

**Exercise 4.1**

- (a)  $x - 24 = 8$   
 $x = 32$   $IQR = Q_3 - Q_1$  (M1)  
(A1)
- (b) The number of people  
 $= (30 + 10) \left( \frac{3}{4} \right)$   
 $= 30$   $\frac{3n}{4}$  (M1)  
(A1)
- (c) The mean number of hours  
 $= \frac{900}{30}$   
 $= 30$   $\frac{x_1 + x_2 + \dots + x_n}{n}$  (M1)  
(A1)
- (d) (i) The total number of hours  
 $= (40)(28)$   
 $= 1120$   $n\bar{x}$  (M1)  
(A1)
- (ii) The mean number of hours  
 $= \frac{1120 - 900}{10}$   
 $= 22$   $\frac{x_1 + x_2 + \dots + x_n}{n}$  (M1)  
(A1)
- (e) (i) The required mean  
 $= 22 - 3$   
 $= 19$   $\bar{x} - k$  (M1)  
(A1)
- (ii) The required variance  
 $= 2.5^2$   
 $= 6.25$   $\sigma^2$  (A1)  
(A1)

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Exercise 4.2



- (a) 20 minutes (A1)
- (b) 10 minutes (A1)
- (c) The number of students  
 $= 270 - 90$  270 - 90 (M1)  
 $= 180$  (A1)
- (d) The number of students spent not more than  $k$   
minutes to travel to school  
 $= 360 - 360 \times \frac{1}{6}$  360 - 360  $\times \frac{1}{6}$  (M1)  
 $= 300$  300 (A1)  
 $\therefore k = 30$  (A1)
- (e)  $r$   
 $= 25 + (1.5)(10)$   $Q_3 + 1.5IQR$  (M1)  
 $= 40$  (A1)
- (f) Systematic sampling (A1)

### Exercise 4.3



- (a) (i)  $r = 0.3346566771$   
 $r = 0.335$  (A1)
- (ii) **Weak, positive** (A1)(A1)
- (b) (i)  $a = 0.4228571429$   
 $a = 0.423$  (A1)  
 $b = 6.22$  (A1)
- (ii)  **$b$  represents the expected sales in 2023.** (A1)
- (c) The estimated sales  
 $= 0.4228571429(2.5) + 6.22$   $x = 2.5$  (M1)  
 $= 7.277142857$  millions of dollars  
 $= 7.28$  millions of dollars (A1)

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Exercise 4.4



- (a) (i)  $P(A \cap B) = 0$  (A1)
- (ii)  $P(B) = 0.5$  (A1)
- (b) (i)  $P(A \cup C) = P(A) + P(C) - P(A \cap C)$  Setting equation (M1)  
 $0.33 = 0.05 + P(C) - 0.02$   
 $P(C) = 0.3$  (A1)
- (ii)  $P(A \cap C') = 0.03$  (A1)
- (iii)  $P(A' \cap C) = 0.28$  (A1)
- (c)  $P(A' | C)$   
 $= \frac{P(A' \cap C)}{P(C)}$   $\frac{P(A' \cap C)}{P(C)}$  (M1)  
 $= \frac{0.28}{0.3}$   
 $= \frac{14}{15}$  (A1)
- (d)  $P(B \cap C)$   
 $= P(B)P(C)$   $P(B)P(C)$  (M1)  
 $= (0.5)(0.3)$   
 $= 0.15$  (A1)

**Exercise 4.5**

- (a)  $P(X = 0) + P(X = 10) + P(X = 20) + P(X = 30) = 1$  **Sum of probabilities (M1)**  
 $5k + 5k + 2k + 8k = 1$   
 $20k = 1$   
 $k = 0.05$  **(A1)**
- (b)  $E(X)$   
 $= (0)(0.25) + (10)(0.25) + (20)(0.1) + (30)(0.4)$  **(0)(0.25) + \dots + (30)(0.4) (A1)**  
 $= 16.5$  **(A1)**

**Exercise 4.6**

- (a) Let  $X \sim B(75, 0.11)$  be the number of left-handed students.  
 $E(X)$   
 $= (75)(0.11)$   **$np$  (M1)**  
 $= 8.25$  **(A1)**
- (b) The required probability  
 $= P(X = 10)$   **$P(X = 10)$  (M1)**  
 $= 0.1103559416$   
 $= 0.110$  **(A1)**
- (c) The required probability  
 $= P(X > 6)$   **$P(X > 6)$  (M1)**  
 $= 1 - P(X \leq 6)$   **$1 - P(X \leq 6)$  (M1)**  
 $= 0.7312259865$   
 $= 0.731$  **(A1)**
- (d) The required probability  
 $= P(X = 10 | X > 6)$   **$P(X = 10 | X > 6)$  (M1)**  
 $= \frac{P(X = 10 \cap X > 6)}{P(X > 6)}$   
 $= \frac{P(X = 10)}{P(X > 6)}$   **$\frac{P(X = 10)}{P(X > 6)}$  (M1)**  
 $= \frac{0.1103559416}{0.7312259865}$   
 $= 0.1509190642$   
 $= 0.151$  **(A1)**



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Exercise 4.7



Let  $X$  be the time taken for students to travel to school.

$$P(X < 11) = 0.39$$

$$P\left(Z < \frac{11 - \mu}{\sigma}\right) = 0.39$$

$$Z = \frac{X - \mu}{\sigma} \text{ (M1)}$$

$$\frac{11 - \mu}{\sigma} = -0.279319035$$

$$-0.279319035 \text{ (A1)}$$

$$11 - \mu = -0.279319035\sigma$$

$$\mu = 11 + 0.279319035\sigma \dots (1)$$

$$11 + 0.279319035\sigma \text{ (A1)}$$

$$P(X > 13) = 0.12$$

$$P\left(Z > \frac{13 - \mu}{\sigma}\right) = 0.12$$

$$\frac{13 - \mu}{\sigma} = 1.174986791$$

$$1.174986791 \text{ (A1)}$$

$$13 - \mu = 1.174986791\sigma$$

$$\mu = 13 - 1.174986791\sigma \dots (2)$$

$$13 - 1.174986791\sigma \text{ (A1)}$$

$$(1) = (2)$$

$$11 + 0.279319035\sigma = 13 - 1.174986791\sigma$$

$$\text{Setting equation (M1)}$$

$$1.454305826\sigma = 2$$

$$\sigma = 1.375226561$$

$$\mu$$

$$= 11 + 0.279319035(1.375226561)$$

$$= 11.38412696$$

$$\therefore \mu = 11.4, \sigma = 1.38$$

$$(A1)(A1)$$

**Exercise 4.8**

- (a) (i) Let  $H$  be the height of a tree.  
 The required probability  
 $= P(H < 3.2)$   $P(H < 3.2)$  (M1)  
 $= 0.0111354575$   
 $= 0.0111$  (A1)
- (ii) The required probability  
 $= P(H < 3 | H < 3.2)$   $P(H < 3 | H < 3.2)$  (M1)  
 $= \frac{P(H < 3 \cap H < 3.2)}{P(H < 3.2)}$   
 $= \frac{P(H < 3)}{P(H < 3.2)}$   $\frac{P(H < 3)}{P(H < 3.2)}$  (M1)  
 $= \frac{0.0021374316}{0.0111354575}$   
 $= 0.1919482518$   
 $= 0.192$  (A1)
- (b)  $P(H > \alpha) = 0.31$   $P(H > \alpha)$  (M1)  
 $\alpha = 4.173547621$   
 $\alpha = 4.17$  (A1)
- (c) The required probability  
 $= (P(H < 3.2))^2$   $(P(H < 3.2))^2$  (M1)  
 $= 0.0111354575^2$   
 $= 0.0001239984137$   
 $= 0.000124$  (A1)
- (d) (i) Let  $X$  be the number of short trees.  
 $E(X)$   
 $= (400)(0.0111354575)$   $np$  (M1)  
 $= 4.454182999$   
 $= 4.45$  (A1)
- (ii) The required probability  
 $= P(X > 8)$   $P(X > 8)$  (M1)  
 $= 1 - P(X \leq 8)$   $1 - P(X \leq 8)$  (M1)  
 $= 0.0372881747$   
 $= 0.0373$  (A1)

