

Exercise 3E

- 1 $Q_2 = \$36.50$, $Q_3 = \$45.75$, $IQR = \$30.50$
 $Q_1 = Q_3 - IQR$
 $= 45.75 - 30.50$
 $= \$15.25$
 $Q_2 - Q_1 = 36.50 - 15.25 = \21.25
 $Q_3 - Q_2 = 45.75 - 36.50 = \9.25
 $Q_2 - Q_1 > Q_3 - Q_2$, so negatively skewed.

- 2 a Mean = 31.1 minutes
 Variance = 78.05 minutes²
 Median = 29.7 minutes
 $Q_1 = 25.8$ minutes
 $Q_3 = 34.8$ minutes
 Since variance = σ^2
 $\sigma = \sqrt{78.05} = 8.834\dots$

$$\frac{3(\text{mean} - \text{median})}{\text{standard deviation}} = \frac{3(31.1 - 29.7)}{8.834\dots}$$

$$= 0.475\dots$$

$$= 0.475 \text{ (3 s.f.)}$$

Therefore the data are positively skewed.

- b Use the median and the quartiles because of the skew.

- 3 a 64 mm

- b The median is the $\frac{n+1}{2} = \frac{67+1}{2} = 34$ th piece of data.

Therefore the median is 65 mm.

To find the lower quartile:

$$\frac{n}{4} = \frac{67}{4} = 16.75$$

Since this is not a whole number round up, so the lower quartile is the 17th piece of data, therefore

$$Q_1 = 56 \text{ mm}$$

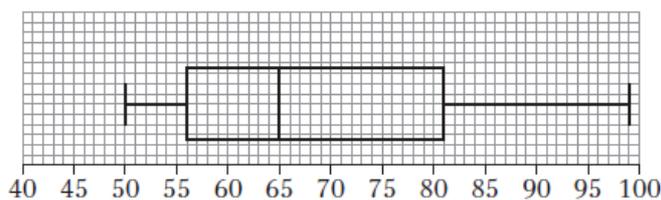
To find the upper quartile:

$$\frac{3n}{4} = \frac{201}{4} = 50.25$$

Since this is not a whole number round up, so the lower quartile is the 51st piece of data, therefore

$$Q_3 = 81 \text{ mm}$$

c



- d The distribution is positively skewed.

$$\begin{aligned}
 3 \text{ e } \bar{x} &= \frac{\sum x}{\sum f} \\
 &= \frac{4604}{67} \\
 &= 68.716\dots \\
 &= 68.7 \text{ mm (3 s.f.)} \\
 \sigma^2 &= \frac{\sum x^2}{\sum f} - \left(\frac{\sum x}{\sum f} \right)^2 \\
 &= \frac{328\,996}{67} - (68.716\dots)^2 \\
 &= 188.499\dots \\
 \sigma &= 13.729\dots \\
 &= 13.7 \text{ mm (3 s.f.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{f } Q_2 - Q_1 &= 65 - 56 = 9 \text{ mm} \\
 Q_3 - Q_2 &= 81 - 65 = 16 \text{ mm} \\
 Q_2 - Q_1 &< Q_3 - Q_2 \\
 &\text{Therefore positive skew.}
 \end{aligned}$$

g Use answer **b**, because of the skew.

Challenge

There are $(1 \times 10) + (3.5 \times 10) + (5.5 \times 10) + (2 \times 10) = 120$ small squares.
Therefore 1 small square represents 1 orange.

$$\bar{x} = \frac{\sum fx}{\sum f} \text{ where } x \text{ is the midpoint of each group.}$$

$$\bar{x} = \frac{65 \times 10 + 75 \times 35 + 85 \times 55 + 95 \times 20}{120}$$

$$= 82.083\dots$$

$$= 82.1 \text{ mm (3 s.f.)}$$

$$\sigma^2 = \frac{65^2 \times 10 + 75^2 \times 35 + 85^2 \times 55 + 95^2 \times 20}{120} - (82.083\dots)^2$$

$$= 70.714\dots$$

$$\sigma = 8.409\dots$$

$$= 8.41 \text{ mm (3 s.f.)}$$

It is an estimate because the data is grouped. There are values above and below 2 standard deviations and therefore there are probably outliers. The distribution is negatively skewed.