

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.

1(i)	(a) -1 (b) 0	B1 B1 2	allow ≈ -1 or close to -1 not “strong corr’n”, not -0.99 allow ≈ 0 or close to 0 not “no corr’n”
(ii)	$\begin{array}{ccccc} 4 & 3 & 2 & 1 & \text{or } 1 & 2 & 3 & 4 \\ 1 & 3 & 4 & 2 & & 4 & 2 & 1 & 3 \\ \Sigma d^2 & & & & & (= 14) \\ 1 - \frac{6\Sigma d^2}{4(4^2-1)} \\ = -0.4 \text{ oe} \end{array}$	M1 A1 M1 M1 A1 5	Ranks attempted, even if opp Dep M1 or $S_{xy} = 23 \cdot 100/4$ or $S_{xx} = S_{yy} = 30 \cdot 100/4$ Dep 2 nd M1 $S_{xy}/\sqrt{(S_{xx}S_{yy})}$
Total		7	
2(i)	$\frac{{}^7C_2 \times {}^8C_3}{{}^{15}C_5}$ $= {}^{56}/_{143} \text{ or } {}^{1176}/_{3003} \text{ or } 0.392 \text{ (3 sfs)}$	M1 M1 A1 3	${}^7C_2 \times {}^8C_3$ or 1176 : M1 $(\text{Any C or P})/{}^{15}C_5$: M1 (dep < 1) or $\frac{7}{15} \times \frac{6}{14} \times \frac{8}{13} \times \frac{7}{12} \times \frac{6}{11}$ or 0.0392: M1 $\times {}^5C_2$ or $\times 10$: M1 (dep ≥ 4 probs mult) if 2 \leftrightarrow 3, treat as MR max M1M1
(ii)	$3! \times 2!$ or ${}^3P_3 \times {}^2P_2$ not in denom $= 12$	M1 A1 2	BABAB seen: M1 120-12: M1A0 NB $4!/2! = 12$: M0A0
Total		5	
3(i)(a)	0.9368 or 0.937	B1 1	
(b)	$0.7799 - 0.5230$ or ${}^8C_5 \times 0.45^3 \times 0.55^5$ $= 0.2569$ or 0.2568 or 0.257	M1 A1 2	Allow 0.9368 – 0.7799
(c)	0.7799 seen – 0.0885 (not 1 – 0.0885) $= 0.691$ (3 sfs)	M1 M1 A1 3	${}^8C_5 \times 0.45^3 \times 0.55^5 + {}^8C_4 \times 0.45^3 \times 0.55^4 + {}^8C_3 \times 0.45^3 \times 0.55^3$: M2 1 term omitted or wrong or extra: M1
(ii)(a)	${}^{10}C_2 \times ({}^7/_{12})^8 \times ({}^5/_{12})^2$ seen $= 0.105$ (3 sfs)	M1 A1 2	or 0.105 seen, but not ISW for A1
(b)	$2^{31/72}$ or ${}^{175}/_{72}$ or 2.43 (3 sfs)	B1 1	NB ${}^{12}/_5 = 2.4$: B0
Total		9	
4(i)	${}^{1/20} \times {}^{1/10}$ or ${}^{1/200}$ or 0.005 $\times 2$ $= {}^{1/100}$ or 0.01	M1 M1dep A1 3	
(ii)	$E(X) = 0 + 50 \times {}^{1/10} + 500 \times {}^{1/20}$ or $0 + 0.5 \times {}^{1/10} + 5 \times {}^{1/20}$ $= 30p$ = £0.30 or ${}^3/_{10}$ Charge “30p” + 20p or 0.3 + 0.2 $= 50p$ or 0.50 or 0.5	M1 A1 M1 A1 4	or eg 20 goes: $2 \times £0.50 + £5.00$ $= £6.00$ $(“£6.00” + 20 \times £0.20) \div 20$ condone muddled units eg 0.3 + 20 $x = 20, 70, 520$: M1A1 $20 \times {}^{17}/_{20} + 70 \times {}^{1/10} + 520 \times {}^{1/20}$: M1 $= 50$: A1 $x, (x - 50), (x - 500)$: M1A1 $x \times {}^{17}/_{20} + (x - 50) \times {}^{1/10} + (x - 500) \times {}^{1/20} = 20$: M1 $x = 50$: A1 Ignore “£” or “p”
Total		7	

5(i)	$^{12}_{22} \times ^{11}_{21}$ $= \frac{2}{7}$ oe or 0.286 (3 sfs)	M1 A1 2	or $^{12}C_2 / ^{22}C_2$
(ii)	$\frac{7}{15} \times \frac{6}{14} \times \frac{8}{13}$ or $\frac{8}{65}$ oe $\times 3$ oe $= \frac{24}{65}$ or 0.369 (3 sfs)	M1 M1 A1 3	Numerators any order $^7C_2 \times ^8C_1$:M1 3 x prod any 3 probs (any C or P) $^{15}C_3$:M1 (dep <1) $1 - (\frac{8}{15} \times \frac{7}{14} \times \frac{6}{13} + 3 \times \frac{8}{15} \times \frac{7}{14} \times \frac{7}{13} + \frac{7}{15} \times \frac{6}{14} \times \frac{5}{13})$: M2 one prod omitted or wrong: M1
(iii)	$\frac{x}{45} \times \frac{x-1}{44} = \frac{1}{15}$ oe $x^2 - x - 132 = 0$ or $x(x-1) = 132$ $(x-12)(x+11) = 0$ or $x = \frac{1 \pm \sqrt{1^2 - 4 \times (-132)}}{2}$ No. of Ys = 12	M1 A1 M1 A1 4	not $\frac{x}{45} \times \frac{x}{44} = \frac{1}{15}$ or $\frac{x}{45} \times \frac{x}{45} = \frac{1}{15}$ or $\frac{x}{45} \times \frac{x-1}{45} = \frac{1}{15}$ oe ft 3-term QE for M1 condone signs interchanged allow one sign error Not $x = 12$ or -11 ans 12 from less wking, eg $12 \times 11 = 132$ or T & I: full mks Some incorrect methods: $\frac{x}{45} \times \frac{x-1}{44} = \frac{1}{15}$ oe M1 $x^2 + x = 132$ A0 $x = 11$ M1A0 $12 \times 11 = 132$ M1A1M1 $x = 12$ and (or “or”) 11 A0 NB 12 from eg 12.3 rounded, check method
Total		9	

6(i)(a)	256	B1 1	
(b)	Total unknown or totals poss diff or Y13 may be smaller or similar or size of pie chart may differ	B1 1	(i)(b) & (ii)(abc): ISW ie if correct seen, ignore extras pie chart shows only proportions oe or no. of students per degree may differ not "no. of F may be less" not "Y13 may be larger"
(ii)(a)	B&W does not show frequencies oe	B1 1	or B&W shows spread or shows mks or M lger range
(b)	F generally higher or median higher F higher on average or F better mks F IQR is above M IQR F more compact M wide(r) range or gter IQR or gter variation or gter variance or more spread or less consistent M evenly spread or F skewed	B1 B1 2	1 mk about overall standard, based on median or on F's IQR being "higher" 1 mk about spread (or range or IQR) or about skewness. must be overall, not indiv mks must be comparison, not just figures Examples: not F higher mean not M have hiest and lowest mks condone F +ve skew
(c)	<u>Advantage:</u> B&W shows med or Qs or IQR or range or hiest & lowest or key values <u>Disadvantage:</u> B&W loses info' B&W shows less info' B&W not show freqs B&W not show mode B&W: outlier can give false impression hist shows more info hist shows freqs or fds hist shows modal class (allow mode) hist shows distribution better can calc mean from hist	B1 B1 2	not B&W shows skewness not B&W shows info at a glance not B&W easier to compare data sets not B&W shows mean not B&W shows spread not B&W easier to calculate or easier to read not B&W does not give indiv (or raw) data not B&W does not show mean not hist shows freq for each mark not hist shows all the results not hist shows total allow adv of hist as disadv of B&W
(iii)	102 x 51 + 26 x 59 ÷ 128 = 52.6 (3 sfs)	M1 M1dep A1 3	or 5202 + 1534 or 6736
Total		10	

7(i)	Geo stated $0.7^3 \times 0.3$ $\frac{1029}{10000}$ oe or 0.103 (3 sfs)	M1 M1 A1 3	or implied by $0.7^7 \times 0.3$ or $0.3^7 \times 0.7$ Allow $0.7^4 \times 0.3$
(ii)	0.7^6 alone = 0.118 (3 sfs)	M1 A1 2	$1 - (0.3 + 0.3 \times 0.7 + \dots + 0.3 \times 0.7^5)$ not $1 - 0.7^6$
(iii)	0.7^9 $1 - 0.7^9$ 0.960 (3 sfs)	M1 M1 A1 3	not 0.3×0.7^9 allow $1 - 0.7^{10}$ or 0.972 for M1 allow 0.96, if no incorrect wking seen $0.3 + 0.7 \times 0.3 + \dots + 0.7^8 \times 0.3$: M2 1 term omitted or wrong or "correct" extra: M1
(iv)	Bin stated ${}^5C_2 \times 0.7^3 \times 0.3^2$ or 0.8369 – 0.5282 = 0.3087 or 0.309 (3 sfs)	M1 M1 A1 3	or implied by table or nC_r or $0.7^3 \times 0.3^2$ or 0.0309
Total		11	
8(i)	$\frac{168.6 - \frac{88 \times 16.4}{8}}{\sqrt{(1136 - \frac{88^2}{8})(34.52 - \frac{16.4^2}{8})}}$ = -0.960 (3 sfs)	M2 A1 3	$(= \frac{-11.8}{\sqrt{168 \times 0.9}})$ M1: correct subst in any correct S formula M2: correct substn in any correct r formula allow -0.96, if no incorrect wking seen
(ii)	must refer to, or imply, external constraint on x e.g x is controlled or values of x fixed or chosen allow x is fixed	B1 1	not x is not random not x affects y not x not affected by y not x goes up same amount each time not charge affects no. of vehicles not x not being measured
(iii)	$\frac{168.6 - \frac{88 \times 16.4}{8}}{1136 - \frac{88^2}{8}}$ = -0.0702 (3 sfs) or $^{-59/840}$ or $^{-11.8/168}$ $y - \frac{16.4}{8} = "-0.0702"(x - \frac{88}{8})$ $y = -0.07x + 2.8$ or better	M1 A1 M1 A1 4	ft their S_{xy} and S_{xx} incl $\frac{168.6}{1136}$ if used in (i) or -0.07 if no incorrect wking or $a = \frac{16.4}{8} - ("-0.0702") \times \frac{88}{8}$ or $\frac{2371}{840}$ oe eg $y = \frac{-59}{840}x + \frac{2371}{840}$
(iv)(a)	"-0.07" $\times 20 + "2.8"$ = 1.4(2) million (2 sfs)	M1 A1 2	no ft
(b)	r close to -1 or corr'n is high just outside given data, so reliable	B1 B1 2	or good corr'n or pts close to line but not if "close to -1, hence unreliable" if r low in (i), ft: " r low" or "poor corr'n" etc or outside given data so unreliable not "reliable as follows trend" not "reliable as follows average" no ft from (iv)(a)
(v)	y on x x is indep	B1 B1 2	or x controlled or y depends on x or y not indep dep on not " x on y "
Total		14	r close to -1 so makes little difference: B2