



Mark Scheme (Results)

October 2020

Pearson Edexcel IAL In Statistics 1
Paper 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.

EDEXCEL IAL MATHEMATICS

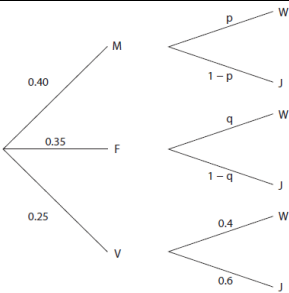
General Instructions for Marking

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

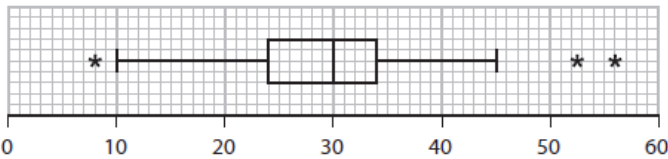
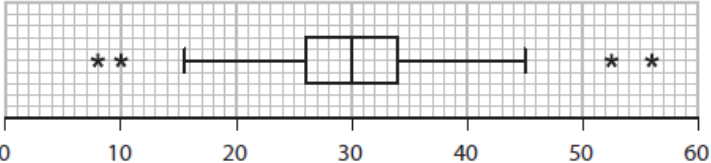
These are some of the traditional marking abbreviations that will appear in the mark schemes.

- bod – benefit of doubt
 - ft – follow through
 - the symbol $\checkmark$ 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
 - $\square$ 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 the last most complete solution.
 7. Ignore wrong working or incorrect statements following a correct answer

Question Number	Scheme						Marks												
1.	<table><tr><td>x</td><td>-1</td><td>2</td><td>3</td><td>4</td><td>7</td></tr><tr><td>$P(X = x)$</td><td>$\frac{9}{k}$</td><td>$\frac{6}{k}$</td><td>$\frac{5}{k}$</td><td>$\frac{4}{k}$</td><td>$\frac{1}{k}$</td></tr></table>						x	-1	2	3	4	7	$P(X = x)$	$\frac{9}{k}$	$\frac{6}{k}$	$\frac{5}{k}$	$\frac{4}{k}$	$\frac{1}{k}$	M1
	x	-1	2	3	4	7													
	$P(X = x)$	$\frac{9}{k}$	$\frac{6}{k}$	$\frac{5}{k}$	$\frac{4}{k}$	$\frac{1}{k}$													
	$\sum P(X = x) = 1 \Rightarrow \frac{25}{k} = 1$						M1												
	$k = 25$						A1												
$E(X) = \frac{1}{25}[-1 \times 9 + 2 \times 6 + 3 \times 5 + 4 \times 4 + 7 \times 1]$						M1													
	$= \frac{41}{25}$						A1												
							[5]												
	Notes																		
	1 st M1 for at least 3 correct probabilities in terms of k (may be seen used in expression for $E(X)$) 2 nd M1 for attempting to use sum of 5 probs = 1 (ft their probabilities) 1 st A1 for $k = 25$ (stated or used correctly) 3 rd M1 for attempt at a correct expression at least 3 products (ft their k – value or letter) 2 nd A1 for $\frac{41}{25}$ or exact equivalent e.g. 1.64 Correct answer with no incorrect method marks scores 5/5																		

Question Number	Scheme	Marks
2. (a)		B1 B1
(b)	$P(W) = 0.4p + 0.35q + "0.25" \times 0.4 \quad [= 0.4p + 0.35q + 0.1]$	B1ft (2)
(c)	Correct expression: $P(W \cap V) = "0.1" = "0.25" \times P(W) \quad \underline{\text{or}} \quad P(W) = P(W V) = 0.4$ $0.1 = 0.25(0.4p + 0.35q + 0.25 \times 0.4) \quad \underline{\text{or}} \quad 0.4p + 0.35q + 0.25 \times 0.4 = 0.4$	M1 A1 (2)
(d)	$\frac{7}{30} = \frac{0.35(1-q)}{"P(J)"}$ Since V and W are independent so are V and $W' = J$ so $P(J) = 0.6 \quad \underline{\text{or}}$ sub $P(J) = 1 -$ their (b) to get an equation in p and q [May see $8p - 23q + 12 = 0$] [So $1 - q = \frac{2}{3} P(J)$ therefore] <u>$q = 0.6$</u> $8p + 7 \times "0.6" = 6$ So <u>$p = 0.225$</u> or $\frac{9}{40}$	M1 dM1 A1 ddM1 A1 (5)
(e)	$\{P(V W) = P(V) = 0.25 \quad (\text{since independent}) \quad \text{and} \quad P(M W) = 0.225 (= p)\}$ $P(F W) = \frac{0.35 \times "0.6"}{"0.4"} \quad \underline{\text{or}} \quad \frac{0.35q}{(b)} ; = \frac{21}{40} \quad \text{or} \quad 0.525$ [Since this prob > 0.5 therefore it must be the largest] so conclusion <u>is</u> correct Allow B1ft for comparing 3 calculated probs of the form $P(M \cap W)$ needn't be correct ft	M1 ; A1 B1ft (3) [13]
Notes		
(a)	1 st B1 0.25 for $P(V)$ 2 nd B1 for correct probabilities on 2 nd branches $(1 - p)$, $(1 - q)$ [allow their values] and 0.6	
(b)	B1ft for a correct expression using their values from tree diagram	
(c)	M1 for sight or use of a correct expression in V and W or correct equation in p and q (ft their part (b)) A1 for a fully correct equation (needn't be simplified) [may see $0.4p + 0.35q = 0.3 \underline{\text{or}} \quad 8p + 7q = 6$]	
(d)	1 st M1 for using given conditional probability to form an equation in q and $P(J)$ using $\frac{7}{30}$ 2 nd dM1 (dep on 1 st M1) for a getting $P(J) = 0.6 \underline{\text{or}}$ sub 1 – their (b) and get 2 nd equation in p and q 1 st A1 for $q = 0.6$ [NB must be $q = 0.6$ not just $P(J) = 0.6$] May see after 3 rd M1 for solving with p 3 rd ddM1(dep on both Ms) for seeing substitution of their 1 st value to find the 2 nd value (p or q) Allow ft of their p or q in one of their equations provided p and q both lie in $(0, 1)$ 2 nd A1 for $p = 0.225$ or exact equivalent After the 2 nd M1, sight of $p = 0.225$ and $q = 0.6$ earns the final 3 marks	
(e)	M1 for a method for finding $P(F W)$ A1 for a correct value $\frac{21}{40}$ or exact equivalent B1ft for a correct conclusion based on enough probs found ft their probabilities	

Question Number	Scheme	Marks
3. (a)	$[D = \text{distance achieved}] P(D > 4.3) = P\left(Z > \frac{4.3 - 3.8}{0.9}\right) \quad \text{or} \quad P(Z > 0.555\dots)$ $= 1 - 0.7123 \text{ (tables)}$ $= 0.2877 \text{ (tables) or } 0.289257\dots \text{ (calc) awrt } \underline{0.288} \text{ or awrt } \underline{0.289}$	M1 M1 A1 (3)
(b)	$\frac{d - 3.8}{0.9} = -0.8416 \quad (\text{calc } -0.84162123\dots)$ $d = 3.0425\dots \quad \text{awrt } \underline{3.04}$	M1 ; B1 A1 (3)
(c)	$P(D > g \mid D > 4.3) = \frac{P(D > g)}{P(D > 4.3) \text{ or (a)}} \quad \left[= \frac{1}{3} \right] \text{ (o.e.)}$ $\therefore P(D > g) = \frac{1}{3}(a) = 0.096419\dots$ $\frac{g - 3.8}{0.9} = 1.302228\dots$ so $g = 4.97200\dots \quad \text{awrt } \underline{4.97} \text{ or awrt } \underline{4.98}$	M1 A1ft (o.e) dM1 A1 (4)
(d)	$P(\text{no gold medals}) = \left(\frac{2}{3}\right)^3$ $P(\text{at least one gold}) = 1 - \left(\frac{2}{3}\right)^3$ $= \underline{\underline{\frac{19}{27}}}$	M1 M1 A1 (3)
[13]		
Notes		
(a)	1 st M1 for standardising 4.3 with 3.8 and 0.9 (allow $\pm$) 2 nd M1 for $1 - p$ (where $0.7 < p < 0.8$) A1 for awrt 0.288 or 0.289 (calc. 0.289257) (correct answer only 3/3)	
(b)	M1 for standardising with d , 3.8 and 0.9 and setting equal to a z value $0.8 < z < 0.9$ B1 for $z = \pm 0.8416$ or better used A1 for awrt 3.04 (condone $d \geq \dots$) For awrt 3.0425 or 3.0426 score 3/3 For awrt 3.04 score M1B0A1	
Ans only		
(c)	1 st M1 for either expression for the conditional prob. [or sight of $\frac{1}{3}(a)$] (ft their answer to (a) to 2 sf) 1 st A1ft for $P(D > g) = 0.096$ or better (0.289 gives 0.09633... calc 0.096419...) The $P(D > g)$ may be clearly shown on a diagram. 1 st M1A1 can be awarded for $P(D > g) = \frac{1}{3}(a)$ or for $P(D < g) = 1 - \frac{1}{3}(a)$ [ft their (a) to 2 sf] 2 nd dM1 (dep on 1 st M1) for standardising with g , 3.8 and 0.9 and put equal to a z value where $ z > 1$ 2 nd A1 for awrt 4.97 or 4.98 (Correct answer with no incorrect working seen 4/4) (condone $g \geq \dots$)	
SC	(Medals v Certificates) 1 st B1 for $[P(D > g) =] \frac{1}{3} \times 0.8 = \frac{4}{15}$ or 0.267 (score as 1 st M0 1 st A1) 2 nd B1 for $g = \text{awrt } 4.36$ (4.358 tables, 4.3606..calc) (score as 2 nd M0 2 nd A1)	
(d)	1 st M1 for a correct probability of no gold medals or 2 of: $3\left(\frac{2}{3}\right)^2 \times \frac{1}{3}$ or $3\left(\frac{1}{3}\right)^2 \times \frac{2}{3}$ or $\left(\frac{1}{3}\right)^3$ 2 nd M1 for $1 - p^3$ or $3(p)^2(1 - p) + 3p(1 - p)^2 + (1 - p)^3$ where $0 < p < 1$ A1 for $\frac{19}{27}$ (or exact equivalent) only e.g. $0.\dot{7}0\dot{3}$	

Question Number	Scheme	Marks
4. (a)	Upper quartile = 34 Lower limit = $24 - 15 = 9$ or upper limit is " 34 " + $15 = 49$ So outliers are: 8, 52.5 and 56	B1 M1 A1ft, A1ft (4)
(b)		B1 B1 B1 (3)
(c)	$Q_2 - Q_1 (=6) > ("4" =) Q_3 - Q_2$ or e.g. in words e.g. " Q_3 closer to Q_2 than Q_1 is" So <u>negative</u> (skew)	M1 A1ft (2)
(d)	IQR now " 34 " - $26 = 8$ so new outlier limits are $26 - 1.5 \times "8" = 14$ and " 34 " + $1.5 \times "8" = 46$	M1
		A1ft A1 (3)
(e)	$[Q_1$ has increased so both above 24 Median same so either side of or on median] So one between 26 and 30 inc $[Q_3$ unchanged so must be either side of Q_3] so one between "34" and 45 inc	B1 B1 (2)
[14]		
Notes		
(a)	B1 for $Q_3 = 34$ either stated or used/implied (score if seen on box plot) M1 for one correct calculation (ft their 34 for upper limit) [May be implied by correct outliers] 2 nd A1ft for the lower outlier at 8 (ft their limit provided limit ≤ 12) 3 rd A1ft for upper outliers at 52.5 and 56 (ft their limit provided it is > 45) NB These accuracy marks are for the outliers not the limits	Award if their outliers are seen on box plot
(b)	1 st B1 for a box with $Q_1 = 24$, $Q_2 = 30$ $Q_3 =$ their 34 and two whiskers one on each side. 2 nd B1 for one lower whisker ending at 10 (or their 9) and outlier at 8 only 3 rd B1 for one upper whisker ending at 45 (or their 49 to match " 9 ") and outliers at 52.5 and 56 only	
SC	Extra whiskers. If one set of whiskers gives a correct box plot award B1B0B0 Usual accuracy for plots – to within 0.5 of a square.	
(c)	M1 for correct comparison of $Q_2 - Q_1$ and $Q_3 - Q_2$ (ft their Q_3) (if no values seen <u>must</u> see comparison otherwise accept correctly assigned 6 and 4 without $>$) A1ft for correct deduction based on their Q_3 (+ve (skew) if their $Q_3 > 36$, <u>no skew</u> if their $Q_3 = 36$)	
(d)	M1 for recognising new IQR and at least one correct new limit (ft their 34, implied by correct plot) 1 st A1ft for a correct lower whisker ending at 15.5 (or their 14) and 2 correct outliers at 8 and 10 2 nd A1 for a <u>fully</u> correct box plot with upper whisker to 45 (or could go to 46 [to match their 14])	
SC	Extra whiskers. If one set of whiskers gives a correct box plot award M1A0A1	
(e)	1 st B1 for a range $[26, 30]$ allow that (...) (o.e. eg between 26 and 30) 2 nd B1 for a range $[34, 45]$ condone [...] or (...) (ft their 34 and allow o.e. e.g. between 34 and 45)	

Question Number	Scheme	Marks
5. (a)	$y = 6.066 + 0.136 \times 80$ $= 16.946$ (so annual rent is) \$ 16 946	M1 A1 (2)
(b)	$S_{yy} = 3434 - \frac{183^2}{10}$ or $S_{xx} = 84\,818 - \frac{900^2}{10}$ $S_{yy} = \underline{85.1}$ $S_{xx} = \underline{3818}$	M1 A1 A1 (3)
(c)	Need S_{xy} so use b so $S_{xy} = b \times S_{xx} = 0.136 \times 3818$ or 519.248 $[r =] \frac{0.136 \times "3818"}{\sqrt{"3818" \times "85.1"}}$ $= 0.9109448...$ awrt 0.911	M1; A1 M1 A1 (4)
(d)	Since (new $x = 90$ and [original or] new $\bar{x} = 90$) the term $(x - \bar{x})$ will be 0 Therefore (the 11 th shop makes no change) S_{xy} stays the same	M1 A1 (2)
(e)	S_{xx} will be the same so b will be the same New $\bar{y} = \frac{183+15}{11} = 18$ (or a is reduced by 0.3) Equation is $y = 5.766 + 0.136x$	M1 M1 A1 (3)
(f)	$x = 300$ is outside the range $300 \gg 90$ [$300 \gg 90 + 3\sigma = 90 + 3 \times 18.63 \approx 146$] So not suitable (since involves extrapolation) (o.e.)	B1 (1)
[15]		
Notes		
(a)	M1 for substituting $x = 80$ into the given equation A1 for awrt \$ 16 900 (or better)(allow "16.9 thousand dollars"). Must have some units. Condone $y =$	
(b)	M1 for a correct expression for either (can be implied by sight of either correct answer) 1 st A1 for 85.1 2 nd A1 for 3818 or accept 3820	
(c)	1 st M1 for an attempt to use gradient of regression line to find S_{xy} 1 st A1 for awrt 519 2 nd M1 for a correct expression using their values (M0 if $S_{xy} = 900 \times 183 = 164700$) 2 nd A1 for awrt 0.911	
(d)	M1 for stating or showing [old or] new $\bar{x} = 90$ (new $x = 90$ implied) <u>or</u> stating that $(x - \bar{x})$ term = 0 A1 for a fully correct argument mentioning new $x = \bar{x} = 90$ <u>and</u> that extra $(x - \bar{x})$ term = 0 Condone using $\bar{y} = 18.3$ instead of 18	
(e)	1 st M1 for a correct statement about S_{xx} or b (may be implied by 0.136 used correctly) 2 nd M1 for a correct value for new $\bar{y}$ (calculation may be seen in (d) scores here when 18 is used) A1 for $y = 5.766$ (or awrt 5.77 or awrt 5.76) + 0.136x (correct equation scores 3/3)	
(f)	B1 for suitable comparison (must see 300 vs 90 or 3000 vs 900) that says or implies that 300 will be <u>outside</u> the range and therefore <u>not</u> suitable. Not sufficient to just say "larger"	

Question Number	Scheme	Marks
6. (a)	$[E(A) =] 1 \times 0.4 + 4 \times 0.2 + 5 \times 0.25 + 7 \times 0.15$ $= \underline{3.5} \quad (*)$	M1 A1cso (2)
(b)	$[E(A^2) =] 1 \times 0.4 + 4^2 \times 0.2 + 5^2 \times 0.25 + 7^2 \times 0.15 [= 17.2]$ $\text{Var}(A) = E(A^2) - [E(A)]^2 = 17.2 - 3.5^2$ $= \underline{4.95}$	M1 M1 A1 (3)
(c)	(Discrete) uniform (distribution)	B1 (1)
(d)	By symmetry $k = 6$	B1 (1)
(e)	$\left[\text{Sam has } Z = \frac{3.5 - 4}{3} = -\frac{1}{6} \text{ and} \right] \text{ Tim needs } \frac{3.5 - A}{4} < -\frac{1}{6} \text{ so } A > 4.166..$ $\text{So prob} = 0.25 + 0.15 = \underline{0.4}$	M1 A1 (2)
(f)	Need largest possible $\mu = 7$ and smallest possible $\sigma = 1$ $P(X > 3.5) \text{ is then } P\left(Z > \frac{3.5 - 7}{1}\right) = P(Z > -3.5)$ $= \underline{0.9998} \text{ (tables) or } 0.999767... \text{ (calc)}$	B1, B1 M1 A1 (4)
(g)	$[\text{Need } A = 7 \text{ and } B = 1 \text{ (or ft from (f)) so}] P(A = 7) \times P(B = 1) \text{ or } "0.15" \times 0.25$ $= \underline{0.0375}$	M1 A1cso (2)
[15]		
Notes		
(a)	M1 for an attempt at $E(A)$ – at least 3 correct products seen A1cso for 3.5 or exact equivalent with no incorrect working seen and M1 scored	
(b)	1 st M1 for an attempt at $E(A^2)$ – at least 3 correct products 2 nd M1 for use of $E(A^2) - [E(A)]^2$ ft their value for $E(A^2)$	
ALT	M2 for $(-2.5)^2 \times 0.4 + (0.5)^2 \times 0.2 + (1.5)^2 \times 0.25 + (3.5)^2 \times 0.15$ (at least 3 correct products) A1 for 4.95 or an exact equivalent e.g. $\frac{99}{20}$	
(c)	B1 for uniform (continuous uniform is B0)	
(d)	B1 for stating $k = 6$ with a suitable reason e.g. mention of symmetry or full calculation	
(e)	M1 for a suitable calculation for A e.g. $\frac{3.5 - A}{4} < -\frac{1}{6}$ or stating $A = 5$ or 7 or $A > \text{awrt } 4.2$ (o.e.) A1 for 0.4 (must be based on some correct calculation seen)	
(f)	1 st B1 for $\mu = 7$ may be implied from a standardisation with 3.5 seen 2 nd B1 for $\sigma = 1$ may be implied from a standardisation with 3.5 seen M1 for attempting correct probability i.e. $P(Z \dots \text{ or } X \dots)$ ft standardisation using 3.5, their $\mu \neq 4$ and their $\sigma \neq 3$ but their μ and σ must be “possible” values or $P(Z > -3.5)$ A1 for 0.9998 or better	
(g)	M1 for “0.15” $\times$ 0.25 ft their value of A from (f) A1cso for 0.0375 or exact equivalent e.g. $\frac{3}{80}$ (Must clearly come from $A = 7$ and $B = 1$ in (f))	

