

# 4732 Probability & Statistics 1

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

<b>1 (i)</b>	$0.2^2 + 0.7 \times 0.1 \times 2$ = 0.18 <b>AG</b>	M2	0.2 <sup>2</sup> or 0.7 × 0.1: M1
<b>(ii)</b>	$0.28 + 2 \times 0.18 + 3 \times 0.04 + 4 \times 0.01$ = 0.8 oe $0.28 + 2^2 \times 0.18 + 3^2 \times 0.04 + 4^2 \times 0.01$ - “0.8” <sup>2</sup> = 0.88 oe	A1 3 M1 A1 M1 M1 A1 5	no errors seen NB $2 \times 0.9 \times 0.1 = 0.18$ M0A0 $\geq 2$ terms correct (excl $0 \times 0.49$ ) $\div 5$ (or 4 or 10 etc): M0 $\geq 2$ terms correct (excl $0^2 \times 0.49$ ) dep +ve result cao $\Sigma(x - \mu)^2$ : 2 terms: M1; 5 terms M2 $0.8^2 \times 0.49 + 0.2^2 \times 0.28 + 1.2^2 \times 0.18 + 2.2^2 \times 0.04 + 3.2^2 \times 0.01$ SC Use original table, 0.4:B1 0.44: B1
<b>Total</b>		<b>8</b>	
<b>2(i)(a)</b>	$8736.9 - \frac{202 \times 245.3}{7}$ or $\frac{1658.24}{1470.86}$ $\frac{7300 - \frac{202^2}{7}}{7}$ = 1.127... (= 1.13 <b>AG</b> )	M1 A1 2	correct sub in any correct formula for $b$ eg $\frac{236.8921}{210.1249}$ must see 1.127... ; 1.127.. alone: M1A1
<b>(b)</b>	$y - \frac{245.3}{7} = 1.13(x - \frac{202}{7})$ $y = 1.1x + 2.5$ (or 2.4) or $y = 1.13x + 2.43$	M1 A1 2	or $a = \frac{245.3}{7} - 1.13 \times \frac{202}{7}$ 2 sfs suff. (exact: $y = 1.127399...x + 2.50934...$ )
<b>(ii)(a)</b>	$(1.1(..) \times 30 + 2.5(..)) = 35.5$ to 36.5	B1f 1	
<b>(b)</b>	$(1.1(..) \times 100 + 2.5(..)) = 112.4$ to 115.6	B1f 1	
<b>(iii)</b>	(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
<b>Total</b>		<b>8</b>	
<b>3(i)(a)</b>	Geo stated $(\frac{7}{8})^2 (\frac{1}{8})$ $\frac{49}{512}$ or 0.0957 (3 sfs)	M1 M1 A1 3	or impl. by $(\frac{7}{8})^n (\frac{1}{8})$ or $(\frac{1}{8})^n (\frac{7}{8})$ alone
<b>(b)</b>	$(\frac{7}{8})^3$ alone  $\frac{343}{512}$ or 0.670 (3 sfs) allow 0.67	M2 A1 3	or $1 - (\frac{1}{8} + \frac{7}{8} \times \frac{1}{8} + (\frac{7}{8})^2 \times \frac{1}{8})$ : M2 one term incorrect, omit or extra: M1 $1 - (\frac{7}{8})^3$ or $(\frac{7}{8})^2$ alone: M1
<b>(ii)</b>	8	B1 1	
<b>(iii)</b>	Binomial stated or implied ${}^{15}C_2 (\frac{7}{8})^{13} (\frac{1}{8})^2$ = 0.289 (3 sfs)	M1 M1 A1 3	eg by $(\frac{7}{8})^a (\frac{1}{8})^b$ ( $a+b = 15, a,b \neq 1$ ), not just ${}^nC_r$
<b>Total</b>		<b>10</b>	
<b>4 (i)</b>	1 2 3 4 5 or 5 4 3 2 1 3 5 4 1 2 3 1 2 5 3 $\Sigma d^2$ (= 32) $1 - \frac{6 \times "32"}{5(25-1)}$ = -0.6	M1 A1 M1dep M1dep A1 5	attempt ranks correct ranks $S_{xx}$ or $S_{yy} = 55 - 15^2/5 (= 10)$ or $S_{yy} = 39 - 15^2/5 (= -6)$ $^{-6}/\sqrt{(10 \times 10)}$

<b>(ii)</b>	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	fit if $-1 < (i) < -0.9$ , ans 1 & 2  NOT: furthest from 0 or closest to $\pm 1$ little corr'n most disagreement
<b>Total</b>		<b>7</b>	

<b>5 (i)</b>	68 75 – 59 = 16	B1 M1 A1 3	attempt 6 <sup>th</sup> & 18 <sup>th</sup> or 58-60, 74-76 & subtr must be from 75 – 59
<b>(ii)</b>	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
<b>(iii)</b>	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 frequs shows results more clearly B&W does not show frequs  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
<b>(iv)</b>	m = 68.1 sd = 9.7 (or same)	NOT by restart NOT by restart	B1 B1 2
<b>Total</b>		<b>8</b>	Restart mean or mean & sd: 68.1 or 68.087 & 9.7 or 9.73 B1 only

<b>6 (i) (a)</b>	8! = 40320	M1 A1 2	Allow ${}^4P_4$ & ${}^3P_3$ instead of 3! & 4! thro'out Q6
<b>(b)</b>	$\frac{4}{8} \times \frac{4}{7} \times \frac{3}{6} \times \frac{3}{5} \times \frac{2}{4} \times \frac{2}{3} \times \frac{1}{2}$ $\times 2$  = $\frac{1}{35}$ or 0.0286 (3 sfs)	M1 M1dep  A1 3	$4! \times 4! \div 8!$ $\times 2$  allow 1 – above for M1 only oe, eg $\frac{1152}{40320}$
<b>(ii)(a)</b>	$4! \times 4!$ = 576	M1 A1 2	allow $4! \times 4! \times 2$ : M1
<b>(b)</b>	$\frac{1}{16}$ or 0.0625	B1 1	
<b>(c)</b>	Separated by 5 or 6 qus stated or illus  $\frac{1}{4} \times \frac{1}{4} \times 3$ or $\frac{1}{16} \times 3$ ( $\frac{1}{4} \times \frac{1}{4}$ or $\frac{1}{16}$ alone or $\times(2$ or 6): M1)  $\frac{3}{16}$ 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 $\times(2$ or 6); or $(3! + 3!) \times 3$ : M1) ( $\div 576$ )  correct ans, but clearly B, J sep by 4: M0M2A0  1- P(sep by 0, 1, 2, 3, (4)) M1 $1 - (\frac{1}{4} + \frac{1}{4} + \frac{1}{4} \times \frac{3}{4} + \frac{1}{4} \times \frac{1}{2})$ or $1 - (\frac{1}{4} \times \frac{1}{4} + \frac{1}{2} \times \frac{1}{4} + \frac{3}{4} \times \frac{1}{4} + 1 \times \frac{1}{4} + \frac{3}{4} \times \frac{1}{4})$ M2 (one omit: M1)
<b>Total</b>		<b>12</b>	

<b>7 (i)</b>	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
<b>(ii)(a)</b>	$0.9744 - 0.8891$ or ${}^{12}C_3 \times 0.9^9 \times 0.1^3$ = 0.0852 or 0.0853 (3 sfs)	M1 A1 2	
<b>(b)</b>	$1 - 0.2824$ or $1 - 0.9^{12}$ = 0.718 (3 sfs)	M1 A1 2	allow $1 - 0.6590$ or $1 - 0.9^{11}$
<b>(iii)</b>	“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
<b>Total</b>		<b>12</b>	

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

Total 72 marks