

OCR Maths S1

Topic Questions from Papers

Discrete Random Variables

Answers

1	(i)	$k = 1 - \left(\frac{1}{4} + \frac{1}{5} + \frac{2}{5} + \frac{1}{10}\right)$ $\frac{1}{20}$	M1 A1	2	Use $\Sigma p = 1$ or 0.05
	(ii)	$E(X) = \Sigma xp(x)$ $= -1/10$ $\Sigma x^2 p(x) = 2$ $\Sigma x^2 p(x) - \mu^2$ $= 1.99$	M1 A1 M1 M1 A1	5	Use $\Sigma xp(x)$ with a value for k and correct signs $-1/10$ or -0.1 only Attempt $\Sigma x^2 p(x)$ } or $\Sigma (x - \mu)^2 p(x)$: M2 Subtract their μ^2 } Answer, 1.99 or 1 99/100

(Q4, Jan 2005)

2	(i)	$\frac{1}{3} + \frac{1}{4} + p + q = 1$ oe $0 \times \frac{1}{3} + 1 \times \frac{1}{4} + 2p + 3q = 1\frac{1}{4}$ oe equalize coeffs, eg mult eqn (i) by 2 or 3 Or make p or q subject of (i) or (ii) $p = \frac{1}{4}, q = \frac{1}{6}$ oe	B1 B1 M1 A1A1	5	allow one error. ft their equns subst or subtr not nec'y
	(ii)	$\Sigma x^2 p$ (not $\frac{1}{4}$ or $\frac{1}{3}$ etc) $(= 2\frac{3}{4})$ $- (\frac{1}{4})^2$ $= 1.1875$ or $1\frac{3}{16}$ oe sd = $\sqrt{(\text{their } 1.1875)} = 1.09$ (3 sfs)	M1 M1 A1 B1f	4	≥ 2 non-zero terms correct. dep +ve result indep if +ve result or $(x - \frac{1}{4})^2 p$ $(\geq 2$ (non-0) terms correct): M2 ft (i) ($0 \leq p, q < 1$) or letters p, q both M1s cao dep 1st M1 & $\sqrt{(\text{+ve no.})}$ eg $\sqrt{2.75} = 1.66$
Total				9	

(Q5, June 2006)

3	(i)	$1 - (\frac{3}{10} + \frac{1}{5} + \frac{2}{5})$ $\frac{1}{10}$	M1 A1	2	or $(\frac{3}{10} + \frac{1}{5} + \frac{2}{5}) + p = 1$
	ii	$\frac{3}{10} + 2 \times \frac{1}{5} + 3 \times \frac{2}{5}$ $\frac{19}{10}$ oe	M1 A1	2	$\div 4 \text{ or } 6 \Rightarrow \text{M0A0}$
Total				4	

(Q1, Jan 2007)

4	$(0 \times 0.1) + 1 \times 0.2 + 2 \times 0.3 + 3 \times 0.4$ $= 2.0$	M1 A1	≥ 2 non-zero terms correct eg $\div 4$: M0
	$(0^2 \times 0.1) + 1 \times 0.2 + 2^2 \times 0.3 + 3^2 \times 0.4 (= 5)$ $- 2^2$ $= 1$	M1 M1 A1 5	≥ 2 non-zero terms correct $\div 4$: M0 Indep, fit their μ . Dep +ve result $(-2)^2 \times 0.1 + (-1)^2 \times 0.2 + 0^2 \times 0.3 + 1^2 \times 0.4$: M2 ≥ 2 non-0 correct: M1 $\div 4$: M0
Total		5	

(Q1, June 2007)

5 (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) $0.28 + 2 \times 0.18 + 3 \times 0.04 + 4 \times 0.01$ $= 0.8$ oe $0.28 + 2^2 \times 0.18 + 3^2 \times 0.04 + 4^2 \times 0.01$ $- "0.8" ^2$ $= 0.88$ oe	M1 A1 M1 M1 A1 5	≥ 2 terms correct (excl 0×0.49) $\div 5$ (or 4 or 10 etc): M0 ≥ 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
Total		8	

(Q1, Jan 2009)

6 (i)	$\Sigma x \div 11$ 70 Σx^2 attempted $\sqrt{\frac{\Sigma x^2}{11} - \bar{x}^2} = \sqrt{(54210/11 - 70^2)}$ or $\sqrt{28.18}$ or 5.309 (= 5.31) AG	M1 A1 M1 A1 4	≥ 5 terms, or $\Sigma(x - \bar{x})^2$ or $\sqrt{\frac{\Sigma(x - \bar{x})^2}{11}} = \sqrt{310/11}$ or $\sqrt{28.18}$ ie correct substn or result If $\times 11/10$: M1A1M1A0
ii	Attempt arrange in order med = 67 74 and 66 IQR = 8	M1 A1 M1 A1 4	or (72.5 – 76.5) – (65.5 – 66.5) incl must be from 74 – 66
iii	no (or fewer) extremes this year oe sd takes account of all values sd affected by extremes less spread tho' middle 50% same less spread tho' 3 rd & 9 th same or same gap	B1 1	iii, iv & v: ignore extras fewer high &/or low scores highest score(s) less than last year Not less spread or more consistent Not range less
iv	sd measures spread or variation or consistency oe	B1 1	sd less means spread is less oe or marks are closer together oe
v	more consistent, more similar, closer together, nearer to mean less spread	B1 1	allow less variance Not range less Not highest & lowest closer
Total		11	

(Q6, June 2009)

7 (i)	$(0 \times \frac{1}{2}) + 1 \times \frac{1}{4} + 2 \times \frac{1}{8} + 3 \times \frac{1}{8}$ $= \frac{7}{8}$ or 0.875 oe $(0 \times \frac{1}{2}) + 1 \times \frac{1}{4} + 2^2 \times \frac{1}{8} + 3^2 \times \frac{1}{8} (=$ $1 \frac{7}{8})$ $- (\frac{7}{8})^2$ $= \frac{71}{64}$ or 1.11 (3 sfs) oe	M1 A1 M1 M1 A1 5	≥ 2 non-zero terms seen If $\div 3$ or 4 M0M0M1(poss) ≥ 2 non-zero terms seen dep +ve result M1 all4 $(x-0.875)^2$ terms seen. M1 mult p, Σ A1 1.11
(ii)	Bin stated or implied 0.922 (3 sfs)	M1 A1 2	Eg table or $\frac{1}{4}^n \times \frac{3}{4}^m$ ($n+m=10, n,m \neq 1$) or 10C4 or 5(or 4 or 6) terms correct
(iii)	$n = 10$ & $p = \frac{1}{8}$ stated or implied ${}^{10}C_4 \times \frac{7}{8}^6 \times \frac{1}{8}^4$ $= 0.0230$ (3 sfs)	M1 M1 A1 3	condone 0.023
Total		[10]	

(Q4, Jan 2010)

8 (i)	$\frac{1}{2} \times \frac{1}{3}$ or $\frac{2}{4} \times \frac{1}{3}$ or $\frac{1}{4C_2}$ or $\frac{2}{12}$ (= $\frac{1}{6}$ AG)	B1	or 1 out of 6 or 2 out of 12 or $\frac{2!}{4!} \times 2$
	$\frac{1}{4} \times \frac{2}{3}$ or $2 \times \frac{1}{4} \times \frac{1}{3}$ or $\frac{1}{2} \times \frac{1}{3}$ or $\frac{2}{4} \times \frac{1}{3}$ Add two of these or double one (= $\frac{1}{3}$ AG)	B1 B1 3	or $\frac{2}{12}$ or $\frac{1}{6}$ or $\frac{1}{3!}$ or $\frac{1}{4C_2}$ or $\frac{2!}{4!} \times 2$ or $\frac{2}{4C_2}$ or $4 \times \frac{1}{4} \times \frac{1}{3}$ or $\frac{2}{4} \times \frac{2}{3}$ or $\frac{4}{12}$ or $\frac{2!}{4!} \times 4$ B1B1 or $\frac{2}{6}$ or $2 \times \frac{1}{6}$ or $\frac{2}{3!}$ or $\frac{2!}{3!}$ B1B1
ii	$X = 3, 4, 5, 6$ only, stated or used P(X=5) wking as for P(X=4) above or $1 - (\frac{1}{6} + \frac{1}{3} + \frac{1}{6})$ or $\frac{1}{3}$ P(X=3) wking as for P(X=6) above or $1 - (\frac{1}{3} + \frac{1}{3} + \frac{1}{6})$ or $\frac{1}{6}$ $\begin{matrix} 3 & 4 & 5 & 6 \\ \frac{1}{6} & \frac{1}{3} & \frac{1}{3} & \frac{1}{6} \end{matrix}$ oe	B1 M1 M1 A1 4	Allow repetitions Allow other values with zero probabilities. or M1 for total of their probs = 1, dep B1 or P(X=3)= $\frac{1}{6}$, P(X=4)= $\frac{1}{3}$, P(X=5)= $\frac{1}{3}$, P(X=6)= $\frac{1}{6}$ Complete list of values linked to probs
	iii	Σxp = $4 \frac{1}{2}$ $\Sigma x^2 p$ (= $21 \frac{1}{6}$) - $4 \frac{1}{2}^2$ = $\frac{11}{12}$ or 0.917 (3 sf)	M1 A1 M1 M1 A1 5
Total		12	

(Q5, June 2010)

9 (i)	$(0 \times a) + 2 \times (1 - a)$ = $2 - 2a$ or $2(1 - a)$ oe	M1 A1 2	or $2(1 - a)$ Not ISW	Condone $2 \times 1 - a$ NB $2 \times (1 - a) \div 2 : M0A0$ Eg $E(X) = 2 - 2a; 2 - 2a = 1; a = 0.5: M1A0$			
	$(0 \times a) + 2^2 \times (1 - a)$ - $(2 - 2a)^2$ = $4 - 4a - 4 + 8a - 4a^2$ = $4a - 4a^2$ (= $4a(1 - a)$) AG <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>-2 + 2a</td><td>2a</td></tr><tr><td>a</td><td>1 - a</td></tr></table> M1 Var(X) = $a(-2+2a)^2 + 4a^2(1 - a)$ M1 $4a^3 - 8a^2 + 4a + 4a^2 - 4a^3$ $4a - 4a^2$ A1	-2 + 2a	2a	a	1 - a	M1 A1 3	or $4 - 4a$ oe - (i) ² dep contains a; ISW; Indep mk or $4(1 - a) - 4(1 - a)^2$ $4(1 - a)(1 - (1 - a))$ Correct table oe
-2 + 2a	2a						
a	1 - a						
Total		5					

(Q7, Jan 2011)

10	(i)	$0.1 + 0.3 + 2p + p = 1$ oe $p = 0.2$	M1 A1 [2]		
	(ii)	Σxp $= 2.7$ oe	M1 A1f [2]	≥ 2 terms correct, FT p	eg $\div 4$: M0A0

(Q1, Jan 2012)

11		$\frac{1.4}{50}$ (= 0.028) $1.5 + \frac{1.4}{50}$ $= 1.528$ or $\frac{191}{125}$ or 1.53 (3 sf) $\frac{0.05}{50} - (\frac{1.4}{50})^2$ or 0.000216 seen $\sqrt{0.000216}$ $= 0.0147$ (3 sf)	M1 M1 dep M1 A1 M1 M1 A1 [6]	$1.4 + 50 \times 1.5$ (= 76.4) $\frac{76.4}{50}$ $(\Sigma x^2 - 2 \times 1.5 \times '76.4' + 50 \times 1.5^2 = 0.05)$ $(\Rightarrow \Sigma x^2 = 116.75; \text{no marks yet})$ $\frac{0.05 + 2 \times 1.5 \times '76.4' - 50 \times 1.5^2}{50} - '1.528'^2$ all correct	eg $\frac{1.4+1.5}{50}$ M0M0A0 not $\frac{0.05}{50} - '1.528'^2$
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(Q2, June 2012)

12	(i)	$2k + 4k + 6k + 8k = 1$ $k = \frac{1}{20}$ AND $6 \times \frac{1}{20} = \frac{3}{10}$ AG	M1 A1 [2]	or $2 + 4 + 6 + 8 = 20$ M1 Must see both for A1 or $2k + 4k + 6k + 8k = 20k$ M1 $P(X = 6) = \frac{6k}{20k} = \frac{3}{10}$ A1	Must see correct wk'g for $k = \frac{1}{20}$, otherwise M0A0 NB $k \times 6 = \frac{3}{10} \Rightarrow k = \frac{1}{20}$ M0A0 (even if tested by showing that $k = \frac{1}{20}$ gives $\Sigma p = 1$) Just showing $\frac{1}{10} + \frac{2}{10} + \frac{3}{10} + \frac{4}{10} = 1$ M0A0
	(ii)	$2 \times \frac{1}{10} + 4 \times \frac{2}{10} + 6 \times \frac{3}{10} + 8 \times \frac{4}{10}$ oe $= 6$ $2^2 \times \frac{1}{10} + 4^2 \times \frac{2}{10} + 6^2 \times \frac{3}{10} + 8^2 \times \frac{4}{10}$ oe (= 10) $- '6'^2$ $= 4$	M1 A1 M1 M1 A1 [5]	≥ 3 terms correct fit their values of p , dep $\Sigma p = 1$ cao ≥ 3 terms correct; fit their values of p ; dep $\Sigma p = 1$ fit their values of p ; dep +ve result & $\Sigma p = 1$ cao	Allow i.t.o. k for M1 $\div 4$ M0 Allow i.t.o. k for M1M1 $\div 4$ M0 NOT $-m^2 \div 4$ $\sqrt{4} = 2$ lose final A1, not ISW, unless labelled sd

(Q1, Jan 2013)