(T = 3 \mid \text{rolled twice}) = \dfrac{P((T=3) \cap \text{die rolled twice})}{P(\text{die rolled twice})}$	M1
	$= \dfrac{\dfrac{5}{36}}{\dfrac{1}{2}}$	M1
	$= \dfrac{5}{18}$ oe	A1 (3)
		Total 8

	Notes	
	Correct answer only in (a), (b) or (c) scores full marks for that part. **Methods leading to answers > 1 score 0 marks**	
(a)	M1 for a correct expression A1 allow exact equivalent ($\frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$ is M0A0).	
(b)	1st M1 for $\dfrac{1}{2}$ + at least one correct product 2nd M1 for fully correct expression A1 allow exact equivalent	
(c)	1st M1 for correct conditional probability ratio (this mark may be implied by 2nd M1) **but** going on to assume independence [using numerator $P(T = 3) \times P(\text{rolled twice})$] is M0M0A0. 2nd M1 for a correct numerical ratio of probabilities (allow ft of (their (b) $- \dfrac{1}{2}$) as numerator) A1 allow exact equivalent	

Question Number	Scheme	Marks
6. (a)	$[P(A \cup C) =] \dfrac{9}{10}$ oe	B1
		(1)
(b)	$P(A \cup B) = P(A) + P(B) - P(A) \times P(B)$	M1
	$\dfrac{5}{8} = \dfrac{2}{5} + P(B) - \dfrac{2}{5}P(B)$	M1 A1
	$P(B) = \dfrac{3}{8}$ *	A1cso
		(4)
(c)	$[P(A\mid B) = P(A) =] \dfrac{2}{5}$ oe	B1
		(1)
(d)	Diagram 0.15 and 0.25 0.05 and 0.05 0.175 and 0.325	B1 M1 M1 M1 A1
		(5) **Total 11**

	Notes	
(b)	1st M1 for use of $P(A \cup B) = P(A) + P(B) - P(A \cap B)$	
	2nd M1 for use of $P(A \cap B) = P(A) \times P(B)$ (But just seeing $\frac{2}{5} \times \frac{3}{8} = \frac{3}{20}$ on its own is M0M0)	
	1st A1 a correct equation 2nd A1 cso (No wrong working seen dependent on all previous marks) (allow a full verification method, however, substitution of P(B)=3/8 into only one P(B) to find the other P(B) (e.g. using 3/20 to find 3/8) can score M1M0A0A0)	
(d)	B1 3 circles intersecting, see diagram above, (at least 2 labelled) with the two zeros showing A does not intersect C (Do not allow blank spaces for the two zeros) **or** 3 circles, see diagram below, (at least 2 labelled) where B intersects A and C but A and C do not intersect	
	1st M1 0.15 placed in $(A \cap B \cap C')$ and 0.25 placed in $(A \cap B' \cap C')$	
	2nd M1 0.3 – 'their 0.25' and 1 – ('their 0.15' + 'their 0.25' + 'their 0.05' + $\frac{1}{2}$)	
	3rd M1 $\dfrac{3}{8}$ – ("their 0.15" + "their 0.05"), i.e. $P(B) = \frac{3}{8}$ and $\dfrac{1}{2}$ – "their 0.175", i.e. $P(C) = \frac{1}{2}$	
	For the 3rd M mark, blank regions inside P(B) and P(C) are not treated as 0s and score M0	
	A1 fully correct with box	

Question Number	Scheme	Marks
7(a)(i)	$P(X > 505) = P\left(Z > \dfrac{505 - 503}{1.6}\right)$	M1
	$= 1 - P(Z < 1.25) \quad = 1 - 0.8944$	M1
	$= 0.1056$ awrt **0.106**	A1
		(3)
(ii)	$P(501 < X < 505) = 1 - 2 \times 0.1056 \quad \text{or} \quad 0.8944 - 0.1056$	M1
	$= 0.7888$ awrt **0.789**	A1
		(2)
(b)	$P(X < w) = 0.9713 \text{ or } P(X > w) = 0.0287 \text{ (may be implied by } z = \pm 1.9)$	M1
	$\dfrac{w - 503}{1.6} = 1.9 \quad \text{or} \quad \dfrac{(1006 - w) - 503}{1.6} = -1.9$	M1
	$w = 506.04\ldots$ awrt **506**	A1
		(3)
(c)	$\dfrac{r - 503}{q} = -2.3263$	M1A1
	$\dfrac{r + 6 - 503}{q} = 1.6449$	M1A1
	$1.6449q - 6 = -2.3263q$	ddM1
	$q = 1.51\ldots$ awrt **1.51**	A1
	$r = 499.48\ldots\ldots$ awrt **499**	A1
		(7)
		Total 15
	Notes	
(a)(i)	1st M1 standardising with 505, 503 and 1.6. May be implied by use of 1.25 (Allow $\pm$)	
	2nd M1 for $1 - P(Z < 1.25)$ i.e. a correct method for finding $P(Z > 1.25)$, e.g. $1 - p$ where $0.5 < p < 0.99$	
(ii)	M1 $1 - 2 \times$ their(i)	
(b)	1st M1 for using symmetry to find the area of one tail (may be seen in a diagram)	
	2nd M1 a single standardisation with 503, 1.6 and w (or $1006 - w$) <u>and</u> set $= \pm z$ value ($1.8 < |z| < 2$)	
	A1 for awrt 506 which must come from correct working. (**Answer only**: 506 scores 0/3, but 506.0…with no working send to review)	
(c)	1st M1 $\dfrac{r - 503}{q} = z$ value where $|z| > 2$	
	1st A1 $\dfrac{r - 503}{q} = \text{awrt} - 2.3263$ (signs must be compatible)	
	2nd M1 $\dfrac{r + 6 - 503}{q} = z$ value where $|z| > 1$	
	2nd A1 $\dfrac{r + 6 - 503}{q} = \text{awrt } 1.6449$ (signs must be compatible)	
	Special Case: Less than 4dp z-values: use of awrt 2.32/2.33/2.34 **and** awrt 1.64/1.65 could score M1 A0 M1 and then A1 provided both equations have compatible signs.	
	3rd M1 (dep on both Ms) attempt to solve simultaneous equations leading to a value for q or r	
	3rdA1 for awrt 1.51	
	4thA1 for awrt 499 (allow 499.5)	