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Mark Scheme (Results)

January 2025

Pearson Edexcel International Advanced Level
In Statistics S1 (WST01) Paper 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.

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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

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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

Special notes for marking Statistics exams (for AAs only)

- Any correct method should gain credit. If you cannot see how to apply the mark scheme but believe the method to be correct then please send to review.
- For method marks, we generally allow or condone a slip or transcription error if these are seen in an expression. We do not, however, condone or allow these errors in accuracy marks.

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Question Number	Scheme	Marks
1 (a)	**Discrete uniform**	B1
		(1)
(b)	$\frac{1}{2}$	B1
		(1)
(c)(i)	[E(R) =] 2.5	B1
(ii)	[E(B) =] 4	B1
		(2)
(d)	$[\mathrm{E}(B^2) =]\frac{1}{4}\left(1^2+3^2+5^2+7^2\right)=21$	M1
	$\mathrm{Var}(B)=\mathrm{E}(B^2)-\left(\mathrm{E}(B)\right)^2="21"-"4"^2$	M1
	$=5$	A1
		(3)
(e)	Possible combinations (R, B) : (1,1) (1,3) (2,1) (3,1) (4,1) (2,3) <u>or</u> $\frac{1}{4}\times\frac{1}{4}\times 6$	M1
	$\mathrm{P}(R+B\text{„ }5)=\frac{6}{16}$	A1
		(2)
(f)	R^2 | 1 | 4 | 9 | 16 B | 1 | 3 | 5 | 7	
	Possible combinations (R, B) : (1,3) (1,5) (1,7) (2 (4),5) (2 (4),7) <u>or</u> $\frac{1}{4}\times\frac{1}{4}\times 5$	M1A1
	$\mathrm{P}(R^2<B)=\frac{5}{16}$	A1
		(3)
(g)	$B=5$ and $R=1, B=7$ and $R=3[\rightarrow D=4]$; $B=7$ and $R=2[\rightarrow D=5]$	M1
	$\mathrm{P}(D=4)=\frac{1}{4}\times\frac{1}{4}\times 2=\frac{1}{8}$; $\mathrm{P}(D=5)=\frac{1}{4}\times\frac{1}{4}=\frac{1}{16}$	A1
	$p=\mathrm{F}(4)=\frac{3}{4}+\frac{1}{8}=\frac{7}{8}$; $p=\mathrm{F}(5)-\mathrm{P}(D=5)=\frac{15}{16}-\frac{1}{16}=\frac{7}{8}$	A1
		(3)
	Notes	**Total 15**

(a)	**B1**	Must include both words (in either order). Ignore extraneous non-contradictory words.
(b)	**B1**	0.5 oe
(c) (i)	**B1**	cao need not be labelled unless done in wrong order (blue then red)
(ii)	**B1**	cao need not be labelled unless done in wrong order (blue then red)
(d)	**M1**	Correct method to find $\mathrm{E}(B^2)$ at least 3 terms correct (implied by $\mathrm{E}(B^2)=21$). Ignore label. $\mathrm{E}(B^2)=\frac{21}{4}$ is M0
	M1	Correct method to find Var(B) ft their $\mathrm{E}(B^2)$ and their E(B)
	A1	cao an answer of 5 without working send to review
(e)	**M1**	At least 4 correct combinations identified with no incorrect ones given. Ignore duplicates, but do not accept eg (1, 4) as a duplicate of (4, 1). If not labelled, combinations must be consistently ordered. **<u>or</u>** if no combinations given, correct probability calculation (implied by correct answer with no obvious incorrect working)
	A1	0.375 oe must come from correct combinations or correct working

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(f)	**M1**	At least 3 correct combinations identified with no incorrect ones given. Ignore duplicates, but do not accept eg (1, 4) as a duplicate of (4, 1). If not labelled, combinations must be consistently ordered. (allow 4, 5 and 4, 7 stated as combinations instead of 2, 5 and 2, 7)
	A1	All 5 correct combinations with no extras or duplicates. **or** if no combinations given, correct probability calculation (M1A1 implied by correct answer with no obvious incorrect working)
	A1	$\frac{5}{16}$ oe (accept awrt 0.313) must come from correct combinations or correct working
(g)	**M1**	Correct combinations identified for $D = 4$ or $D = 5$ (may be implied by correct working for 1st A1).
	A1	$\mathrm{P}(D = 4) = \frac{1}{8}$ or $\mathrm{P}(D = 5) = \frac{1}{16}$ need not be labelled but working/combinations must imply the correct label do not award this mark for $\mathrm{F}(4) = \frac{1}{8}$ on its own These may be seen as part of the probability distribution of *D*
	A1	0.875 oe Correct answer does not automatically imply 3 out of 3. Need to see correct combinations identified or see correct probability calculation/distribution. Answer only is 0 out of 3.

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Question Number	Scheme	Marks
2 (a)	[Range = 0.87 – 0.21] = **0.66**	B1
		(1)
(b)	Median (24th value) = = **0.48**	B1
		(1)
(c)	LQ (12th value) = 0.35 0.31 = UQ – "0.35" [UQ = 0.66] a = **6**	B1 M1 A1
		(3)
(d)	$\text{sd} = \sqrt{\frac{13.4228}{47} - \left(\frac{23.72}{47}\right)^2}$ **or** $S_{xx} = 13.4228 - \frac{23.72^2}{47}$ [= 1.4517...] and $\text{sd} = \sqrt{\frac{S_{xx}}{47}}$	M1
	= 0.17575… = **0.176***	A1*
		(2)
(e)(i)	$\frac{\sum y + 23.72}{65} = 0.502$ **or** $0.502 \times 65 = 32.63$	M1
	$32.63 = \sum y + 23.72$ **8.91***	A1*
		(2)
(ii)	$0.204 = \sqrt{\frac{\left[13.4228 + \sum y^2\right]}{65} - 0.502^2}$ **or** $0.204^2 = \frac{\left[13.4228 + \sum y^2\right]}{65} - 0.502^2$	M1
	$\sum y^2 = (0.204^2 + 0.502^2) \times 65 - 13.4228$	M1
	=5.6625 awrt **5.66**	A1
		(3)
	Notes	**Total 12**

(a)	**B1**	0.66 oe
(b)	**B1**	0.48 oe (do not accept 4|8)
(c)	**B1**	LQ = 0.35 stated or implied allow 35 for this mark (but 35.25 or the UQ = 35th value is B0).
	M1	0.31 = UQ – "0.35" allow any rearrangement of this for M1 Condone eg 0.6a for UQ Also allow use of 35 + 31 for this mark (implied by 66 or 0.66)
	A1	cao May come from poor notation eg 0.6a = 0.66 Do not isw. Do not award for 66 or 0.66
(d)	**M1**	Use of correct formula (need $\sqrt{\ }$) $\sqrt{\frac{13.4228}{47} - \frac{23.72^2}{47}}$ is M0
	A1*	awrt 0.176 with correct exact working seen allow awrt 0.176 coming from 0.1757…or better allow awrt 0.176 with the mean to 0.5046… or better seen Note: Inaccurate working on its own scores M1A0 eg $\sqrt{\frac{13.4228}{47} - 0.505^2} = 0.176$ (note s = 0.17765… send to review)
(e)(i)	**M1**	For a correct equation for sample mean **or** for 0.502× 65 (implied by 32.63 seen)
	A1*	8.91 cso Correctly rearranging $\sum y$ leading to given answer with 1 line of intermediate working. $\sum y = 0.502 \times 65 - 23.72 = 8.91$ is M1A1 Condone poor notation for A1 but working must be correct.
(ii)	**M1**	Use of correct standard deviation or variance formula seen For this mark we only require 0.204, 65 and 0.502 in the correct places – allow any numerator

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	M1	Find $\sum y^2$ using correct order of operations on $a = \sqrt{\frac{b+\sum y^2}{65} - c}$ **or** $m = \frac{n+\sum y^2}{65} - p$ $b \neq 0, n \neq 0$ At least 1 line of rearrangement from **variance** must be shown to score this mark. Condone poor notation for $\sum y^2$ (may be implied by awrt 5.66)
	A1	awrt 5.66 (SC attempting to use s gives 5.62 send to review)

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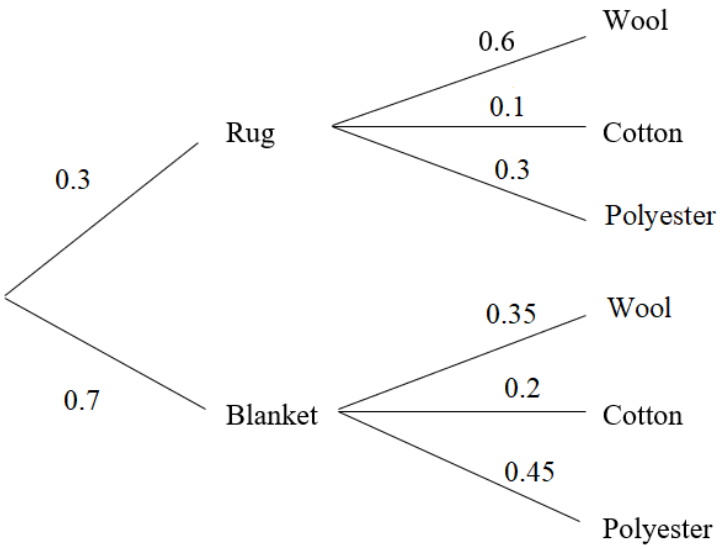
Question Number	Scheme	Marks
3(a)		B1 B1
		(2)
(b) (i)	$P(W') = 0.3\times(0.1+0.3)+0.7\times(0.2+0.45)$ or $P(W') = 1-(0.3\times0.6+0.7\times0.35)$ $= \underline{\mathbf{0.575}}$	M1 A1
		(2)
(ii)	$P(B \mid W') = \frac{P(B \cap W')}{P(W')} = \frac{0.7\times(0.2+0.45)}{'0.575'}$	M1
	$= \frac{91}{115}$	A1
		(2)

		Notes	Total 6
(a)	**B1**	At least 5 probabilities correct (allow fraction, percentage or decimal) But do not allow eg $\frac{3.5}{10}$ or 35 (without percentage symbol)	
	B1	All 8 probabilities correct (allow fraction, percentage or decimal) But do not allow eg $\frac{3.5}{10}$ or 35 (without percentage symbol)	
(b)(i)	**M1**	Correct probability expression ft the probabilities from their part (a)	
	A1	$\frac{23}{40}$ oe allow equivalent fraction, decimal or percentage	
(ii)	**M1**	Correct method for conditional probability used ft their part (a) and ft their (b)(i)	
	A1	awrt 0.791 allow awrt 79.1%	

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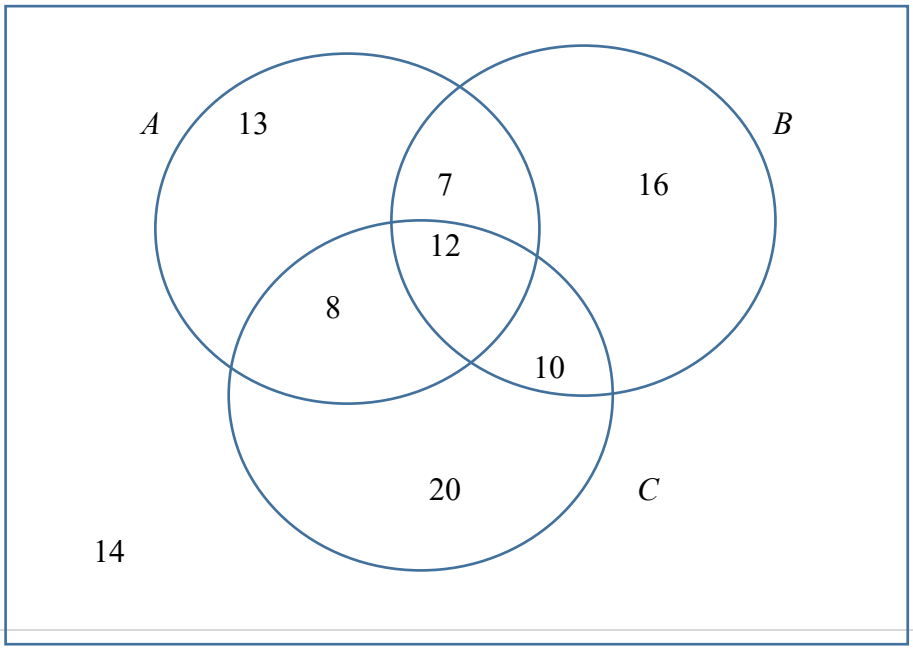
Question Number	Scheme	Marks
4(a)		B1 B1 B1ft B1
		(4)
(b)	$P(A)=\frac{40}{100}$ $P(C)=\frac{50}{100}$ $P(A\cap C)=\frac{20}{100}$ $P(A)\times P(C)=P(A\cap C)$ therefore (A and C are) independent **or** $P(A)=\frac{40}{100}$ $P(A\mid C)=\frac{20}{50}$ $P(A)=P(A\mid C)$ therefore (A and C are) independent	M1 A1 (2)
(c)(i)	$\left[\frac{'13'+'16'+'20'}{100}=\right]\frac{49}{100}$	B1ft
		(1)
(ii)	$P(\text{likes } B\mid\text{likes } C)=\frac{'12'+'10'}{'12'+'10'+'8'+'20'}$ $=\frac{22}{50}$	M1 A1 (2)

		Notes	**Total 9**
(a)		In part (a) allow the numbers in the Venn diagram written as probabilities eg 0.12, 0.07, 0.08 etc.	
	B1	12 correct in the centre of the Venn diagram	
	B1	At least **two** of 7, 8 and 10 correct	
	B1ft	Any **one** of 13, 16 or 20 correct ft their 7,8,10 and 12 (must be positive) such that the 4 regions of A = 40 or the 4 regions of B = 45 or the 4 regions of C =50 Do not accept blank regions as 0 for ft.	
	B1	All correct including the 14	
(b)	**M1**	Labelling all of the probabilities needed for a test of independence (probabilities must be correct or correct ft from their Venn diagram). Must use A and C Either $P(A), P(C)$ and $P(A\cap C)$ or eg $P(A)$ and $P(A\mid C)$	
	A1	Stating correct test with correct values $P(A)\times P(C)=P(A\cap C)$ or eg $P(A)=P(A\mid C)$ and correct conclusion of independence	
(c)(i)	**B1ft**	Ft their "13", "16" and "20" provided the answer is a probability	
(ii)	**M1**	Correct method for conditional probability using all appropriate regions of their Venn Diagram Condone $\frac{n}{50}$ (provided it does **not** come from simplification of $\frac{2n}{100}$) or $\frac{\frac{n}{100}}{\frac{50}{100}}$ with n „ 34 $\frac{\frac{22}{100}}{\frac{50}{100}}$ scores M1 Assuming independence is M0 eg $\frac{\frac{45}{100}\times\frac{50}{100}}{\frac{50}{100}}$	
	A1	0.44 oe	

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Question Number	Scheme	Marks
5(a)(i)	$P(S > 640) = P\left(Z > \frac{640-700}{50}\right)$	M1
	awrt **0.885**	A1 (2)
(ii)	$675 < S < 725$	M1
	$P(675 < S < 725) = P(S < 725) - P(S < 675)$ **or** use of symmetry to find correct area	M1
	$P(S < 725) = P\left(Z < \frac{725-700}{50}\right)$ or $P(S < 675) = P\left(Z < \frac{675-700}{50}\right)$	M1
	$P(-0.5 < Z < 0.5) = 0.6915 - (1 - 0.6915)$ or $1 - 2\times 0.3085$ or $2\times(0.6915 - 0.5)$	A1
	$= 0.383$ awrt **0.383**	A1
		(5)
(b)(i)	$\frac{680-\mu}{\sigma} = 1.5$ $\frac{599-\mu}{\sigma} = -0.5244$	M1A1 A1
		(3)
(ii)	$(680-\mu)-(599-\mu) = 1.5\sigma - (-0.5244)\sigma$	M1
	$(81 = 2.0244\sigma)$	
	$\sigma = 40.01185$ $\mu = 619.98....$ awrt **40** (to 2sf) awrt **620** (to 3sf)	A1A1
		(3)
		Total 13

(a)(i)	**M1**	Attempt to standardise with 640, 700 and 50 allow ± (**not** implied by ±1.2 on its own)
	A1	awrt 0.885 (calc gives 0.884930…) answer only is M0A0 must see standardisation do not isw if 1 – 0.8849 is then found
(ii)	**M1**	Sight of 675 or 725
	M1	Use of $P(675 < S < g) = P(S < g) - P(S < 675)$ where $724 \leqslant g \leqslant 725$ **or** correct use of symmetry eg $P(675 < S < 725) = 2(P(S < 725) - 0.5)$ or eg $P(675 < S < 725) = 1 - 2P(S < 675)$
	M1	One correct standardisation seen of 675 or g with 700 and 50 where $724 \leqslant g \leqslant 725$ Allow for just ± 0.5 oe seen as a z-value (not a probability)
	A1	(dep on 3rd M1) sight of awrt 0.69 or awrt 0.31
	A1	(dep on 3rd M1) awrt 0.383
	SC Use of 650 and 750	Use of 650 and 750 scores a maximum of 4 out of 5 [**Must be 650 and 750** to apply SC] M0 M1 Use of $P(650 < S < 750) = P(S < 750) - P(S < 650)$ or use of symmetry to find correct area M1 standardising 650 or 750 with 700 and 50 or just ±1 seen as a z –value (not a probability) A1 (dep on 3rd M1) sight of awrt 0.84 or awrt 0.16 A1 (dep on 3rd M1) awrt 0.683
		Mark parts (b)(i) and (b)(ii) together
(b)(i)	**M1**	$\pm\frac{680-\mu}{\sigma} = z$ with $1 < \lvert z\rvert < 2$ **or** $\pm\frac{599-\mu}{\sigma} = z$ with $0.5 < \lvert z\rvert < 0.6$
	A1	1 correct equation with $z = 1.5$ or better (calc gives 1.5000556…) or $z = -0.5244$ or better (calc gives –0.5244004…)
	A1	Both equations correct require both 1.5 or better **and** –0.5244 or better
(ii)	**M1**	Attempt to eliminate μ or σ from the 2 equations (implied by awrt $\mu = 620$ and awrt $\sigma = 40$)
	A1	awrt $\mu = 620$ (3sf) **or** awrt $\sigma = 40$ (2sf)
	A1	awrt $\mu = 620$ (3sf) **and** awrt $\sigma = 40$ (2sf)

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Question Number	Scheme	Marks
6 (a)	$S_{tt} = 14837 - \frac{635^2}{30} \quad \left(= \frac{8377}{6} = 1396.1666...\right)$	M1
	$r = \frac{-1648.83}{\sqrt{2396.97 \times 1396.166...}} = -0.9013136...*$	A1*
		(2)
(b)	Possible **linear** relationship between *t* and *w* / points lie close to a (straight) line	B1 B1
	a negative gradient/slope / as *w* increases *t* decreases	
		(2)
(c)		
	$b = \frac{S_{wt}}{S_{ww}} = \frac{-1648.83}{2396.97}$	M1
	$= -0.68788\ldots$ awrt **–0.69**	A1
	$a = \frac{635}{30} - ('-0.68788...') \times \frac{839}{30} = 40.404...$	M1
	$t = 40.4 - 0.688w$	A1
		(4)
(d)	On average as **score increases by 1**, **time decreases by '0.688'** minutes	B1ft
		(1)
(e)(i)	(pmcc would) stay the same	B1
(ii)	(Magnitude of gradient would) decrease	B1
(iii)	(Intercept would) stay the same	B1
		(3)

	Notes		Total 12
(a)	**M1**	Use of correct formula to find S_{tt} implied by 1396 or better	
	A1*	Correct calculation shown to find *r* **and** answer awrt –0.901	
(b)	**B1**	One correct feature Mention of linear relationship/close to a straight line oe Just mentioning the word line is not enough – must imply the points/graph form a (straight) line **or** negative gradient/slope oe allow eg downward gradient for negative gradient Do not allow negative correlation/negative trend/negative relationship. A single comment eg 'The gradient of the line is negative' scores B1B0 (since the mention of line here does not imply that the points form a line)	
	B1	Two correct features Mention of linear relationship/close to a straight line oe Just mentioning the word line is not enough – must imply the points/graph form a (straight) line **and** negative gradient/slope oe allow eg downward gradient for negative gradient Do not allow negative correlation/negative trend/negative relationship. A single comment eg 'The gradient of the line is negative' scores B1B0 (since the mention of line here does not imply that the points form a line)	
(c)	**M1**	Correct method for *b* (implied by awrt –0.69)	
	A1	awrt –0.69 (may be seen in final equation)	
	M1	Correct method to find *a* ft their *b* (implied by awrt 40.4)	
	A1	Fully correct equation must be in terms of *t* and *w* with awrt 40.4 and awrt –0.688. No fractions.	
(d)	**B1ft**	For a numerical interpretation which must mention score (oe) **and** time/minutes (oe) **or** *w* **and** *t*, ft their '–0.688'. Condone eg as score increases by 1, time increases by '–0.688' ft interpretation must be compatible with the sign of their gradient.	
(e)(i)	**B1**	oe allow –0.901	
(ii)	**B1**	oe condone 'halves'	
(iii)	**B1**	oe allow '40.4'	

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Question Number	Scheme	Marks
7 (a)	$\mathrm{P}(C < 570) = 0.5 + \frac{570-550}{650-550} \times 0.25$ or $\frac{x-100}{150-100} = \frac{570-550}{650-550}$	M1
	$= 0.55$	A1
		(2)
(b)	$Q_3 + 1.5 \times (Q_3 - Q_1) = 650 + 1.5 \times 200$	
	$= 950$	B1
		(1)
(c)	Normal distribution is supported as box plot is reasonably **symmetrical** oe	B1
		(1)
(d)	$z = 2$	
	$\mathrm{P}(Z > 2)[= 1 - 0.9772]$	M1
	$= 0.0228$	A1
		(2)
(e)	$1000 = 560 + 2\sigma$ or $1000 > 560 + 2\sigma$	M1
	$\sigma = 220$	A1
		(2)
	Notes	**Total 8**

(a)	**M1**	Correct method $0.5 + p \times 0.25$ where $0 < p < 1$ or attempt to find the number of cabbages weighing less than 570 (implied by $x = 110$)
	A1	0.55 condone awrt 0.55 for 2 out of 2 marks
(b)	**B1**	cao
(c)	**B1**	Supports Normal/Yes (supports assumption) **and** reference to symmetry or no skew eg $Q_3 - Q_2 = Q_2 - Q_1$ oe in words Do not allow mean = median on its own for symmetric
(d)	**M1**	Use of $\mathrm{P}(Z > 2)$ can be implied by sight of awrt 0.977 or sight of awrt 0.0228
	A1	awrt 0.0228 (calculator gives 0.0227501…)
(e)	**M1**	Attempt to use $560 + 2\sigma$ to set up appropriate equation or inequality (allow …) Implied by sight of 220
	A1	allow $\sigma < 220$ or σ „ 220 condone 219.999… but eg 219 as final answer is A0

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