

Statistical Distributions – Mark Scheme

June 2017 Mathematics Advanced Paper 1: Statistics and Mechanics 1

1.

Question Number	Scheme	Marks
<p>4.</p> <p>(a)</p>	$a = \frac{1}{3} \text{ and } e = 1$ $c = \left[1 - \frac{5}{6}\right] = \frac{1}{6}$ $\frac{1}{3} + 2b = \frac{5}{6} \text{ or } \frac{1}{3} + 2b + \frac{1}{6} = 1$ $\Rightarrow b = \frac{1}{4}$ $d = a + b = \frac{1}{3} + \frac{1}{4} \text{ or } d = \frac{5}{6} - \frac{1}{4} \text{ (o.e.) so } d = \frac{7}{12}$	<p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>B1ft</p> <p>(5)</p>
<p>(b)</p>	$\left[P(X^2 = 1) = a + b = \right] \frac{7}{12}$	<p>B1ft</p> <p>(1)</p>
Notes		
Probabilities not in [0, 1] score 0 for corresponding A or B marks		
Allow exact decimals or equivalent fractions		
<p>(a)</p>	<p>In part (a) you may see answers in the tables. If answers in the table and answers on the page disagree take the answers on the page. If jumbled working is followed by a list of answers on the page mark the list.</p> <p>M1 for an equation for b. Follow through their value of a and possibly c if both in $[0,1]$ Must be seen as an equation with b the only unknown. NB $b = d - a$ is <u>not</u> a suitable equation and use of this is M0</p> <p>1st A1 for $b = \frac{1}{4}$ or 0.25 (Correct answer only is 2/2)</p> <p>3rd B1ft for $d = \frac{7}{12}$ <u>or</u> their $a +$ their b but their d must satisfy $\frac{1}{3} < d < \frac{5}{6}$</p>	
<p>(b)</p>	<p>B1ft for $\frac{7}{12}$ <u>or</u> their $a +$ their b <u>or</u> their d</p>	
Please check the two B1ft marks carefully		

2.

Question Number	Scheme	Marks														
6. (a)	$[E(X)] = [0 \times \frac{1}{12}] + 3 \times \frac{2}{3} + 6 \times \frac{1}{4}$, $= \frac{7}{2}$ or <u>3.5</u>	M1, A1 (2)														
(b)	$[E(X^2)] = [0^2 \times \frac{1}{12}] + 3^2 \times \frac{2}{3} + 6^2 \times \frac{1}{4}$ (= 15) $[Var(X)] = "15" - (\frac{7}{2})^2$ $= \frac{11}{4}$ or <u>2.75</u>	M1 M1 A1 (3)														
(c)	$5p + 2(1-p) = 3$ or [allow $p + q = 1$ and $5p + 2q = 3$ for M1] So $p = \frac{1}{3}$ (*)	M1A1 A1 cso (3)														
(d)	$P(Y = 2) = \frac{2}{3}$ and $P(Y = 5) = \frac{1}{3}$	B1 (1)														
(e)	$P(S = 30) = P(X = 6 \text{ and } Y = 5)$ $= \frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$	M1 A1cso (2)														
(f)	<table border="1"> <tr> <td>[s]</td> <td>4</td> <td>6</td> <td>12</td> <td>15</td> <td>25</td> <td>(30)</td> </tr> <tr> <td>[P(S = s)]</td> <td>$\frac{2}{36}$</td> <td>$\frac{16}{36}$</td> <td>$\frac{6}{36}$</td> <td>$\frac{8}{36}$</td> <td>$\frac{1}{36}$</td> <td>$(\frac{3}{36})$</td> </tr> </table>	[s]	4	6	12	15	25	(30)	[P(S = s)]	$\frac{2}{36}$	$\frac{16}{36}$	$\frac{6}{36}$	$\frac{8}{36}$	$\frac{1}{36}$	$(\frac{3}{36})$	M1A1A1 (3)
[s]	4	6	12	15	25	(30)										
[P(S = s)]	$\frac{2}{36}$	$\frac{16}{36}$	$\frac{6}{36}$	$\frac{8}{36}$	$\frac{1}{36}$	$(\frac{3}{36})$										
(g)	$E(S) = \frac{1}{36}[4 \times 2 + 6 \times 16 + 12 \times 6 + 15 \times 8 + 25 \times 1 + 30 \times 3]$ $= 11\frac{5}{12}$ or $\frac{137}{12}$ or <u>11.416</u>	M1 A1 (2)														
(h)	$E(X^2) = 15$ and $E(S) = 11.416...$ or $E(X^2) > E(S)$... so <u>Charlotte</u> has the higher total score	B1ft dB1ft (2)														
		[18]														

Notes	
(a)	M1 for a fully correct expression (allow missing 0 term). Correct ans only is 2/2
(b)	1 st M1 for a fully correct expression (allow missing 0 term) for $E(X^2)$. Allow $\text{Var}(X)$ label 2 nd M1 for their $E(X^2) - \text{their } E(X)^2$
(c)	1 st M1 for attempting a linear eq'n in p (or x etc). Must see = 3 and have 2 terms in p , 1 correct 1 st A1 for a fully correct equation for p or for solving their eqns leading to correct eqn in p 2 nd A1 for $p = \frac{1}{3}$ with M1 scored and no incorrect working seen.
(d)	B1 for correct values for $P(Y = 2)$ and $P(Y = 5)$. Needn't be in formal table but labelled.
(e)	M1 for $6 \times 5 = 30$ or $P(30) = P(6,5)$ or $P(30) = P(6) \times P(5)$ or $S = (XY) 6 \times 5$ or $X = 6$ and $Y = 5$ A1 also dep on M1 scored for with no incorrect working seen e.g. $30 = \frac{1}{3} \times \frac{1}{4}$ is A0
(f)	1 st M1 for an attempt at prob. distribution with at least 3 correct (s and $P(S = s)$) Exc' $s = 30$ 1 st A1 for 6 correct s values 2 nd A1 for a fully correct prob. distribution including $s = 30$
(g)	M1 for attempting $E(S)$ using their values. Must see ...3 products (correct ft) decimals to 3sf A1 for $11\frac{5}{12}$ or $\frac{137}{12}$ or any <u>exact</u> equivalent. (Correct ans. only 2/2, awrt 11.4 only M1A0)
(h)	1 st B1 for correct comparison of their $E(S)$ and $E(X^2)$ labelled in (b) or (h) [expressions or values] 2 nd d B1 dependent on a correct comparison of their values for choosing correct player.