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Mark Scheme (Results)

January 2017

Pearson Edexcel
International A Level Mathematics

Statistics 1 (WST01)

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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 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 $\surd$ 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.

January 2017 WST01 Mark Scheme

Question Number		Scheme	Marks
1.	(a)	25 small sq' = 5 tomatoes <u>or</u> 1 large square = 5 tomatoes <u>or</u> fd=5 for 2~3 <u>or</u> $\frac{5}{25}\times 20$ <u>or</u> 5×0.8 <u>or</u> 2×2 $= \underline{\mathbf{4}}$	**M1** **A1** **(2)**
	(b)	$100-(5+'4')$ <u>or</u> $16+32+25+10+8$, so probability = $\frac{91}{\underline{100}}$ (condone 91%)	**M1, <u>A1</u>** **(2)**
	(c)	$\frac{(7-6.25)\times 16+25+10+8}{100}$ <u>or</u> $1-\frac{(a)+5+16+(6.25-5)\times 16}{100}$ =, $\frac{55}{\underline{100}}$	**M1, <u>A1</u>** **(2)**
	(d)	Since '0.55' > 0.5 (or equivalent reason) <u>and</u> state median > 6.25	**B1** **(1)**
	(e)	Median > mean, so negative skew	**B1** **(1)**
	(f)	Freq. for $(5.5 < \text{weight} < 7) = (7-5.5)\times '16'$ or $\frac{3}{4}\times '32'$, probability $= \frac{24}{\underline{100}}$ P (both weigh between 5.5 and 7) = $\frac{24}{100}\times\frac{23}{99}=\frac{46}{825}$ (o.e.) or **awrt <u>0.056</u>**	**M1, <u>A1</u>** **M1 A1** **(4)**
			[12 marks]

Notes

A correct answer with no working scores M1A1 in parts (a)~(c)

(a)
M1 for a correct: statement linking area with frequency <u>or</u> calculation <u>or</u> at least 2 values on the fd scale on axis <u>or</u> at least 2 frequencies on/in histogram bars.
A1 for an answer of 4 (if not in script, can be awarded if 4 seen correctly on histogram). If answers on both diagram and script contradict, the script has preference.

(b)
M1 for 100 – (5 + '(a)') ft $0 <$ 'their (a)' < 10 **<u>or</u>** for a correct method for finding the sum of the areas of all the bars above 3 (condone one slip if 5 terms seen)

(c)
M1 fully correct expression (possibly ft their (a)) and need division by 100 (o.e.)
A1 for $\frac{11}{20}$ or 0.55 (o.e.) [Allow 55% or ratio 55:100]

(d)
B1 for $Q_2 > 6.25$ with reason based on (c) where $0.5 <$ 'their (c)' < 1 [comparison of "55" & 50]

(e)
B1 for stating "median > mean" <u>and</u> "negative skew" (independent of (d))

(f)
1st M1 for method to find the frequency between 5.5 and 7 (Implied by the 24 used)
e.g. $(4+5+16+16\times 2)-(4+5+16+16\times 0.5)=57-33$ based on $(\leqslant 7)-(\leqslant 5.5)$
1st A1 for $\frac{24}{100}$ (o.e.)
2nd M1 for $\frac{'24'}{100}\times\frac{'24'-1}{99}$ ft their 24 but must have numerator < denominator of 100×99
2nd A1 for $\frac{46}{825}$ (o.e.) or awrt 0.056 NB $\frac{24}{100}\times\frac{24}{100}$ scores M1A1M0A0 [0.0576 alone 0/4]

Question Number	Scheme	Marks
2. (a)	(The event that) the integer selected is <u>prime</u> **<u>and</u>** <u>ends in a 3</u> (and is between 1 and 50 inclusive)	**B1** **(1)**
(b)	$\frac{15}{50}$ (or equivalent e.g. 0.30) [condone 30%]	**B1** **(1)**
(c)	$\frac{12}{50}$ (or equivalent e.g. 0.24) [condone 24%]	**B1** **(1)**
(d)	$\left[\mathrm{P}(A\mid C)=\right]\frac{\mathrm{P}(A\cap C)}{\mathrm{P}(C)}=\frac{\frac{7}{50}}{\frac{30}{50}}=,\ \underline{\frac{7}{30}}$	**M1, <u>A1</u>** **(2)**
(e)	$\frac{15}{50}\neq\frac{7}{30}$, so not independent.	**M1, A1** **(2)**
(f)	$\left[\mathrm{P}(B\mid(A\cap C))=\right]\frac{\mathrm{P}(B\cap A\cap C)}{\mathrm{P}(A\cap C)}=\frac{\frac{2}{50}}{\frac{7}{50}}=,\ \underline{\frac{2}{7}}$	**M1, <u>A1</u>** **(2)** **[9 marks]**
(d)	M1 for a correct ratio expression (may be in words) with at least one correct probability substituted or correct ratio expression <u>and</u> $\frac{7}{n}$ or $\frac{m}{30}$ where $7 < n$ or $m < 30$ <u>or</u> fully correct ratio of probabilities. A1 for $\frac{7}{30}$ or any exact equivalent e.g. $0.2\dot{3}$ but 0.233 is M1A0 (Correct ans only = M1A1)	
(e)	M1 for correctly comparing 'their (b)' with 'their (d)', can be in words or symbols e.g. $\mathrm{P}(A)\neq\mathrm{P}(A\mid C)$ in symbols. A1 dependent on a correct (b) and (d) (or awrt 0.233 in (d)) and for concluding <u>not</u> independent	
SC	For a correct test using correctly labelled $\mathrm{P}(A)=\frac{15}{50}$, $\mathrm{P}(C)=\frac{30}{50}$ and $\mathrm{P}(A\cap C)=\frac{7}{50}$ with all correct probabilities and $\frac{15}{50}\times\frac{30}{50}=\frac{9}{50}\neq\frac{7}{50}$ (o.e.) seen leading to "not independent" score M0A1	
(f)	M1 for a correct ratio expression (may be in words) with at least one correct probability substituted or correct ratio expression <u>and</u> $\frac{r}{7}$ or $\frac{2}{t}$ where $r < 7$ or $2 < t$ <u>or</u> fully correct ratio of probabilities A1 for $\frac{2}{7}$ or an exact equivalent. **Allow** awrt 0.286 here as well.(Correct ans. only = M1A1)	

Question Number	Scheme	Marks
3. (a)	$[\bar{y} =]\dfrac{-27}{12} = \underline{-2.25}$, $\text{Var}(Y) = \dfrac{62.98}{12} - (-2.25)^2$	**B1**, **M1**
	$= 0.1858333\ldots$ (allow $\frac{223}{1200}$) **awrt 0.186**	**A1**
		(3)
(b)(i)	$S_{xy} = -1190.7 - \dfrac{(504)(-27)}{12}$ or -56.7	**B1**
	$r = \dfrac{'-56.7'}{\sqrt{(1674)(2.23)}} =$, $-0.9280105...$ **awrt – 0.928**	**M1, A1**
(ii)	Negative correlation, so Priya's belief is incorrect.	**B1**
		(4)
(c)	$b = \dfrac{'-56.7'}{1674}$ [= $-0.033870\ldots$]	**M1**
	$\dfrac{-27}{12} = a + 'b' \times \dfrac{504}{12}$ or $a = -2.25 - '-0.03387...' \times 42$, $a =$ awrt -0.827	**M1 ,A1**
	$y = -0.827 - 0.0339x$	**A1**(dep on M2)
		(4)
(d)	$[y = -0.827 - 0.0339(32) =] -1.9°C$ **awrt –1.9** (no fractions)	**B1**
		(1)
(e)	$\dfrac{(w-32)}{1.8} = -0.827 - 0.0339x$ (o.e.)	**M1**
	$w = 30.5 - 0.061x$	**A1**
		(2)
(f)(i)	$\text{Var}(W) = 1.8^2\ \text{Var}(Y)$, $= 0.602..$ **awrt 0.60**	**M1, A1**
(ii)	$r_{yx} = r_{wx} = -0.928$	**B1ft**
		(3)
		[17 marks]

	Notes
(a)	B1 either fraction or exact decimal equivalent [must see mean separately to earn this mark]
	M1 for expr' for variance $\dfrac{62.98}{12} - \bar{y}^2$ [ft $\bar{y}$] or $\dfrac{S_{yy}}{12}$, (allow s^2 i.e. $\dfrac{S_{yy}}{11}$ = awrt 0.203) [No $\sqrt{\ }$]
	For M1 in (b)(i) and 1st M1 in (c) do not allow ft for S_{xy} = – 1190.7
(b)(i)	B1 Correct expression for S_{xy} or -56.7 (May be implied by a correct value for r)
	M1 for correct express' for r with 1674, 2.23 and their S_{xy} [Correct ans. only 3/3, $r = -0.93$ is 2/3]
(ii)	B1 for Priya's belief **not** supported **and** reason e.g. negative correlation or r is negative or r is close to -1 or as salinity (or x) increases, temperature (or y) decreases
(c)	1st M1 for correct expression for b f.t. their S_{xy} (May be implied by correct answer)
	2nd M1 for correct use of $a = \bar{y} - b\bar{x}$ to find a (f.t. their value of b)(Implied by –0.827)
	1st A1 for a = awrt –0.827 (no fraction)
	2nd A1 for an equ'n in the form $y = a + bx$ with their a and b = awrt -0.0339 (no fraction)
(e)	M1 for substituting $\dfrac{(w-32)}{1.8}$ for y (o.e.) in their regression equation
	A1 for a correct equation for w in terms of x with c = awrt 31 and d = awrt – 0.061
(f)(i)	M1 for $1.8^2 \times \text{Var}(Y)$ f.t. their "(a)" (if > 0)][Allow use of s^2 = awrt 0.66 to score M1A1]
(ii)	B1ft their answer to (b)(i) to at least 2sf (Must see a value written down here)

Question Number	Scheme	Marks
4. (a)	$[\mathrm{E}(X)=]5\times0.13+6\times0.21+7\times0.29+8\times0.37,$ $= \underline{\mathbf{6.9}}$	**M1, A1** **(2)**
(b)	$[\mathrm{E}(X^2)=]5^2\times0.13+6^2\times0.21+7^2\times0.29+8^2\times0.37\left[=48.7\right]$ $= \underline{\mathbf{1.09}}$ $\mathrm{Var}(X)=48.7-'6.9'^2,$	**M1** **M1, A1** **(3)**
(c)	$\mathrm{Var}(3-2X)=(-2)^2\mathrm{Var}(X),$ $= \underline{\mathbf{4.36}}$	**M1, A1** **(2)**
(d)	$[\mathrm{E}(Y)] = \underline{\mathbf{6.5}}$ or $\frac{13}{2}$ (o.e.)	**B1** **(1)**
(e)	$\mathrm{P}(X=Y)=\frac{1}{4}\times0.13+\frac{1}{4}\times0.21+\frac{1}{4}\times0.29+\frac{1}{4}\times0.37\ ,=\frac{1}{4}$ (oe)	**M1, A1** **(2)**
(f)	$\mathrm{P}(X>Y)=\mathrm{P}(X=6\cap Y<6)+\mathrm{P}(X=7\cap Y<7)+\mathrm{P}(X=8\cap Y<8)$ $=0.21\times0.25+0.29\times0.50+0.37\times0.75$ $= \underline{\mathbf{0.475}}$	**M1** **M1** **A1** **(3)**
		[13 marks]

Notes

(a) M1 for a correct expression for $\mathrm{E}(X)$ (Correct answer only is M1A1)

(b) 1st M1 for attempting a correct expression for $\mathrm{E}(X^2)$, sum of at least 3 correct products seen
The first M1 can be implied by 48.7
Stating Var(X) = the expression for $\mathrm{E}(X^2)$ can score M1M0A0 and may get M1 in (c)
2nd M1 for correct use of $\mathrm{Var}(X)=\mathrm{E}(X^2)-[\mathrm{E}(X)]^2$ f.t. their $\mathrm{E}(X)$
A1 for 1.09 (Correct answer only is M1M1A1)

(c) M1 for $(-2)^2\mathrm{Var}(X)$ or $(-2)^2\times'(b)'$ [if '(b)' > 0] (condone no brackets if final answer is > 0)
or a **fully** correct expr' for Var(3 – 2X) based on

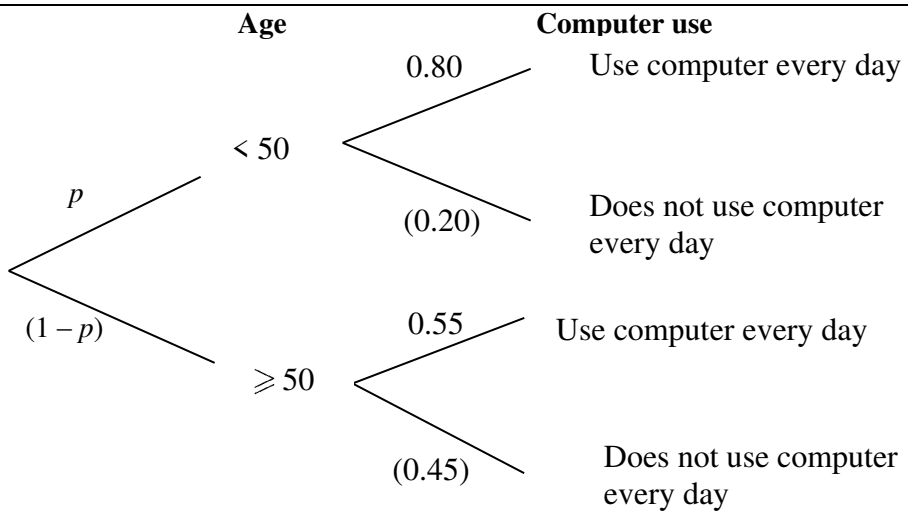
$3-2x$	-7	-9	-11	-13
Prob	0.13	0.21	0.29	0.37

A1 for 4.36 (Correct answer only with no working scores M1A1)

(e) M1 for an expression for $\mathrm{P}(X=Y)$ (at least 3 of the 4 products correct).
May be implied by a correct answer.

(f) 1st M1 for a correct probability formula (as in scheme) or complete list of $X > Y$ [e.g. $X = 6$ and Y=5; X =7 and Y =6; X =7 and Y =5; X = 8 and Y =5; X = 8 and Y = 6; X = 8 and Y =7]
2nd M1 for a correct probability expression(i.e. correct values in formula)
NB alternative expressions e.g. $\frac{1}{4}(0.37+0.66+0.87)$ from listing $Y < X$ rather than $X > Y$
The 1st M1 may be implied by scoring the 2nd M1
A1 for 0.475 or $\frac{19}{40}$

SC/ ($Y > X$) **Only apply if they reach [P($Y > X$) =** $0.13\times\frac{3}{4}+0.21\times\frac{2}{4}+0.29\times\frac{1}{4}$ **=]** **0.275**

Question Number	Scheme	Marks
5. (a)		**B1** **B1** **(2)**
(b)	$p \times 0.80 + (1-p) \times 0.55 = 0.70$ $p = 0.6$	**M1** **A1** **(2)**
(c)	$\left[\text{P}(<50 \mid \text{use computer daily})\right] = \dfrac{\text{P}(<50 \cap \text{use computer daily})}{\text{P(use computer daily)}} = \dfrac{'0.6' \times 0.80}{0.70}$ $= \dfrac{48}{70}$	**M1** **A1oe** **(2)** **[6 marks]**

	Notes
(a)	**Allow undefined letters for labels e.g. U(use) and U' or N and NE** **Allow labels on branches and probabilities at the ends** **Condone 80% and 55% etc on tree diagram and in (b)** 1st B1 for correct shape (2 branches then 4 branches) and correct labels on first set of branches (p , < 50 and ⩾ 50 but condone > 50) 2nd B1 for correct labels on second set of branches (0.80, 0.55, daily and not daily) Allow $0.8p$ and $0.55(1-p)$ on or at the end of the appropriate branches. NB they do not require the probabilities in brackets for either of these two marks.
(b)	M1 for a correct equation to find p using their tree diagram. A1 for 0.6 [condone 60%] (Correct answer only will score M1A1)
(c)	M1 for a correct expression with 0.70 substituted correctly and numerator < denominator or correct ratio of probabilities f.t. their p provided $0 < p < \frac{7}{8}$ A1 for $\dfrac{48}{70}$ or an exact equivalent e.g. $\dfrac{24}{35}$ (Correct answer only is M1A1) Allow awrt 0.686 following a correct expression. [68.6% is A0]

Question Number	Scheme	Marks
6. (a)	98% (Condone 0.98)	**B1**
		(1)
(b)	$z = \pm 2.3263$ (or better: calculator gives 2.326347877…)	**B1**
	$\frac{256-250}{\sigma} = 2.3263$	**M1**
	$\sigma = 2.579...$ **awrt 2.58**	**A1**
		(3)
(c)	[P($X < 246 \cup X > 254$) =]	
	$2\times \mathrm{P}\left(Z > \frac{254-250}{"2.579..."}\right)$ or $1-\mathrm{P}\left(\frac{246-250}{"2.579"} < Z < \frac{254-250}{"2.579"}\right)$	**M1**
	$= 2\times \mathrm{P}(Z > 1.55)$ or $1-\mathrm{P}(-1.55 < Z < 1.55) = 0.12(12)$	**A1**
	P(both bags outside range) = $(0.1212)^2$ =, 0.01468… **awrt 0.0146/7**	**dM1, A1**
		(4)
		[8 marks]

	Notes
(b)	B1 for $\pm$ 2.3263 or better seen and used, can be with σ^2 (may be implied by σ = awrt 2.579)
	M1 for standardising with 256 or 244, 250 and σ and equating to a z-value $\lvert z\rvert > 2$
	A1 for awrt 2.58 from correct working.
z = 2.33	Use of $z = 2.33$ leads to $\sigma = 2.575...$ can score B0M1A1
z = 2.32	Special case: use of $z = 2.32$ from tables gives 2.586… σ = awrt 2.59 can score B0M1A1
Ans only	B1M1A1 can be awarded for sight of at least σ = awrt 2.5791 or awrt 2.5792
(c)	1st M1 for attempt to find sum of the area above 254 and below 246 or 2 × area above 254 or 2 × area below 246 (2 ×needed) Allow ft of their σ (provided $\sigma > 0$)
	1st A1 for awrt 0.12 (NB 1 – 0.1212 = 0.8788 is A0 here and 1st M0 too)
	2nd dM1 for p^2 dependent on previous M1
	2nd A1 for awrt 0.0146 (use of calculator value) or 0.0147
SC	'B1' for those who use 1 tail only and get 0.06… but then do $(0.06…)^2$ Score as M0A0M1A0
	Do **not** award for $2\times(0.06...)^2$ or $3\times(0.06...)^2$

Question Number	Scheme	Marks
7. (a)	Sum of probabilities = 1 gives $\frac{a+b}{60}+\frac{2a+b}{60}+\frac{3a+b}{60}+\frac{4a+b}{60}=1$	**M1**
	e.g. $\frac{10a+4b}{60}=1$ leading to $5a+2b=30$*	**A1cso** **(2)**
(b)	$P(X=1)+P(X=2)+P(X=3)=\frac{13}{20}$ or $P(X=4)=\frac{7}{20}$ (o.e.)	**M1** **A1**
	$\frac{6a+3b}{60}=\frac{13}{20}$ or $\frac{4a+b}{60}=\frac{7}{20}$	
	e.g. $\begin{matrix}(6a+3b=39)\times 2\\(5a+2b=30)\times 3\end{matrix}$ leading to $3a=12$ $\quad$ $\begin{matrix}(4a+b=21)\times 2\\(5a+2b=30)\end{matrix}$ leading to $3a=12$	**dM1**
	***a* = 4** and ***b* = 5**	**A1** **(4)**
(c)	[y] [<1] **1** [⩽ y < 4] **4** [⩽ y < 9] **9** [⩽ y <16] [⩾] **16** [F(y)] [0] $\frac{9}{60}=\left(\frac{3}{20}\right)$ $\frac{22}{60}=\left(\frac{11}{30}\right)$ $\frac{39}{60}=\left(\frac{13}{20}\right)$ $\frac{60}{60}=(1)$	**B1** **B1cao** **M1** **A1** **(4)** **[10 marks]**

Notes

(a)

1st M1 for use of sum of probabilities = 1 to form a linear equation in a and b (4 terms seen)

A1 cso for fully correct solution with no errors or omissions seen and at least one intermediate line of working seen

(b)

1st M1 for use of $\sum_{i=1}^{3}P(X=i)=\frac{13}{20}$ or $P(X=4)=\frac{7}{20}$ to form a 2nd equation in a and b

1st A1 for a correct 3 term 2nd equation in a and b with a and b terms collected.

2nd dM1 dependent on 1st M1 for solving 2 relevant linear equations i.e. eliminating a or b leading to a linear equation in 1 variable. Allow 1 numerical or sign slip.

2nd A1 for both $a = 4$ **and** $b = 5$ (Correct answer only can score all 4 marks)

(c)

1st B1 for all y-values, can allow label of x^2 (accept 1, 4, 9 and 16 or 1, 2^2, 3^2, 4^2)

2nd B1cao for $F_Y(1)=\frac{9}{60}$ oe but must be clearly labelled as **cdf** linked to $Y = 1$ but not for $P(Y = y)$ or $P(Y = 1)$

M1 for a correct method to find $F_Y(4)$ or $F_Y(9)$ ft their a and b [dep' on correct y-values seen]

A1 for fully correct cumulative distribution function allow $F(1)=\frac{9}{60}$, $F(4)=\frac{22}{60}$, $F(9)=\frac{39}{60}$, $F(16)=1$

NB $F(y)=\frac{2y+7\sqrt{y}}{60}$ for y =1,4,9,16 (o.e.)

Is OK for all marks only with y values given

NB: Probability distribution of X

x	1	2	3	4
$P(X = x)$	$\frac{9}{60}$	$\frac{13}{60}$	$\frac{17}{60}$	$\frac{21}{60}$

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