S1

1. (a)

(1,1) (1,2) (1,3) (1,4)
(2,1) (2,2) (2,3) (2,4)
(3,1) (3,2) (3,3) (3,4)
(4,1) (4,2) (4,3) (4,4) M1A1

(b) (i) Attempting to count the number of pairs. M1

Prob = $\frac{3}{16}$ A1

(ii) Attempting to count the number of pairs M1

Prob = $\frac{6}{16}$ A1

2. (a) $p + p = 0.64$ M1
$p = 0.32$ A1

(b) (i) $P(A \cap B) = p^2$ B1

Using $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$0.64 = 2p - p^2$ M1

whence $25p^2 - 50p + 16 = 0$ (so k = 16) A1

(ii) $p = \dfrac{50 \pm \sqrt{2500 - 1600}}{50}$ M1

$p = 0.4$ cao A1

[Award A0 if both 0.4 and 1.6 are given]

Special case : If the solutions to (a) and (b) are interchanged, mark according to the scheme and then deduct 3 marks subject to the final mark being non-negative.

3 (a) Prob = $\frac{6}{12} \times \frac{4}{11} \times \frac{2}{10} \times 6$ or $\binom{6}{1} \times \binom{4}{1} \times \binom{2}{1} \div \binom{12}{3}$ M1A1

[M1 multiplying sensible probabilities, A1 the 6]

$= \frac{12}{55}$ cao A1

(b) Prob = $\frac{6}{12} \times \frac{5}{11} \times \frac{4}{10}$ or $\binom{6}{3} \div \binom{12}{3} = \frac{1}{11}$ M1A1

(c) P(All pop) = $\frac{4}{12} \times \frac{3}{11} \times \frac{2}{10}$ or $\binom{4}{3} \div \binom{12}{3}$ $\left(\frac{1}{55}\right)$ B1

P(All same type) = sum of (b) and (c) = $\frac{6}{55}$ cao M1A1

4. Mean = $0.2n$ and SD = $\sqrt{0.8 \times 0.2n}$ B1B1

We are given that

$0.2n = 2\sqrt{0.8 \times 0.2n}$ M1

$0.04n^2 = 0.64n$ A1

$n = 16$ A1

5. (a) (i) Prob = $e^{-15} \times \frac{15^8}{8!}$ or 0.0374 – 0.0180 or 0.9820 – 0.9626 = 0.0194

[M0 answer only] M1A1

(ii) Prob = 0.9170 – 0.0699 or 0.9301 – 0.0830 B1B1

= 0.8471 cao B1

[No marks answer only]

(b) (i) $Y = 8X - 50$ B1

(ii) $E(Y) = 8 \times 15 - 50 = 70$ M1A1

Var(Y) = $64 \times 15 = 960$ M1A1

[FT on (i)]

6. (a) P(found guilty) = $0.8 \times 0.9 + 0.2 \times 0.05$ M1A1

= 0.73 A1

(b) Reqd prob = $\frac{0.8 \times 0.9}{0.73}$ B1B1

= $\frac{72}{73}$ cao B1

[FT the denominator from (a)]

7 (a) (i) [0,0.4] [Accept ( )] B1

(ii) $E(X) = 0.4 - \alpha + 2.2\alpha + 3(0.6 - \alpha)$

= 2.2 (so independent of α) A1

(iii) $E(X^2) = 0.4 - \alpha + 4.2\alpha + 9(0.6 - \alpha)$ M1

= $5.8 - 2\alpha$ A1

Var(X) = $5.8 - 2\alpha - 2.2^2$ A1

Var(X) = 0.66 gives $\alpha = 0.15$ A1

[FT their E(X) where possible]

(b) Possibilities are 1,1 ; 2,2 ; 3,3 B1

Prob = $\left(0.15^2 + 0.5^2 + 0.35^2\right)$ M1A1

= 0.395 cao A1

8. (a) (i) B(20,0.05) B1

[Parameters may be given later]

(ii) Prob = $\binom{20}{1} \times 0.05^1 \times 0.95^{19} = 0.377$ M1A1

(iii) $P(X \geq 3) = 1 - 0.9245 = 0.0755$ M1A1

(b) The number broken, *Y*, is approx Poi(10). B1

$P(Y < 5) = 1 - 0.9707 = 0.0293$ M1A1

9. (a) E(*X*) = $\int_1^3 \frac{1}{6}x.(x+1)\,\mathrm{d}x$ M1A1

[M1 for integral of *xf*(*x*), A1 completely correct, limits may appear on next line]

$= \left[\frac{x^3}{18} + \frac{x^2}{12}\right]_1^3$ A1

$= \frac{19}{9}$ (2.11) cao A1

(b) (i) $F(x) = \int_1^x \frac{1}{6}(t+1)\,\mathrm{d}t$ M1

[Award M1 for integral of *f*(*x*)]

$= \left[\frac{t^2}{12} + \frac{t}{6}\right]_1^x$ A1

$= \frac{x^2}{12} + \frac{x}{6} - \frac{1}{4}$ $\left\{\frac{1}{12}(x^2 + 2x - 3)\right\}$ A1

(ii) *F*(4) = 1 B1

(iii) Prob = *F*(2) – *F*(1.5) M1

$= \frac{2^2}{12} + \frac{2}{6} - \frac{1}{4} - \frac{1.5^2}{12} - \frac{1.5}{6} + \frac{1}{4}$ A1

$= \frac{11}{48}$ (0.229) A1

[FT on their *F*(*x*)]

(iv) The median *m* satisfies

$\frac{m^2}{12} + \frac{m}{6} - \frac{1}{4} = 0.5$ M1

[M1 for putting their *F*(*x*) = 0.5

$m = \frac{-2 \pm \sqrt{4+36}}{2}$ m1

[Only award if a quadratic equation is being solved]

m = 2.16 ($\sqrt{10} - 1$) cao A1