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Mark Scheme (Results)

October 2025

International Advanced Level in Statistics S2

WST02/01A

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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.

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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.

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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

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Question Number	Scheme		Marks
1(a)	$1-\mathrm{F}(4)=1-\frac{3}{5}=\frac{2}{5}$	$\int_4^5\left(\frac{2}{5}\right)\mathrm{d}x=2-\frac{8}{5}=\frac{2}{5}$	M1A1
			(2)
(b)	$\mathrm{F}(a)-\mathrm{F}(3)=0.642$ or $\mathrm{F}(a)-\mathrm{F}(4)=0.292$ or $\mathrm{F}(a)-0.25=0.642$ or $\mathrm{F}(a)-0.6=0.292$	From $x=3$ to 4: $\int_3^4\left(\frac{1}{10}x\right)\mathrm{d}x=\frac{7}{20}$	M1
	$\mathrm{F}(a)=0.892=\frac{223}{250}$	From $x=4$ to a: $\int_4^a\left(\frac{2}{5}\right)\mathrm{d}x=\left(\frac{2}{5}a-\frac{8}{5}\right)$	A1
	$\frac{1}{5}(2a-5)=\text{"0.892"}$	$\frac{7}{20}+\frac{2}{5}a-\frac{8}{5}=0.642$	M1
	$a=4.73$		A1
			(4)
(c)	$\mathrm{f}(x)=\frac{\mathrm{d}}{\mathrm{d}x}(\mathrm{F}(x))=\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{1}{20}(x^2-4)\right)=\frac{1}{10}x$ $\mathrm{f}(x)=\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{1}{5}(2x-5)\right)=\frac{2}{5}$		M1
	$\mathrm{f}(x)=\begin{cases}\frac{1}{10}x, & 2\le x\le 4\\ \frac{2}{5}, & 4<x\le 5\\ 0, & \text{otherwise}\end{cases}$		A1A1B1
			(4)

	Notes		Total 10
(a)	**M1**	For 1 – F(4) seen or used. May be implied by $\frac{2}{5}$ oe Allow1 – P($X \le 4$) or a correct integral with limits seen or used	
	A1	Oe	
(b)	**M1**	for $\mathrm{F}(a)-\mathrm{F}(3)=0.642$ seen or used or F(a) – F(4) = 0.292 seen or used or for correct attempt at area from 3 to 4 or 4 to a Allow P($X \le$ a) – P($X \le$ 3) = 0.642 or P($X \le$ a) – P($X \le$ 4) = 0.292 Allow any letter for a May be implied by $\mathrm{F}(a)=0.892$	
	A1	for $\mathrm{F}(a)=0.892$ oe or for either correct area	
	M1	For solving $\frac{1}{5}(2a-5)=\text{"0.892"}$ ft their 0.892 Allow any letter for a or for total area = 0.642 ISW e.g. $\frac{1}{20}\left(a^2-4\right)=0.892$ **SC use of a – 1 leading to 5.73 scores M1**	
	A1	Cao If 4.67 is shown as well then it must be rejected	
(c)	**M1**	For attempt at differentiation of either line of cdf $(x^n \to x^{n-1})$ May be implied by either of the first two lines of the cdf above correct	
	A1	For $\frac{1}{10}x$ (must be on its own) with correct limits	
	A1	For $\frac{2}{5}$ (must be on its own) with correct limits	
	B1	for the 3rd line of the cdf above Allow 0 for $x < 2$ and 0 for $x > 5$ for 0 otherwise Allow use of ≤/≥ for this mark only	

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Question Number	Scheme	Marks
2(a)	**List** of **all** the **customers** (who eat in the restaurant)	B1
		(1)
(b)	**Customer(s)** (who ate in the restaurant)	B1
		(1)
(c)	Advantage: more/total accuracy, unbiased	B1
	Disadvantage: time consuming to obtain data and analyse it, expensive, difficult to ensure entire population is included	B1
		(2)
(d)	Let X = the number of customers who would like more choice on the menu	
	$H_0: p = 0.3$ $H_1: p > 0.3$	B1
	$X \sim B(50,0.3)$ $P(X \geq 20) = 1 - P(X \leq 19)$ or CR $P(X \geq 21) = 1 - P(X \leq 20)$ 0.9522 $= 1 - 0.9152$ $= 1 - 0.9522$ $= 0.0848$ $X \geq 21$	M1 A1
	Do not reject H_0/ not significant/20 is not in critical region	M1
	The percentage of **customers** who would like more **choice** on the menu is not more [than 30%] or There is no evidence to reject **Bill's belief**	A1ft
		(5)

	Notes	Total 9
(a)	**B1**	Need the idea of list/register/data base and customer(s). Do not allow customer's opinions. 'ALL' may be implied. Do not allow a partial list e.g. A list of 50 customers
(b)	**B1**	Customer(s) Do not allow customer's opinion
(c)	**B1**	If not labelled, assume the response refers to a census Correct advantage (If not labelled as advantage then take the first answer as the advantage)
	B1	Correct disadvantage (If not labelled as disadvantage then take the second answer as the disadvantage)
(d)	**B1**	Both hypotheses in terms of p or π
	M1	For writing or using $1 - P(X \leq 19)$ or $1 - P(X \leq 20)$
	A1	Awrt 0.0848 or a correct CR (allow any letter)
	M1	For a correct non contextual statement. Ft their probability/CR provided a binomial distribution is used. Do not allow contradictory non contextual statements. May be implied by a correct contextual statement on its own
	A1ft	For a correct contextual statement. Must mention customers and choice or Bill and belief/believes. Ft their probability/CR

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Question Number	Scheme	Marks
3(a)(i)	B(60, 0.1)	B1
	$[P(Y=0)+P(Y=1)=](0.9)^{60}+60(0.1)^{1}(0.9)^{59}$ oe	M1
(ii)	=0.013777... awrt 0.0138	A1
		(3)
(b)	Po(6)	B1
	$[P(Y\leq 1)=]0.01735....$ or 0.0174 from tables awrt 0.0174	B1
		(2)
(c)	N(6, 5.4)	B1
	$[P(Y\leq 1)\approx]P\left(Z<\frac{1.5-6}{\sqrt{5.4}}\right)$	M1M1
	$=P(Z<-1.936...)$	A1
	$=1-0.9738=0.0262$ (or from calc 0.02640...)	A1
		(5)
(d)	[Poisson approximation is more suitable since] *p* is not close to 0.5 or *n* is large and *p* is small or (b) is closer to the true value	B1
		(1)
	Notes	**Total 11**

(a)(i)	**B1**	For writing or using B(60, 0.1) Allow if used in (ii)
	M1	For a correct expression oe Allow use of $^{60}C_0$ oe and $^{60}C_1$ oe ISW after a correct expression. Allow if seen in (ii)
(ii)	**A1**	Awrt 0.0138 **NB** SC answer only scores B1M0A0
(b)	**B1**	For writing or using Po(6)
	B1	Awrt 0.0174
(c)	**B1**	For writing or using N(6, 5.4) May be seen in a standardisation NB 5.4 = $\left(\frac{3\sqrt{15}}{5}\right)^2$
	M1	For continuity correction 1 ± 0.5
	M1	For standardising using 1, 0.5 or 1.5 with their mean and their standard deviation Allow ±
	A1	Awrt ±1.94 May be implied by awrt 0.026
	A1	Awrt 0.026
(d)	**B1**	For a correct reason (No need to mention Poisson) Ignore any reference to $np < 10$ oe e.g. the rate is small. Do not accept mean ≈ variance since 6 is not approximately 5.4 but ignore if alongside a correct answer

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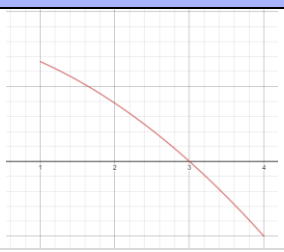
Question Number	Scheme	Marks
4(a)		B1B1
	This is not a valid probability density function since f(x) < 0 for x > 3	B1
		(3)
(b)	$[g(y)=k(12y-y^3)]\Rightarrow[g'(y)]=k(12-3y^2)$	M1
	$12-3y^2=0$ so $y=2$	dM1A1
		(3)
(c)	$\int k(12y-y^3)\mathrm{d}y=k\left[6y^2-\frac{y^4}{4}\right]_1^3$	M1
	$k\left(6\times3^2-\frac{3^4}{4}-6+\frac{1}{4}\right)=1$ so $k=\frac{1}{28}$	dM1A1
		(3)
(d)	$\int_1^m "\frac{1}{28}"(12y-y^3)\mathrm{d}y="\frac{1}{28}"\left(6\times m^2-\frac{m^4}{4}-\left(6\times1^2-\frac{1^4}{4}\right)\right)=0.5$ or $\int "\frac{1}{28}"(12y-y^3)\mathrm{d}y="\frac{1}{28}"\left(6y^2-\frac{y^4}{4}\right)+c$ and use of F(3) = 1 or F(1) = 0 to find c	M1
	$m^4-24m^2+79=0$ oe so $m=1.98437...$ awrt 1.98	M1A1
		(3)
(e)	Median ≈ Mode, therefore there is no skew	M1A1ft
		(2)
	Notes	**Total 14**
(a)	**B1** For correct shape between 1 and 3. Ignore any parts of the graph that extend before x = 1 and or after x =4 Allow even if 3 is not marked on the x axis as long it crosses the x- axis between 1 and 4	
	B1 For a correct shape between 1 and 4 with 1, 3 and 4 labelled on the x-axis	
	B1 For not a density function/Albert is incorrect with supporting reason e.g. probabilities cannot be less than 0	
(b)	**M1** For expanding and attempting to differentiate (or using product rule to differentiate)	
	dM1 Dep on previous M1 For equating to 0 and attempt to solve	
	A1 Cao **NB** Answer only scores 0/3 Do not ISW	
(c)	**M1** For an attempt to integrate g(y) $\left(y^n\rightarrow y^{n+1}\right)$	
	dM1 Dep on previous M1 For equating to 1 and use of correct limits (May be implied by $\frac{135}{4}-\frac{23}{4}$)	
	A1 Oe **NB** Answer only scores 0/3	

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(d)	**M1**	For writing or using $\int_1^m g(y)\mathrm{d}y = 0.5$ ft k from part c Allow any letter for m Must see limits/correct use of limits or $\int g(y)\mathrm{d}y$ and use of F(3) = 1 or F(1) =0 to find c
	M1	For $m^4 - 24m^2 + 79 = 0$ oe e.g. $\frac{3}{14}y^2 - \frac{1}{112}y^4 - \frac{23}{112} = 0.5$
	A1	Awrt 1.98 only Must reject other root(s) if seen
(e)	**M1**	For a comparison of their part (b) with their part (d) Allow comparison of the mean (1.9857..) provided the mean is calculated
	A1 ft	For no skew/zero skew oe Condone symmetrical/symmetric (allow [slight] negative [skew]) ft their part (b) and part (d) or the mean provided the mean is calculated Do not allow equal/even skew or normal/normally distributed

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Question Number	Scheme	Marks
5(a)	Po(6)	
(i)	P(X = 7) = $\mathrm{P}(X \leq 7) - \mathrm{P}(X \leq 6) = 0.7440 - 0.6063$	M1
	= 0.1377 awrt 0.138	A1
(ii)	$\mathrm{P}(X > 7) = 1 - \mathrm{P}(X \leq 7) = 1 - 0.744$	M1
	= 0.256	A1
		(4)
(b)	Let *Y* be the number of cars that pull into the service station	
	$Y \sim \mathrm{N}(\lambda, \lambda)$	M1
	$\lambda = 0.6n$	B1
	$\mathrm{P}(Y > 40) = 0.2266$	
	$\frac{40.5 - \lambda}{\sqrt{\lambda}} = 0.75$	M1M1B1
	$\lambda + 0.75\sqrt{\lambda} - 40.5 = 0$	A1
	$\sqrt{\lambda} = 6$	M1A1
	n = 60	A1
		(9)

	Notes		Total 13
(a)(i)	**M1**	For writing or using $\mathrm{P}(X \leq 7) - \mathrm{P}(X \leq 6)$ or use of $\frac{\mathrm{e}^{-\lambda}\lambda^7}{7!}$	
	A1	Awrt 0.138	
(ii)	**M1**	For writing or using $1 - \mathrm{P}(X \leq 7)$	
	A1	Awrt 0.256	
(b)	**M1**	Normal with mean = Var (can be letters or numbers) May be seen in a standardisation	
	B1	Using $\lambda = 0.6n$ (can be seen at any stage)	
	M1	Use of a continuity correction 40 ± 0.5	
	M1	Standardising with 39.5, 40 or 40.5 and their mean and their standard deviation and set = to a *z* value where 0.74 < |*z*| < 0.76	
	B1	0.75 or better Allow – 0.75 if compatible with their standardisation	
	A1	Fully correct equation in any form	
	M1	Solving their 3TQ If the equation is incorrect then working must be shown. May be implied by *n* = 60	
	A1	For $\sqrt{\lambda} = 6$ or $\lambda = 36$ May be implied by *n* = 60	
	A1	For *n* = 60	

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Question Number	Scheme	Marks
6(a)	(1, 1), (1, 5)[x2] (5, 5), (1, 10)[x2], (5, 10)[x2], (10, 10)	B1B1
		(2)
(b)	[For $M = 1$, (1, 1)] $q \times q = \frac{1}{25}$ so $q = \frac{1}{5}$	M1A1
	[For $M = 5$, (1, 5), (5, 1), (5, 5)] $qr + rq + r^2 = \frac{13}{80}$	M1
	$r^2 + 2(\frac{1}{5})r - \frac{13}{80} = 0 \rightarrow r = \frac{-\frac{2}{5} + \sqrt{(\frac{2}{5})^2 - 4(-\frac{13}{80})}}{2}$ so $r = \frac{1}{4}$	M1A1
	[For $M = 10$, (1, 10), (10, 1), (5, 10), (10, 5), (10, 10)] $2qs + 2rs + s^2 = \frac{319}{400}$ or $q + r + s = 1$ so $s = \frac{11}{20}$	M1A1
		(7)

	Notes	Total 9
(a)	**B1**	For at least 4 correct pairs
	B1	For all 6 correct pairs
(b)	**M1**	For a correct equation to find q May be implied by a correct answer for q
	A1	$\frac{1}{5}$ oe If more than one answer given then it must be rejected
	M1	For a correct equation in terms of r and q (ft their q) May be implied by a correct answer for r
	M1	Attempt to solve 3TQ If the equation is incorrect then working must be shown May be implied by a correct answer for r
	A1	$r = \frac{1}{4}$ oe If more than one answer given then it must be rejected
	M1	For a correct equation in terms of s (ft their q and their r) or use of sum of probabilities =1 May be implied by a correct answer for s
	A1	$s = \frac{11}{20}$ oe If more than one answer given then it must be rejected
Special Case		
(b)	**M1**	$\frac{q}{q+r+s} \times \frac{q}{q+r+s} = \frac{1}{25}$
	A0	$q = 4$
	M1	$\frac{qr}{(q+r+s)^2} + \frac{qr}{(q+r+s)^2} + \left(\frac{r}{q+r+s}\right)^2 = \frac{13}{80}$
	M1	Let $y = \frac{r}{q+r+s}$ so $y^2 + 2(\frac{1}{5})y - \frac{13}{80} = 0 \rightarrow y = \frac{-\frac{2}{5} + \sqrt{(\frac{2}{5})^2 - 4(-\frac{13}{80})}}{2}$ May be implied by $y = \frac{1}{4}$
	A0	$r = 5$

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	M1	$\frac{2qs}{(q+r+s)^2}+\frac{2rs}{(q+r+s)^2}+\left(\frac{s}{q+r+s}\right)^2=\frac{319}{400}$
	A0	$s=11$

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Question Number	Scheme	Marks
7(a)	$E(3-2X)= 3-2E(X)$	M1
	$= 3-2\left(\frac{(a+b)}{2}\right)$ or $3-a-b$	A1
		(2)
(b)	$P(X > \frac{1}{3}b+\frac{2}{3}a) =$ $\frac{b-(\frac{1}{3}b+\frac{2}{3}a)}{b-a}=\frac{2}{3}$ or $1-\frac{(\frac{1}{3}b+\frac{2}{3}a)-a}{b-a}=\frac{2}{3}$	M1A1
		(2)
(c)	$E(3X^2)=\int_a^b \frac{1}{(b-a)}3x^2\,dx$ | $[Var(X)=]\ \frac{(b-a)^2}{12}\left[=E(X^2)\right]$	M1
	$=\left[\frac{1}{(b-(-b))}x^3\right]_{-b}^{b}=\left(\frac{b^3-(-b^3)}{2b}\right)$ | $E(3X^2)=3\left(\frac{(b-(-b))^2}{12}\right)$	dM1
	$=b^2$	A1
		(3)
(d)	Range = $b-a=18$	M1
	Var $(X)=\frac{18^2}{12}=27$	A1
		(2)

	Notes	Total 9
(a)	**M1**	for writing or using $3-2E(X)$
	A1	For a correct expression for $3-2E(X)$ e.g. $3-(a+b)$ Need not be simplified
(b)	**M1**	for a correct expression for $P(X > \frac{1}{3}b+\frac{2}{3}a)$
	A1	for $\frac{2}{3}$
(c)	**M1**	for a correct integral for $E(3X^2)$ (ignore limits) or for a correct expression for Var(X)
	dM1	M1 Dep on 1st M mark. For correct integration and correct use of $a=-b$ or for $3E(X^2)$ and correct use of $a=-b$
	A1	Cao
(d)	**M1**	for writing or using $(b-a)=18$ May be implied by a correct answer or use of U[−9, 9]
	A1	Cao