



Mark Scheme (Results)

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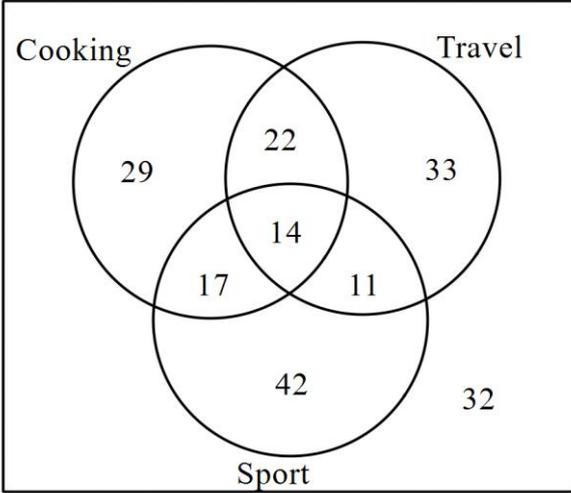
Pearson Edexcel International Advanced Level
In Statistics 1 (WST01) Paper 01

Question Number	Scheme		Marks
1 (a)	[Mode =] 137		B1 (1)
(b)	$a = 106$ $b = 129$ $c = 126$		B1 B1 B1 (3)
(c) (i)	$\left[\text{mean} = \frac{4016}{31} = \right] 129.5$		B1
(ii)	$\left[\text{Standard deviation} = \right] \sqrt{\frac{525056}{31} - \left(\frac{4016}{31}\right)^2}$ or $\sqrt{\frac{31}{30} \left(\frac{525056}{31} - \left(\frac{4016}{31}\right)^2 \right)}$		M1
	= 12.4 or 12.6		A1 (3)
(d)	$\frac{'129.5' - '137'}{'12.4'} [= -0.6]$		M1
	Negative [skew]		A1ft (2)
(e)	A correct difference of the average or a correct difference of the spread e.g. On average action films run for longer than comedy films as the median is greater 129 > 117		B1ft (1)
Notes			Total 10
(a)	B1	Cao Must be seen in part (a)	
(b)	B1	$a = 106$ Must be attached to a (Condone Q_1 /lower quartile for a)	
	B1	$b = 129$ Must be attached to b (Condone Q_2 /median for b)	
	B1	$c = 126$ Must be attached to c (Condone Q_3 /upper quartile for c)	
(c) (i)	B1	awrt 130	
(ii)	M1	For a correct method (including the square root) to find the standard deviation. Ft their mean May be implied by awrt 12.4 or awrt 12.9 or awrt 12.6 if sample standard deviation is calculated	
	A1	awrt 12.4 or awrt 12.6 if sample standard deviation is calculated Correct answer only scores 2/2	
(d)	M1	For substitution of the mode, the mean and the standard deviation into the expression. Ft their mode, their mean and their standard deviation. Allow awrt -0.6 if no working shown.	
	A1ft	A correct interpretation ft their expression. Ignore any reference to correlation	
(e)	B1ft	for a correct comment, referring to length , with reference to a correctly named statistic . Must include the correct figures compared. Ft their values. Ignore any reference to skew	

The following table may be useful (but not an exhaustive list of possible answers)

Statistic	A	C	Comment
Median	129	117	On average action films run for longer as the median is greater 129 > 117
Mean	129.5	114.5	On average action films have a greater running time as the mean is greater 129.5 > 114.5
Mode	137	127	On average comedy films are shorter in length as the mode is less 127 < 137
IQR	17	20	Comedy films have a greater spread of running times as the IQR is greater 20 > 17
Range	57	39	Action films have a larger variation of running times as the range is greater 57 > 39
SD	12.4	11.9	Comedy films show less variability in the length of films as the SD is less 11.9 < 12.4

Question Number	Scheme		Marks
2 (a) (i)	$S_{yy} = 81938.5 - \frac{2015^2}{50} [= 734]^*$		B1*
(ii)	$r = \frac{219.55}{\sqrt{734 \times 72.25}} = 0.95338\dots$	awrt 0.953	M1 A1
			(3)
(b)	e.g. [In general] the longer the rabbit the greater the weight		B1ft
			(1)
(c)	Consistent/Yes as r /PMCC is close to 1		B1ft
			(1)
(d)	$b = \frac{219.55}{734} = 0.2991\dots$		M1 A1
	$a = \left(\frac{125}{50}\right) - 'b' \left(\frac{2015}{50}\right) [= -9.554\dots]$		M1
	$w = -9.55 + 0.299y$		A1
			(4)
(e)	$'-9.55' + '0.299' \times 45 = 3.905$	awrt 3.91	M1 A1ft
			(2)
	Notes		Total 11
(a)(i)	B1*	Answer is given so a correct numerical expression and no incorrect working seen	
(ii)	M1	For use of $\frac{S_{yw}}{\sqrt{S_{yy} \times S_{ww}}}$ May be implied by awrt 0.953	
	A1	awrt 0.953	
(b)	B1ft	A correct interpretation ft their r value (provided that $ r < 1$) e.g as length/ y increases the weight/ w increases Ignore any figures quoted. Do not accept comments about correlation on their own	
(c)	B1ft	A correct statement with a correct reason ft their r value (provided that $ r < 1$) Allow $0.953 \approx 1$ Allow 'my value' to imply r	
(d)	M1	A correct method to find the gradient (May be implied by awrt 0.299 or $\frac{4391}{14680}$)	
	A1	awrt 0.299 (Condone awrt 0.3 if M1 scored) May be implied by a correct gradient in the regression line.	
	M1	A correct method to find the intercept ft their b (May be implied by awrt -9.55)	
	A1	For $w = (\text{awrt}) - 9.55 + (\text{awrt})0.299y$ Must be seen in part (d)	
(e)	M1	For substitution of 45 into their regression equation	
	A1ft	For awrt 3.91 or ft their regression line, provided their final answer is > 0 . If regression line is not correct, then you will need to check their answer	

Question Number	Scheme		Marks
3 (a)			B1 B1 B1 (3)
(b) (i)	$\frac{14}{200}$	B1ft (1)	
(ii)	$\frac{33+11+42+32}{200} = \frac{118}{200}$ or $\frac{200-29-22-14-17}{200} = \frac{118}{200}$	M1 A1 (2)	
(c)	$\frac{14+11}{14+11+22+33} = \frac{25}{80}$	M1 A1 (2)	
Notes			Total 8
(a)	B3	For a fully correct Venn diagram (B2 for at least 6 numbers in the correct place on the Venn diagram) (B1 for at least 3 numbers in the correct place on the Venn diagram) Treat blanks on the diagram as zero Condone correct probabilities instead of frequencies e.g. $\frac{22}{200}$ oe or 0.11 as 22	
(b) (i)	B1ft	For $\frac{14}{200}$ oe ft their Venn diagram	
(ii)	M1	$\frac{33+11+42+32}{200}$ or $\frac{200-29-22-14-17}{200}$ ft their Venn diagram. May be implied by $\frac{118}{200}$ oe	
	A1	For $\frac{118}{200}$ oe	
(c)	M1	$\frac{n}{14+11+22+33}$ provided the answer gives a probability and $0 < n < 80$ ft the Venn diagram for the denominator or $\frac{m}{0.4}$ where $0 < m < 0.4$ ft the Venn diagram for the denominator	$\frac{n}{80}$ provided $0 < n < 80$ ft the Venn diagram for numerator or $\frac{m}{0.4}$ where $0 < m < 0.4$ ft the Venn diagram for numerator
	A1	For $\frac{25}{80}$ oe Allow 0.313	

Question Number	Scheme		Marks
4 (a)	$X \sim N(170, 16^2)$		
	$P(X > 190) = P\left(Z > \frac{190-170}{16}\right) [= P(Z > 1.25)]$		M1
	$[= 1 - 0.8944] = 0.1056$	awrt 0.106	A1
			(2)
(b)	$P(X > d) = 0.9$		
	$\frac{d-170}{16} = -1.2816$ or $\frac{170-d}{16} = 1.2816$ (Calc value $\pm 1.28155\dots$)		M1 A1
	$d = 149.494\dots$	awrt 149	dA1
			(3)
Notes			Total 5
	NB correct answers with no working scores no marks		
(a)	M1	For standardising using 190, 170 and 16 (May be implied by 1.25)	
	A1	awrt 0.106 Do not ISW	
(b)	M1	For standardising and setting = z value, where $1 < z < 2$	
	A1	A fully correct standardisation = a correct compatible z value to 4 dp or better.	
	dA1	Dependent on previous A1 149.5 or awrt 149	

Question Number	Scheme		Marks
5 (a)	[Time is] continuous		B1 (1)
(b)	16 photographers = 160 small squares or 64 photographers = 640 small squares or $\frac{16}{160} = 0.1$ or $\frac{64}{640} = 0.1$ or $\frac{160}{16} = 10$ or $\frac{640}{64} = 10$ Frequency density = 1.6 or Correct scale on the frequency density axis		M1
	$\frac{x}{240} = \frac{16}{160}$ oe or $\frac{(20-12)}{10} \times 16 + \frac{(24-20)}{5} \times 14$		M1
	= 24		A1 (3)
(c)	Using n $[Q_2 =] 20 + \frac{(32-21)}{35-21} \times (25-20)$ oe or $25 - \frac{35-32}{35-21} \times (25-20)$ oe = awrt 23.9	Using $n + 1$ $[Q_2 =] 20 + \frac{(32.5-21)}{35-21} \times (25-20)$ oe or $25 - \frac{35-32.5}{35-21} \times (25-20)$ oe = awrt 24.1	M1 A1 (2)
	(d)	Mean = Median or Mean \approx Median e.g. Appropriate decision. Consistent with expectation for a normal distribution.	M1 A1ft (2)
Notes			Total 8
(a)	B1	Allow not discrete	
(b)	M1	For establishing a ratio between photographers and area or calculating frequency density (may be implied by 2 nd M1)	
	M1	For a correct ratio or expression using areas for photographers from 12 to 24	
	A1	Cao	
(c)	M1	For a correct method to find median using either n or $n + 1$	
	A1	awrt 23.9 or awrt 24.1 if using $n + 1$	
(d)	M1	For a correct comment about mean and median ft their median Allow mean is close to median to imply mean \approx median Ignore any comments made about the shape of the histogram	
		For a correct compatible comment about Charlie's decision ft their median If Mean = Median or Mean \approx Median, then the decision should be that a normal distribution is suitable [due to symmetry] If Mean < Median or Mean > Median or mean \neq median, then the decision should be that a normal distribution is not suitable [due to the skew in the data]	A1ft

Question Number	Scheme							Marks
6(a)	$[10k = 1 \Rightarrow] k = 0.1$							B1
								(1)
(b)	e.g. $P(X = 1) = 0.1$ and $P(X = 2) [= F(2) - F(1)] = 0.1$							B1
	e.g. $P(X = 3) [= F(3) - F(2)] = 0.1$							M1
	X	1	2	3	4	5	6	A1
	P(X = x)	0.1	0.1	0.1	0.2	0.2	0.3	(3)
(c)	$a + a + a + b + b + b + 0.11 + 0.05 = 1$ [$3a + 3b = 0.84$]							M1
	$a + 2a + 3a + 4b + 5b + 6b + 0.77 + 0.4 = 4.02$ [$\Rightarrow 6a + 15b = 2.85$]							M1
	e.g. $9a = 1.35 \Rightarrow a = 0.15^*$							A1*
								(3)
(d)	$b = 0.13$							
	$E(Y^2) = 1^2 \times 0.15 + 2^2 \times 0.15 + 3^2 \times 0.15 + 4^2 \times '0.13' + 5^2 \times '0.13' + 6^2 \times '0.13'$ $+ 7^2 \times 0.11 + 8^2 \times 0.05 = [20.7]^*$							M1 A1*
								(2)
(e)	$[\text{Var}(Y) =] 20.7 - 4.02^2 [= 4.5396]$							M1
	$\text{Var}(5 - 2Y) = 4\text{Var}(Y) = 4 \times '4.5396' = 18.1584$ awrt 18.2							M1 A1
								(3)
(f)	$'0.1' \times 0.15 + '0.1' \times 0.15 = 0.03$							M1 A1
								(2)
Notes								Total 14
(a)	B1	For $k = 0.1$ oe						
(b)	B1	For correct use of F(x) to find 2 probabilities May be implied by two correct probabilities						
	M1	For correct use of F(x) to find one other probability. May be implied by one other correct probability						
	A1	For a fully correct probability distribution. Need not be in a table but probabilities must be attached to the correct X values						
(c)	M1	For use of the sum of the probabilities = 1 to form a linear equation in a and b (May be implied by $3a + 3b = 0.84$)						
	M1	For use of $\sum y \times P(Y = y) = 4.02$ to form a linear equation in a and b (May be implied by $6a + 15b = 2.85$)						
	A1*	Answer is given so there must be a correct line between the 2 equations and the given answer						
(d)	M1	For finding $E(Y^2)$ with their b (At least 4 correct terms). Values for a and b must be substituted into their expression for $E(Y^2)$						
	A1*	For a fully correct expression (no incorrect working seen) eg. $14 \times 0.15 + 77 \times 0.13 + 49 \times 0.11 + 64 \times 0.05$ Allow $0.15 + 0.6 + 1.35 + 2.08 + 3.25 + 4.68 + 5.39 + 3.2$						
(e)	M1	For a correct expression for $\text{Var}(Y)$. May be implied by awrt 4.54 Allow $E(5 - 2Y) = -\frac{76}{25}$ oe and $E((5 - 2Y)^2) = \frac{137}{5}$						
	M1	For use of $4\text{Var}(Y)$ ft their $\text{Var}(Y)$ provided $\text{Var}(Y)$ is not 20.7 or 4.02 Do not allow $5 + 4\text{Var}(Y)$ Allow $\text{Var}(5 - 2Y) = \frac{137}{5} - \left(-\frac{76}{25}\right)^2$ ft their $E(5 - 2Y)$ and their $E((5 - 2Y)^2)$						
	A1	awrt 18.2						
(f)	M1	For use of $P(X = 1) \times P(Y = 2) + P(X = 2) \times P(Y = 1)$ ft their X distribution probabilities						
	A1	Cao						

Question Number	Scheme		Marks	
7 (a)			$\frac{n}{2n+1}$ and $\frac{n+1}{2n+1}$ in the correct places on the tree diagram	B1
			$\frac{n-1}{2n}$ and $\frac{n+1}{2n}$ in the correct places on the tree diagram	B1
			$\frac{n}{2n}$ and $\frac{n}{2n}$ in the correct places on the tree diagram	B1
(3)				
(b)	$\frac{n}{2n+1} \times \frac{n+1}{2n} + \frac{n+1}{2n+1} \times \frac{n}{2n}$		M1	
	$= \frac{2n(n+1)}{2n(2n+1)} = \frac{n+1}{2n+1}$ *		A1*	
(2)				
(c)	$\frac{n+1}{2n+1} = \frac{25}{49} \Rightarrow n = 24$ So 49 counters in the box		M1 A1	
(2)				
(d)	$\frac{\frac{25}{49} \times \frac{24}{48}}{\frac{25}{49}} = \frac{1}{2}$		M1 A1	
(2)				
Notes			Total 9	
(a)	B1	For $\frac{n}{2n+1}$ and $\frac{n+1}{2n+1}$ in the correct places on the tree diagram		
	B1	For $\frac{n-1}{2n}$ and $\frac{n+1}{2n}$ in the correct places on the tree diagram		
	B1	For $\frac{n}{2n}$ and $\frac{n}{2n}$ in the correct places on the tree diagram. Allow $\frac{1}{2}$ for $\frac{n}{2n}$ in both places		
(b)	M1	For use of $P(\text{Red}) \times P(\text{Black}) + P(\text{Black}) \times P(\text{Red})$ ft their tree diagram		
	A1*	Answer is given so no incorrect working can be seen. Must have at least one correct line of working between M1 and the given answer.		
(c)	M1	For solving to find $n = 24$		
	A1	Cao		
(d)	M1	For a correct ratio ft their n and their tree diagram Allow a correct ratio in terms of n e.g. $\frac{n+1}{2n+1} \times \frac{n}{2n}$ oe ft their tree diagram for the numerator $\frac{n+1}{2n+1}$		
	A1	For 0.5 (Working must be seen)		

Question Number	Scheme		Marks	
8 (a)	$\frac{162 - \mu}{\sigma} = -1.2816$ (Calculator gives $-1.28155\dots$)		M1 A1 A1	
	or $\frac{175 - \mu}{\sigma} = 1.04$ (Calculator gives $1.03987\dots$)			
	$\mu - 1.2816\sigma = 162$			
	$\mu + 1.04\sigma = 175$			
	$2.3216\sigma = 13$		dM1	
	$\sigma = 5.5995\dots$ awrt 5.6 $\mu = 169.1764\dots$ awrt 169		A1	
				(5)
(b)	$Q_1 = 208.26$ or $Q_3 - Q_1 = 13.48$		B1	
	$221.74 + 1.5(221.74 - 'Q_1') [= 241.96]$ or $'Q_1' - 1.5(221.74 - 'Q_1') [= 188.04]$		M1	
	Probability of an outlier		1 – Probability of not an outlier	
	$[P(B > '241.96') =]$		dM1	
	$P\left(Z > \frac{'241.96' - 215}{10}\right) [= P(Z > 2.70)]$			
	or			
	$[P(B < '188.04') =]$			
	$P\left(Z < \frac{'188.04' - 215}{10}\right) [= P(Z < -2.70)]$			
	or			
	$= 0.0035$ (Calculator gives $0.0034883\dots$)		$= 0.993$ (Calculator gives $0.99298\dots$)	
$P(\text{Outlier}) = 2 \times '0.0035'$		$P(\text{Outlier}) = 1 - '0.993'$	M1	
$= 0.007$ (Calculator gives $0.006976\dots$) awrt 0.007		$= 0.007$ (Calculator gives $0.007017\dots$) awrt 0.007	A1	
			(5)	
Notes			Total 10	
(a)	M1	For standardising with μ and σ and setting = to a z value with $ z > 1$		
	A1	For one correct equation in any form with correct z value as given or better		
	A1	For a 2 nd correct equation in any form allow 2dp or better for the z value		
	dM1	Dependent on previous M1. For solving their 2 linear simultaneous equations (Can be implied by both correct answers) If answers are incorrect then we need to see evidence of correct working		
	A1	For $\mu =$ awrt 169 and $\sigma =$ awrt 5.6		
(b)	B1	For $Q_1 = 208.26$ or $Q_3 - Q_1 = 13.48$ Do not accept rounded values		
	M1	For a correct method for finding 1 outlier limit, ft their Q_1 or their IQR. You will need to check that these are correct if no working shown.		
	dM1	Dependent on previous M1. For standardising using their limit(s), 215 and 10 (allow \pm) May be implied by \pm awrt 2.70 or awrt 0.0035 or awrt 0.993 or final answer of awrt 0.007		
	M1	If using the LHS of the MS: for multiplying their probability by 2 or If using the RHS of the MS: for 1 – their probability May be implied by awrt 0.007		
	A1	awrt 0.007		