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.

1 (i)	$0.2^2 + 0.7 \times 0.1 \times 2$ $= 0.18$ **AG**	M2 A1 3	0.2^2 or 0.7×0.1: M1 no errors seen NB $2 \times 0.9 \times 0.1 = 0.18$ M0A0
(ii)	$0.28 + 2\times0.18 + 3\times0.04 + 4\times0.01$ $= 0.8$ oe $0.28 + 2^2\times0.18 + 3^2\times0.04 + 4^2\times0.01$ - "0.8"^{2} $= 0.88$ oe	M1 A1 M1 M1 A1 5	≥ 2 terms correct (excl 0×0.49) ÷ 5 (or 4 or 10 etc): M0 ≥ 2 terms correct (excl $0^2\times0.49$) dep +ve result cao $\Sigma(x-\mu)^2$: 2 terms: M1; 5 terms M2 $0.8^2\times0.49+0.2^2\times0.28+1.2^2\times0.18+2.2^2\times0.04+3.2^2\times0.01$ SC Use original table, 0.4:B1 0.44: B1
Total		**8**	
2(i)(a)	$\dfrac{8736.9 - \dfrac{202\times245.3}{7}}{7300 - \dfrac{202^2}{7}}$ or $\dfrac{1658.24}{1470.86}$ $= 1.127\ldots$ (= 1.13 **AG**)	M1 A1 2	correct sub in any correct formula for b eg $\dfrac{236.8921}{210.1249}$ must see 1.127… ; 1.127.. alone: M1A1
(b)	$y - {}^{245.3}/_{7} = 1.13(x - {}^{202}/_{7})$ $y = 1.1x + 2.5$ (or 2.4) or $y = 1.13x + 2.43$	M1 A1 2	or $a = {}^{245.3}/_{7} - 1.13 \times {}^{202}/_{7}$ 2 sfs suff. (exact: y = 1.127399..x + 2.50934…)
(ii)(a)	(1.1(..) × 30 + 2.5(..)) = 35.5 to 36.5	B1f 1	
(b)	(1.1(..) × 100 + 2.5(..)) = 112.4 to 115.6	B1f 1	
(iii)	(a) Reliable (b) Unreliable because extrapolated	B1 B1 2	Both reliable: B1 | (a) more reliable than (b) B1 because (a) within data or (b) outside data B1 Ignore extras
Total		**8**	
3(i)(a)	Geo stated $({}^{7}/_{8})^2({}^{1}/_{8})$ ${}^{49}/_{512}$ or 0.0957 (3 sfs)	M1 M1 A1 3	or impl. by $({}^{7}/_{8})^n({}^{1}/_{8})$ or $({}^{1}/_{8})^n({}^{7}/_{8})$ alone
(b)	$({}^{7}/_{8})^3$ alone ${}^{343}/_{512}$ or 0.670 (3 sfs) allow 0.67	M2 A1 3	or $1-({}^{1}/_{8}+{}^{7}/_{8}\times{}^{1}/_{8}+({}^{7}/_{8})^2\times{}^{1}/_{8})$: M2 one term incorrect, omit or extra: M1 $1-({}^{7}/_{8})^3$ or $({}^{7}/_{8})^2$ alone: M1
(ii)	8	B1 1	
(iii)	Binomial stated or implied ${}^{15}C_2({}^{7}/_{8})^{13}({}^{1}/_{8})^2$ = 0.289 (3 sfs)	M1 M1 A1 3	eg by $({}^{7}/_{8})^a({}^{1}/_{8})^b$ ($a+b=15$, $a,b\neq1$), not just ${}^nC_r$
Total		**10**	
4 (i)	1 2 3 4 5 or 5 4 3 2 1 3 5 4 1 2 3 1 2 5 3 Σd^2 (= 32) $1 - {}^{6\times\text{"32"}}/_{5(25-1)}$ = - 0.6	M1 A1 M1dep M1dep A1 5	attempt ranks correct ranks S_{xx} or S_{yy}=55–$15^2/_5$(=10) or S_{yy}=39–$15^2/_5$(= -6) $^{-6}/\sqrt{(10\times10)}$

(ii)	1 & 3 Largest neg r_s or large neg r_s or strong neg corr'n or close(st) to -1 or lowest r_s	B1ind B1dep 2	ft if -1 < (i) < -0.9, ans 1 & 2 NOT: furthest from 0 or closest to ±1 little corr'n most disagreement
Total		**7**	

5 (i)	68 75 – 59 = 16	B1 M1 A1 3	 attempt 6th & 18th or 58-60, 74-76 & subtr must be from 75 – 59
(ii)	Unaffected by outliers or extremes (allow less affected by outliers) sd can be skewed by one value	B1 1	NOT: … by anomalies or freaks easier to calculate
(iii)	Shows each data item, retains orig data can see how many data items can find (or easier to read) mode or modal class can find (or easier to read) frequs can find mean Harder to read med (or Qs or IQR) Doesn't show med (or Qs or IQR) B&W shows med (or Qs or IQR) B&W easier to compare meds	 B1 B1 2	NOT: shows freqs shows results more clearly B&W does not show freqs NOT: B&W easier to compare B&W shows spread or variance or skew B&W shows highest & lowest Assume in order: Adv, Disadv, unless told Allow disadv of B&W for adv of S&L & vice versa Ignore extras
(iv)	m = 68.1 NOT by restart sd = 9.7 (or same) NOT by restart	B1 B1 2	 Restart mean or mean & sd: 68.1 or 68.087 & 9.7 or 9.73 B1 only
Total		**8**	

6 (i) (a)	8! = 40320	M1 A1 2	Allow $^4P_4$ & $^3P_3$ instead of 3! & 4! thro'out Q6
(b)	$^4/_8 \times {}^4/_7 \times {}^3/_6 \times {}^3/_5 \times {}^2/_4 \times {}^2/_3 \times {}^1/_2$ $\times 2$ $= {}^1/_{35}$ or 0.0286 (3 sfs)	M1 M1dep A1 3	$4! \times 4! \div 8!$ | $4! \times 4! + 4! \times 4!$ $\times 2$ | $\div 8!$ allow 1 – above for M1 only oe, eg $^{1152}/_{40320}$
(ii)(a)	$4! \times 4!$ = 576	M1 A1 2	allow $4! \times 4! \times 2$: M1
(b)	$^1/_{16}$ or 0.0625	B1 1	
(c)	Separated by 5 or 6 qus stated or illus $^1/_4 \times {}^1/_4 \times 3$ or $^1/_{16} \times 3$ ($^1/_4 \times {}^1/_4$ or $^1/_{16}$ alone or ×(2 or 6): M1) $^3/_{16}$ or 0.1875 or 0.188	M1 M2 A1 4	allow 5 only or 6 only or (4, 5 or 6) can be impl by next M2 or M1 $3! \times 3! \times 3$ ($3! \times 3!$ alone or ×(2 or 6); or $(3! + 3!) \times 3$: M1) (÷ 576) correct ans, but clearly B, J sep by 4: M0M2A0 1- P(sep by 0, 1, 2, 3, (4)) M1 $1-(^1/_4+{}^1/_4+{}^1/_4\times{}^3/_4+{}^1/_4\times{}^1/_2)$ or $1-(^1/_4\times{}^1/_4+{}^1/_2\times{}^1/_4+{}^3/_4\times{}^1/_4+1\times{}^1/_4+{}^3/_4\times{}^1/_4)$ M2 (one omit: M1)
Total		**12**	

7 (i)	Binomial $n = 12, p = 0.1$ Plates (or seconds) independent oe Prob of fault same for each plate oe	B1 B1 B1 B1 4	 B(12, 0.1) : B2 NOT: batches indep Comments must be in context Ignore incorrect or irrelevant
(ii)(a)	0.9744 – 0.8891 or $^{12}C_3 \times 0.9^9 \times 0.1^3$ = 0.0852 or 0.0853 (3 sfs)	M1 A1 2	
(b)	1 – 0.2824 or $1- 0.9^{12}$ =0.718 (3 sfs)	M1 A1 2	allow 1 – 0.6590 or $1 – 0.9^{11}$
(iii)	"0.718" and 1 – "0.718" used $(1-0.718)^4 + 4(1-0.718)^3 \times 0.718$ $+ {}^4C_2(1-0.718)^2 \times 0.718^2$ = 0.317 (3 sfs)	B1 M2 A1 4	ft (b) for B1M1M1 M1 for any one term correct (eg opp tail or no coeffs) 1 – P(3 or 4) follow similar scheme M2 or M1 1 – correct wking (= 0.623) B1M2 cao
Total		**12**	

8 (i)	$^1/_6 + 3 \times (^1/_6)^2$ $= ^1/_4$	M2 A1 3	or $3 \times (^1/_6)^2$ or $^1/_6 + (^1/_6)^2$ or $^1/_6 + 2(^1/_6)^2$ or $^1/_6 + 4(^1/_6)^2$ M1
(ii)	$^1/_3$	B1 1	
(iii)	3 routes clearly implied out of 18 possible (equiprobable) routes $^1/_6$	M1 M1 A1 3	or $^1/_3 \times ^1/_6 \times 3$ M2 or $^1/_3 \times ^1/_6$ or $^1/_6 \times ^1/_6 \times 3$ or $^1/_3 \times ^1/_3 \times 3$ or $^1/_4 - ^1/_6$ M1 but $^1/_6 \times ^1/_6 \times 2$ M0 $\frac{(\frac{1}{6})^2 \times 3}{\frac{1}{2}}$ or $\frac{\frac{1}{4}-\frac{1}{6}}{\frac{1}{2}}$ or $\frac{\frac{1}{2}\times\frac{1}{6}}{\frac{1}{2}}$ oe M2 or $\frac{\text{P(4\&twice)}}{\text{P(twice)}}$ stated or $\frac{\text{prob}}{\frac{1}{2}}$ M1 Whatever 1st, only one possibility on 2nd M2 $^1/_6$, no wking M1M1A1 $^1/_{12}$, no wking M0
Total		**7**	

Total 72 marks