4732 Probability & Statistics 1

Note: "(3 sfs)" means "answer which rounds to ... to 3 sfs". If correct ans seen to ≥ 3sfs, 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! × 2 48	M1 M1dep A1 3	or 2 × 3! or 2! × 3! or 2! × ${}^3P_3$ 2 × 3! × 4
ii	${}^1/_5C_2$ 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 ${}^1/_5$ x ${}^1/_4$ or ${}^1/_{20}$ or ${}^1/_5 \times {}^1/_5 \times 2$ or ${}^2/_{25}$ oe
Total		**7**	
2i	$({}^4/_5)^3 \times ({}^1/_5)$ oe = ${}^{64}/_{625}$ or 0.102 (3 sfs)	M1 A1 2	Allow M1 for $({}^4/_5)^4$ x $({}^1/_5)$
ii	$({}^4/_5)^4$ alone or $1-({}^1/_5 + {}^4/_5 x\ {}^1/_5 + ({}^4/_5)^2 x\ {}^1/_5 + ({}^4/_5)^3 x\ {}^1/_5)$ = ${}^{256}/_{625}$ or 0.410 (3 sfs)	M1 A1 2	Allow $({}^4/_5)^3$ or $({}^4/_5)^5$; not 1 - $({}^4/_5)^4$ Allow one term omitted or wrong or "correct" extra Allow 0.41
iii	5	B1 1	
Total		**5**	
3i	$r = \dfrac{212 - \dfrac{24 \times 39}{5}}{\sqrt{(130 - \dfrac{24^2}{5})(361 - \dfrac{39^2}{5})}}$	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 1st B1
iii	$r = 0.855$ $r_s = 0.7$	B1 B1 2	or "unchanged": B1B1 Interchanged: B1
Total		**6**	
4i	0.4 x p = 0.12 or ${}^{0.12}/_{0.4}$ or ${}^{12}/_{40}$ oe p = 0.3 oe	M1 A1 2	
ii	0.4 x (1 – 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 x 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	${}^{15}C_4$ x 0.3^4 x 0.7^{11} = 0.219 (3 sfs)	M2 A1 3	${}^{15}C_4$ x 0.3^{11} x 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	$\geq$ 2 terms added ÷ 3 or ÷ 6 etc: M0 $\geq$ 2 terms added ÷ 3 or ÷ 6 etc: M0 dep +ve result $(-1.3)^2\times0.2+(-0.3)^2\times0.3+0.7^2\times0.5$: M2 one term correct: M1 Use of Z: MR, lose last A1 (2.55, 0.4475)
ii	0.2x0.25 + 0.3x0.1 or 0.05 + 0.03 alone $= 0.08$ oe	M2 A1 3	M1 for one product eg correct×2: M1 or clearly ident (1,2), (2,1): M1
iii	$0.3\times0.1 + 0.3\times0.25 + 0.3\times0.65$ $+ 0.25\times0.2 + 0.25\times0.5$ 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 + prod or 0.25 + prod or clearly identify (1,2) (3,2) (2,2) (2,1) (2,3) M2 for 0.3 + (0.2 + 0.5) × 0.25 or 0.25 + (0.1 + 0.65) × 0.3 or 0.3 + 0.25 – 0.3 × 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	$^{21}C_{10}p^{10}q^{11} = {}^{21}C_9p^9q^{12}$ $\frac{12}{10}p = q$ or $\frac{12}{10}p(1-p)^{-1} = 1$ or similar $1.2p = 1 - p$ oe eg $p = 0.833(1-p)$ or $352716p = 293930(1-p)$ $p = {}^5/_{11}$ or 0.455 (3 sfs) oe	 M1 M1M1 M1 A1 5	or $(1-p)$ for q & allow omit bracket or $352716\,p^{10}q^{11} = 293930\,p^9q^{12}$ 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 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
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	 Decode last 245/49 = 5 mean = 205 $\sqrt{(9849/49 - (^{245}/_{49})^2)}$ = 13.3 (3sfs) or $4\sqrt{11}$ sd = 13.3 or $4\sqrt{11}$ Decode first 245 + 200×49 or 10045 B1 $^{10045}/_{49}$ M1 = 205 A1 $\Sigma x^2 = 9849+400\times10045-49\times40000$ 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 √+ve dep M1 or ans 176; award if not +200 allow $^{445}/_{49}$ or 9.08 seen dep √+ve Σx^2 must be: attempt at Σx^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" x 66.5/8 cao NB 3 sfs
iii	$y = -1150 + 167 \times 7$ = 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