4732 Probability & Statistics 1

Note: "(3 sfs)" means "answer which rounds to ... to 3 sfs". If correct ans seen to $\geq$ 3sfs, ISW for later rounding
Penalise over-rounding only once in <u>paper</u>.

1(i)	(a) -1	B1	allow $\approx$ -1 or close to -1 not "strong corr'n", not -0.99
	(b) 0	B1 2	allow $\approx$ 0 or close to 0 not "no corr'n"
(ii)	4 3 2 1 or 1 2 3 4	M1	Ranks attempted, even if opp
	1 3 4 2 4 2 1 3	A1	
	Σd^2 (= 14)	M1	Dep M1 or $S_{xy} = 23 - ^{100}/_4$ or $S_{xx} = S_{yy} = 30 - ^{100}/_4$
	$1 - \dfrac{6\Sigma d^2}{4(4^2 - 1)}$	M1	Dep 2nd M1 $S_{xy}/\sqrt{(S_{xx}S_{yy})}$
	= -0.4 oe	A1 5	
Total		**7**	
2(i)	$\dfrac{^7C_2 \text{ x } ^8C_3}{^{15}C_5}$	M1 M1	$^7C_2$ x $^8C_3$ or 1176 : M1 (Any C or P)/$^{15}C_5$: M1 (dep < 1) or $\dfrac{7}{15} \times \dfrac{6}{14} \times \dfrac{8}{13} \times \dfrac{7}{12} \times \dfrac{6}{11}$ or 0.0392: M1 $\times ^5C_2$ or $\times$ 10 : M1 (dep $\geq$4 probs mult)
	$= ^{56}/_{143}$ or $^{1176}/_{3003}$ or 0.392 (3sfs)	A1 3	if 2$\leftrightarrow$3, treat as MR max M1M1
(ii)	3! x 2! or $^3P_3$ x $^2P_2$ not in denom	M1	BABAB seen: M1
	= 12	A1 2	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 $^8C_5$ x 0.45^3 x 0.55^5	M1	Allow 0.9368 – 0.7799
	= 0.2569 or 0.2568 or 0.257	A1 2	
(c)	0.7799 seen	M1	$^8C_5$x0.45^3x0.55^5+$^8C_4$x0.45^4x0.55^4+$^8C_3$x 0.45^5 x 0.55^3 : M2
	– 0.0885 (not 1 – 0.0885)	M1	1 term omitted or wrong or extra: M1
	= 0.691 (3 sfs)	A1 3	
(ii)(a)	$^{10}C_2$ x $(^7/_{12})^8$ x $(^5/_{12})^2$ seen	M1	or 0.105 seen, but not ISW for A1
	= 0.105 (3 sfs)	A1 2	
(b)	$2^{31}/_{72}$ or $^{175}/_{72}$ or 2.43 (3 sfs)	B1 1	NB $^{12}/_5$ = 2.4: B0
Total		**9**	
4(i)	$^1/_{20}$ x $^1/_{10}$ or $^1/_{200}$ or 0.005	M1	
	x 2	M1dep	
	$= ^1/_{100}$ or 0.01	A1 3	
(ii)	E(X) = 0+50x$^1/_{10}$+500x$^1/_{20}$ or	M1	or eg 20 goes: 2 × £0.50 + £5.00
	0+0.5x$^1/_{10}$+5x$^1/_{20}$	A1	= £6.00
	= 30p = £0.30 or $^3/_{10}$	M1	("£6.00" + 20 × £0.20) ÷ 20
	Charge "30p" + 20p or 0.3 + 0.2		condone muddled units eg 0.3 + 20
		A1 4	
	= 50p or 0.50 or 0.5		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)	$\frac{12}{22} \times \frac{11}{21}$ $= \frac{2}{7}$ 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 $x = \dfrac{1 \pm \sqrt{(1^2 - 4\times(-132))}}{2}$ 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 $12\times11=132$ 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	
				(i)(b) & (ii)(abc): ISW ie if correct seen, ignore extras
(b)	Total unknown or totals poss diff or Y13 may be smaller or similar or size of pie chart may differ	B1	1	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)				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:
	F generally higher or median higher F higher on average or F better mks F IQR is above M IQR	B1		not F higher mean
	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	2	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	B1		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
	<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	2	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	M1		or implied by $0.7^r \times 0.3$ or $0.3^r \times 0.7$
	$0.7^3 \times 0.3$	M1		Allow $0.7^4 \times 0.3$
	$^{1029}/_{10000}$ oe or 0.103 (3 sfs)	A1	3	
(ii)	0.7^6 alone	M1		$1-(0.3+0.3\times0.7+...+0.3\times0.7^5)$ not $1-0.7^6$
	$= 0.118$ (3 sfs)	A1	2	
(iii)	0.7^9	M1		not 0.3×0.7^9
	$1 - 0.7^9$	M1		allow $1 - 0.7^{10}$ or 0.972 for M1
	0.960 (3 sfs)	A1	3	allow 0.96, if no incorrect wking seen
				$0.3 + 0.7 \times 0.3 + ... + 0.7^8 \times 0.3$: M2
				1 term omitted or wrong or "correct" extra: M1
(iv)	Bin stated	M1		or implied by table or ^nC_r or $0.7^3 \times 0.3^2$
				or 0.0309
	$^5C_2 \times 0.7^3 \times 0.3^2$ or $0.8369 - 0.5282$	M1		
	$= 0.3087$ or 0.309 (3 sfs)	A1	3	
Total		**11**		
8(i)	$$\dfrac{168.6 - \dfrac{88 \times 16.4}{8}}{\sqrt{\left(1136 - \dfrac{88^2}{8}\right)\left(34.52 - \dfrac{16.4^2}{8}\right)}}$$	M2		$\left(= \dfrac{-11.8}{\sqrt{168 \times 0.9}}\right)$
				M1: correct subst in any correct S formula
				M2: correct substn in any correct r formula
	$= -0.960$ (3 sfs)	A1	3	allow -0.96, if no incorrect wking seen
(ii)	must refer to, or imply, external constraint on x			not x is not random
				not x affects y
	e.g x is controlled			not x not affected by y
	or values of x fixed or chosen			not x goes up same amount each time
	allow x is fixed	B1	1	not charge affects no. of vehicles
				not x not being measured
(iii)	$$\dfrac{168.6 - \dfrac{88 \times 16.4}{8}}{1136 - \dfrac{88^2}{8}}$$	M1		ft their S_{xy} and S_{xx}
				incl $^{168.6}/_{1136}$ if used in (i)
	$= -0.0702$ (3 sfs) or $-^{59}/_{840}$ or $-^{11.8}/_{168}$	A1		or -0.07 if no incorrect wking
	$y - ^{16.4}/_8 = "-0.0702"(x - ^{88}/_8)$	M1		or $a = ^{16.4}/_8 - ("-0.0702") \times ^{88}/_8$ or $^{2371}/_{840}$
	$y = -0.07x + 2.8$ or better	A1	4	oe eg $y = -^{59}/_{840}x + ^{2371}/_{840}$
(iv)(a)	"-0.07" x 20 + "2.8"	M1		
	= 1.4(2) million (2 sfs)	A1	2	no ft
(b)	r close to -1 or corr'n is high	B1		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
	just outside given data, so reliable	B1	2	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	B1		
	x is indep	B1	2	or x controlled or y depends on x
				or y not indep
				dep on not "x on y"
				r close to -1 so makes little difference: B2
Total		**14**		