



Mark Scheme (Results)

January 2025

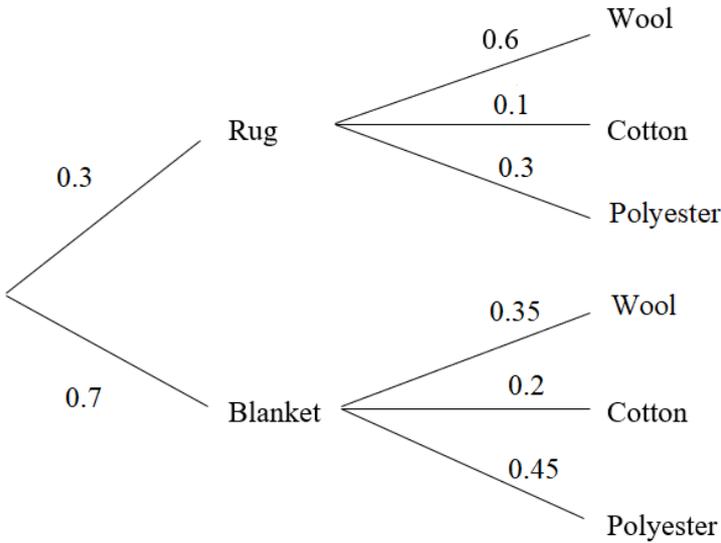
Pearson Edexcel International Advanced Level
In Statistics S1 (WST01) Paper 01

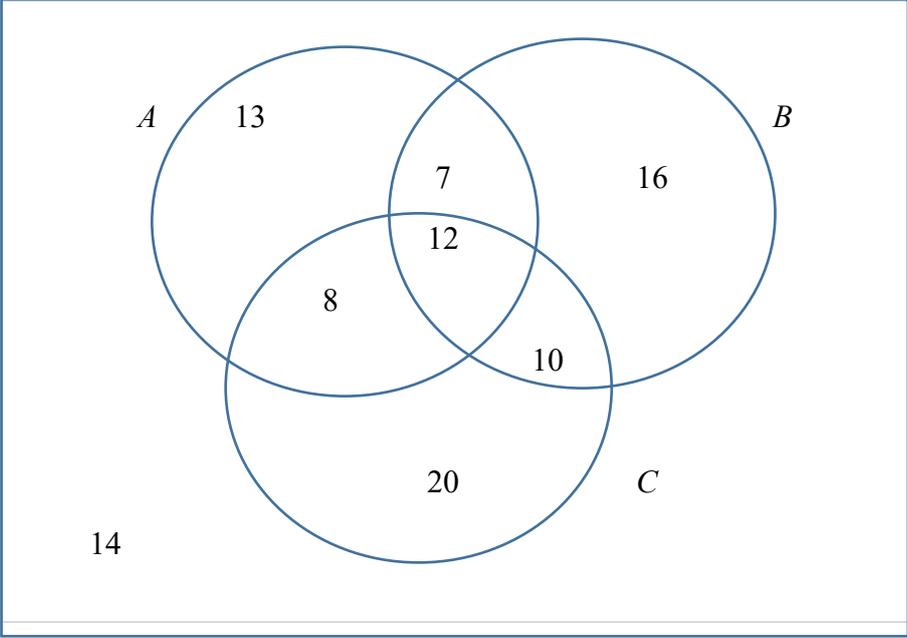
Question Number	Scheme				Marks	
1 (a)	Discrete uniform				B1 (1)	
(b)	$\frac{1}{2}$				B1 (1)	
(c)(i)	[E(R) =] 2.5				B1	
(ii)	[E(B) =] 4				B1 (2)	
(d)	$[E(B^2) =] \frac{1}{4}(1^2 + 3^2 + 5^2 + 7^2) = 21$				M1	
	$\text{Var}(B) = E(B^2) - (E(B))^2 = "21" - "4" ^2$				M1	
	$= 5$				A1	
					(3)	
(e)	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	
	$P(R + B = 5) = \frac{6}{16}$				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	
	$P(R^2 < B) = \frac{5}{16}$				A1 (3)	
(g)	$B = 5 \text{ and } R = 1, B = 7 \text{ and } R = 3 [\rightarrow D = 4]$		$B = 7 \text{ and } R = 2 [\rightarrow D = 5]$		M1	
	$P(D = 4) = \frac{1}{4} \times \frac{1}{4} \times 2 = \frac{1}{8}$		$P(D = 5) = \frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$		A1	
	$p = F(4) = \frac{3}{4} + \frac{1}{8} = \frac{7}{8}$		$p = F(5) - P(D = 5) = \frac{15}{16} - \frac{1}{16} = \frac{7}{8}$		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 $E(B^2)$ at least 3 terms correct (implied by $E(B^2) = 21$). Ignore label. $E(B^2) = \frac{21}{4}$ is M0				
	M1	Correct method to find $\text{Var}(B)$ fit their $E(B^2)$ 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				

(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 1 st A1).
	A1	$P(D = 4) = \frac{1}{8}$ or $P(D = 5) = \frac{1}{16}$ need not be labelled but working/combinations must imply the correct label do not award this mark for $F(4) = \frac{1}{8}$ 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.

Question Number	Scheme		Marks
2 (a)	[Range = 0.87 – 0.21]	= 0.66	B1 (1)
(b)	Median (24 th value) =	= 0.48	B1 (1)
(c)	LQ (12 th value) = 0.35 0.31 = UQ – “0.35” [UQ = 0.66]	$a = \underline{6}$	B1 M1 A1 (3)
(d)	$sd = \sqrt{\frac{13.4228}{47} - \left(\frac{23.72}{47}\right)^2}$ or $S_{xx} = 13.4228 - \frac{23.72^2}{47} [=1.4517...]$ and $sd = \sqrt{\frac{S_{xx}}{47}}$	$= 0.17575... = \underline{0.176^*}$	M1 A1* (2)
(e)(i)	$\frac{\sum y + 23.72}{65} = 0.502$ or $0.502 \times 65 = 32.63$ $32.63 = \sum y + 23.72$	8.91*	M1 A1* (2)
(ii)	$0.204 = \sqrt{\left[\frac{13.4228 + \sum y^2}{65}\right] - 0.502^2}$ or $0.204^2 = \left[\frac{13.4228 + \sum y^2}{65}\right] - 0.502^2$ $\sum y^2 = (0.204^2 + 0.502^2) \times 65 - 13.4228$	$= 5.6625$ awrt 5.66	M1 M1 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 = 35 th value is B0).	
	M1	0.31 = UQ – “0.35” allow any rearrangement of this for M1	
	A1	Condone eg 0.6a for UQ Also allow use of 35 + 31 for this mark (implied by 66 or 0.66) 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 $\sqrt{\quad}$) $\sqrt{\frac{13.4228}{47} - \frac{23.72^2}{47}}$ 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	

	M1	<p>Find $\sum y^2$ using correct order of operations on $a = \sqrt{\frac{b + \sum y^2}{65} - c}$ or $m = \frac{n + \sum y^2}{65} - p$ $b \neq 0, n \neq 0$</p> <p>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)</p>
	A1	awrt 5.66 (SC attempting to use s gives 5.62 send to review)

Question Number	Scheme		Marks
3(a)			B1 B1
(b) (i)	$P(W') = 0.3 \times (0.1 + 0.3) + 0.7 \times (0.2 + 0.45) \quad \text{or} \quad P(W') = 1 - (0.3 \times 0.6 + 0.7 \times 0.35)$ $= \underline{\underline{0.575}}$		(2) M1 A1
(ii)	$P(B W') = \frac{P(B \cap W')}{P(W')} = \frac{0.7 \times (0.2 + 0.45)}{0.575}$		(2) 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%	

Question Number	Scheme		Marks
4(a)			B1 B1 B1ft B1
(b)	$P(A) = \frac{40}{100} \quad P(C) = \frac{50}{100} \quad P(A \cap C) = \frac{20}{100}$ $P(A) \times P(C) = P(A \cap C)$ <p>therefore (A and C are) independent</p>	$P(A) = \frac{40}{100} \quad P(A C) = \frac{20}{50}$ $P(A) = P(A C)$ <p>therefore (A and C are) independent</p>	M1 A1 (2)
(c)(i)	$\left[\frac{'13'+ '16'+ '20'}{100} \right] = \frac{49}{100}$		B1ft (1)
(ii)	$P(\text{likes } B \text{likes } C) = \frac{'12'+ '10'}{'12'+ '10'+ '8'+ '20'}$ $= \frac{22}{50}$		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 ∩ C) or eg P(A) and P(A C)	
	A1	Stating correct test with correct values P(A) × P(C) = P(A ∩ C) or eg P(A) = P(A 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 $\frac{22}{100} \times \frac{50}{100}$ scores M1 Assuming independence is M0 eg $\frac{45}{100} \times \frac{50}{100}$	
	A1	0.44 oe	

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
	$(81 = 2.0244\sigma)$		
	$\sigma = 40.01185$ $\mu = 619.98\dots$		awrt 40 (to 2sf) awrt 620 (to 3sf) A1A1
			(3)
			Total 13
(a)(i)	M1	Attempt to standardise with 640, 700 and 50 allow \pm (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 $724, g, 725$ 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 $724, g, 725$ Allow for just ± 0.5 oe seen as a z -value (not a probability)	
	A1	(dep on 3 rd M1) sight of awrt 0.69 or awrt 0.31	
	A1	(dep on 3 rd 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 3 rd M1) sight of awrt 0.84 or awrt 0.16 A1 (dep on 3 rd M1) awrt 0.683	
		Mark parts (b)(i) and (b)(ii) together	
(b)(i)	M1	$\pm \frac{680 - \mu}{\sigma} = z$ with $1 < z < 2$ or $\pm \frac{599 - \mu}{\sigma} = z$ with $0.5 < z < 0.6$	
	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)	

Question Number	Scheme		Marks
6 (a)	$S_{tt} = 14837 - \frac{635^2}{30} \left(= \frac{8377}{6} = 1396.1666... \right)$		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
	$= -0.68788... \quad \text{awrt } \underline{\mathbf{-0.69}}$		A1
	$a = \frac{635}{30} - (-0.68788...) \times \frac{839}{30} = 40.404... \quad t = 40.4 - 0.688w$		M1 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 '	

Question Number	Scheme		Marks
7 (a)	$P(C < 570) = 0.5 + \frac{570 - 550}{650 - 550} \times 0.25$ 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)	$z = 2$		
	$P(Z > 2) [= 1 - 0.9772]$		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 $P(Z > 2)$ 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 $\sigma \approx 220$ condone 219.999... but eg 219 as final answer is A0	