

Exercise walk-through

# 6.5

## Discrete random variables

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Pearson Edexcel · International A-Level · Mathematics

## Exercises 2.1·2.3

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**2.1**  $X$  has  $P(X = x) = \frac{kx}{6}$  for  $x = 1, 2, 3$ . Find  $k$ ,  $E(X)$  and  $\text{Var}(X)$ . [4]

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**2.2** A fair die is rolled once. Using the uniform results, write down  $E(X)$  and  $\text{Var}(X)$ . [2]

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**2.3**  $Y$  has  $E(Y) = 4$  and  $\text{Var}(Y) = 2.5$ . Find  $E(3Y - 2)$  and  $\text{Var}(3Y - 2)$ . [2]

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**2.1**  $\frac{k}{6}(1 + 2 + 3) = 1$  gives  $k = 1$ : so the probabilities are  $\frac{1}{6}, \frac{2}{6}, \frac{3}{6}$ .  $E(X) = \frac{1+4+9}{6} = \frac{14}{6}$ ;  
 $E(X^2) = \frac{1+8+27}{6} = \frac{36}{6} = 6$ ;  $\text{Var}(X) = 6 - \left(\frac{14}{6}\right)^2 = 6 - \frac{196}{36} = \frac{5}{9}$ .

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**2.2** A fair die is rolled once. Using the uniform results, write down  $E(X)$  and  $\text{Var}(X)$ . [2]

**2.2** Uniform on 1–6:  $E(X) = \frac{7}{2} = 3.5$ ;  $\text{Var}(X) = \frac{36-1}{12} = \frac{35}{12} \approx 2.92$ .

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**2.3** Y has  $E(Y) = 4$  and  $\text{Var}(Y) = 2.5$ . Find  $E(3Y - 2)$  and  $\text{Var}(3Y - 2)$ . [2]

**2.3**  $E(3Y - 2) = 3(4) - 2 = 10$ ;  $\text{Var}(3Y - 2) = 3^2(2.5) = 22.5$ .

## Exercise 3.1

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**3.1** (*Edexcel IAL WST01 June 2025 Q1.*) The discrete random variable  $X$  has probability distribution

| $x$        | 1   | 2   | 3    | 4    |
|------------|-----|-----|------|------|
| $P(X = x)$ | 0.3 | 0.2 | 0.35 | 0.15 |

(a) Find  $F(3.5)$ . (b) Find  $P(3X - 3 < X + 2)$ . (c) Find  $E(X)$ . (d) Show that  $\text{Var}(X) = 1.1275$ . (e) Find  $\text{Var}(5 - 2X)$ . [9]

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**3.1** (a)  $F(3.5) = P(X \leq 3.5) = 0.3 + 0.2 + 0.35 = 0.85$ . (b)  $3X - 3 < X + 2$  simplifies to  $2X < 5$ , i.e.  $X < 2.5$ , so  $P = P(1) + P(2) = 0.5$ . (c)  $E(X) = 0.3 + 0.4 + 1.05 + 0.6 = 2.35$ . (d)  $E(X^2) = 0.3 + 0.8 + 3.15 + 2.4 = 6.65$ ;  $\text{Var}(X) = 6.65 - 2.35^2 = 6.65 - 5.5225 = 1.1275$  ✓. (e)  $\text{Var}(5 - 2X) = (-2)^2(1.1275) = 4.51$ .

## Exercise 3.2

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**3.2** (*Original.*) A game scores  $X$  where  $P(X = 0) = 0.25$ ,  $P(X = 1) = 0.5$  and  $P(X = 4) = 0.25$ . The winnings are  $W = 10X - 3$ . (a) Find  $E(W)$  and  $\text{Var}(W)$ . (b) Find  $P(W > E(W))$ . [6]

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**3.2** (a)  $E(X) = 0 + 0.5 + 1 = 1.5$ ;  $E(W) = 10(1.5) - 3 = 12$ .  $E(X^2) = 0 + 0.5 + 4 = 4.5$ ;  $\text{Var}(X) = 4.5 - 2.25 = 2.25$ ;  $\text{Var}(W) = 100(2.25) = 225$ . (b)  $W > 12 \Leftrightarrow 10X - 3 > 12 \Leftrightarrow X > 1.5 \Leftrightarrow X = 4$ :  $P = 0.25$ .

Local review guidance: probabilities totalled to 1 before anything else; inequality solved for  $X$  first; variance via  $E(X^2) - E(X)^2$  and coding scalars squared. This is authored classroom guidance.