

4732 Probability & Statistics 1

Note: “(3 sfs)” means “answer which rounds to ... to 3 sfs”. If correct ans seen to ≥ 3 sfs, ISW for later rounding
 Penalise over-rounding only once in paper.

1ia	$5!$ or 5P_5 $= 120$	M1 A1 2	
b	$4!$ or 4P_4 seen $4! \times 2$ 48	M1 M1dep A1 3	or $2 \times 3!$ or $2! \times 3!$ or $2! \times {}^3P_3$ $2 \times 3! \times 4$
ii	${}^{1/5}C_2$ or ${}^{1/5} \times {}^{1/4} \times 2$ or 0.4×0.25 or ${}^2/_{5P2}$ $= 1/10$	M1 A1 2	Allow M1 for 5C_2 or ${}^{1/5} \times {}^{1/4}$ or ${}^{1/20}$ or ${}^{1/5} \times {}^{1/5} \times 2$ or ${}^2/_{25}$ oe
Total		7	
2i	$(\frac{4}{5})^3 \times (\frac{1}{5})$ oe $= \frac{64}{625}$ or 0.102 (3 sfs)	M1 A1 2	Allow M1 for $(\frac{4}{5})^4 \times (\frac{1}{5})$
ii	$(\frac{4}{5})^4$ alone or $1 - (\frac{1}{5} + \frac{4}{5} \times \frac{1}{5} + (\frac{4}{5})^2 \times \frac{1}{5} + (\frac{4}{5})^3 \times \frac{1}{5})$ $= \frac{256}{625}$ or 0.410 (3 sfs)	M1 A1 2	Allow $(\frac{4}{5})^3$ or $(\frac{4}{5})^5$; not $1 - (\frac{4}{5})^4$ Allow one term omitted or wrong or “correct” extra
iii	5	B1 1	
Total		5	
3i	$r = \frac{212 - \frac{24 \times 39}{5}}{\sqrt{(130 - \frac{24^2}{5})(361 - \frac{39^2}{5})}}$	B2 2	$\frac{24.8}{\sqrt{14.8 \times 56.8}}$ or $\frac{24.8}{\sqrt{840.64}}$ or $\frac{24.8}{3.85 \times 7.54}$ or $\frac{24.8}{29}$ B2 for correct subst in r B1 for correct subst in any S
ii	$R = 0.7$ or (B) Definition of r_s is PMCC for ranks	B1 B1 2	(A) and (B) true: B0B0 dep 1 st B1
iii	$r = 0.855$ $r_s = 0.7$	B1 B1 2	or “unchanged”: B1B1 Interchanged: B1
Total		6	
4i	$0.4 \times p = 0.12$ or ${}^{0.12}/_{0.4}$ or ${}^{12}/_{40}$ oe $p = 0.3$ oe	M1 A1 2	
ii	$0.4 \times (1 - \text{their } 0.3)$ oe eg ${}^{40}/_{100} \times {}^{28}/_{40}$ 0.28 or 28% oe	M1 A1ft 2	or $0.4 - 0.12$ or 0.28 or 28 seen Not 0.4×0.88 unless ans to (i) is 0.12
Total		4	
5ia	Binomial stated or implied 0.9806	B1 B1 2	by use of tables or $0.2^a \times 0.8^b$, $a+b = 12$
b	0.5583 seen $1 - 0.5583$ $= 0.442$ (3 sfs)	M1 M1 A1 3	add 10 corr terms or 1-(add 3 corr terms): M2 or $1 - 0.7946$ or 0.205 or $1 - 0.6774$ or 0.323 or $1 - 0.3907$ or 0.609 or add 9 terms or 1-(add 2 or 4 terms): M1
ii	${}^{15}C_4 \times 0.3^4 \times 0.7^{11}$ $= 0.219$ (3 sfs)	M2 A1 3	${}^{15}C_4 \times 0.3^{11} \times 0.7^4$: M1
Total		8	

6i	Σyp $= 2.3$ $\Sigma y^2 p$ (= 5.9) $-(\Sigma yp)^2$ $= 0.61$ oe	M1 A1 M1 M1 A1 5	≥ 2 terms added $\div 3$ or $\div 6$ etc: M0 ≥ 2 terms added $\div 3$ or $\div 6$ etc: M0 dep +ve result $(-1.3)^2 \times 0.2 + (-0.3)^2 \times 0.3 + 0.7^2 \times 0.5$: M2 one term correct: M1 Use of Z: MR, lose last A1 (2.55, 0.4475)
ii	$0.2 \times 0.25 + 0.3 \times 0.1$ or $0.05 + 0.03$ alone $= 0.08$ oe	M2 A1 3	M1 for one product eg correct $\times 2$: M1 or clearly ident (1,2), (2,1): M1
iii	$0.3 \times 0.1 + 0.3 \times 0.25 + 0.3 \times 0.65$ $+ 0.25 \times 0.2 + 0.25 \times 0.5$ alone or $0.03 + 0.075 + 0.195 + 0.05 + 0.125$ $= 0.475$ or $^{19}/_{40}$ oe	M2 A1 3	M1 : any 3, 4 of these prods alone or these 5 prods plus 1 extra or repeat or (ii) + prod or $0.3 + \text{prod}$ or $0.25 + \text{prod}$ or clearly identify (1,2) (3,2) (2,2) (2,1) (2,3) M2 for $0.3 + (0.2 + 0.5) \times 0.25$ or $0.25 + (0.1 + 0.65) \times 0.3$ or $0.3 + 0.25 - 0.3 \times 0.25$ or $1 - (0.2 + 0.5)(0.1 + 0.65)$ M1 for $(0.2 + 0.5)(0.1 + 0.65)$
Total		11	
7ia	Results or matches are indep Prob of winning is constant	B1 B1 2	allow "wins" indep; not "trials" indep not "success"
ib	No of wins (or losses)	B1 1	
ii	${}^{21}C_{10} p^{10} q^{11} = {}^{21}C_9 p^9 q^{12}$ $\frac{12}{10} p = q$ or $\frac{12p(1-p)^{-1}}{10} = 1$ or similar $1.2p = 1 - p$ oe eg $p = 0.833(1-p)$ or $352716p = 293930(1-p)$ $p = \frac{5}{11}$ or 0.455 (3 sfs) oe	M1 M1M1 M1 A1 5	or $(1 - p)$ for q & allow omit bracket or $352716p^{10}q^{11} = 293930p^9q^{12}$ M1 for $^{12}/_{10}$ or $^{6}/_5$ or 1.2 or $^{5}/_6$ or 0.833 M1 for p & q cancelled correctly or equiv equn in p or q (cancelled) nos not nec'y cancelled; not alg denom
Total		8	

8i	$m = 26.5$ <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>LQ = 22</td> <td>or 21.5</td> <td>or 21.75</td> </tr> <tr> <td>UQ = 39</td> <td>40</td> <td>39.5</td> </tr> <tr> <td>IQR = 17</td> <td>18.5</td> <td>17.75</td> </tr> </table>	LQ = 22	or 21.5	or 21.75	UQ = 39	40	39.5	IQR = 17	18.5	17.75	B1 M1 A1 3	M1 for either LQ or UQ A1 must be consistent LQ, UQ & IQR
LQ = 22	or 21.5	or 21.75										
UQ = 39	40	39.5										
IQR = 17	18.5	17.75										
ii	Ave or overall or med or "it" similar Male spread greater or M more varied oe	B1f B1f 2	or F med (or ave) higher or F mean less or M & F both have most in 20s or male range greater or more younger F or more older M									
iii	Med less (or not) affected by extreme(s) or Mean (more) affected by extreme(s)	B1 1	oe; not "anomalies" ignore eg "less accurate"									
iv	<u>Decode last</u> $245/49$ $= 5$ mean = 205 $\sqrt{(9849/49 - (245/49)^2)}$ $= 13.3$ (3sfs) or $4\sqrt{11}$ sd = 13.3 or $4\sqrt{11}$ <u>Decode first</u> $245 + 200 \times 49$ or 10045 B1 $10045/49$ M1 $= 205$ A1 $\Sigma x^2 = 9849 + 400 \times 10045 - 49 \times 40000$ or 2067849 B1 $\sqrt{\frac{\Sigma x^2}{49} - \bar{x}^2}$ M1 $= 13.3$ or $4\sqrt{11}$ A1	M1 A1 B1f M1 A1 B1f 6	must consistently decode last or first $200 + "5"$ dep $\sqrt{+ve}$ dep M1 or ans 176; award if not +200 allow $445/49$ or 9.08 seen dep $\sqrt{+ve}$ Σx^2 must be: attempt at $\Sigma x^2 > 9849$ not involve 9849^2 not $(\Sigma x)^2$ eg $10045^2, 445^2$ \bar{x} must be decoded attempt, eg 9.08									
Total		12										
9i	Because growth may depend on pH oe or expt is investigating if y depends on x	B1 1	In context. Not x is controlled or indep									
ii	$S_{xy} = 17082.5 - 66.5 \times 1935/8 (= 997.8125)$ $S_{xx} = 558.75 - 66.5^2/8 (= 5.96875)$ $b = S_{xy}/S_{xx}$ $= 167$ (3 sfs) $y - 1935/8 = "167"(x - 66.5/8)$ $y = -1150 + 167x$	M1 A1 M1 A1 4	Correct sub into any correct b formula or $a = 1935/8 - "167" \times 66.5/8$ cao NB 3 sfs									
iii	$y = -1150 + 167x$ $= 19$ to 23	M1 A1 2	ft their eqn for M1 only									
iv	No (or little) relationship or correlation	B1 1	or weak or small corr'n. Not "agreement"									
va	Reliable as r high oe	B1 1	Allow without "interpolation" oe, but must include r high									
b	Unreliable as extrapolation oe	B1 1	or unreliable as gives a neg value									
vi	Unreliable (or No) because r near 0 or because little (or no or small) corr'n (or rel'n)	B1 1	or No because Q values vary widely for pH = 8.5									
Total		11										

Total 72 marks