

## 6.3 Answers

### A-level Statistics : Year 1 Partitioning Data

#### Answer 1

Qualitative

#### Answer 2

Discrete

#### Answer 3

- ( i ) Qualitative
- ( ii ) Although a continuous flow of water is being measured, the data coming out of the water meter is to the nearest litre and so is discrete.

#### Answer 4

- ( i ) 10 %
- ( ii ) 80 %
- ( iii ) 198 students
- ( iv ) From the box and whisker diagram,

$$Q_3 - Q_2 < Q_2 - Q_1$$

and so the skew is negative, the students are piled up at the high end.

- ( v ) Disagree because only two students scored less than 30% with the remaining 198 students scoring 80 % or more.

#### Answer 5

( a )

$$\begin{aligned} \text{mean}_{28} &= \frac{2.8 + 5.6 + 2.3 + 9.4 + 0.0 + 0.5 + 1.8 + 84.6}{28} \\ &= \frac{107}{28} \\ &= 3.82 \text{ mm} \end{aligned}$$

- ( b ) As the 9.4 was 4.5 too much and ther 0.5 was 4.5 too little the two errors offset each other. Correcting the figures will have no effect on the mean.

#### Answer 6

- ( a ) Rolls of a dice with each face a different colour.
- ( b ) Heights of adult males in the UK.

**Answer 7****( a )**

| Weight<br>(kg) | Midpoint<br>$x$ kg | Frequency<br>$f$ | Cumulative<br>frequency |
|----------------|--------------------|------------------|-------------------------|
| 0.0 - 1.0      | 0.50               | 1                | 1                       |
| 1.0 - 2.0      | 1.50               | 6                | 7                       |
| 2.0 - 2.5      | 2.25               | 60               | 67                      |
| 2.5 - 3.0      | <b>2.75</b>        | 280              | 347                     |
| 3.0 - 3.5      | 3.25               | 820              | 1167                    |
| 3.5 - 4.0      | 3.75               | 320              | 1187                    |
| 4.0 - 5.0      | 4.50               | 10               | 1497                    |
| 5.0 - 6.0      | <b>5.50</b>        | 3                | 1500                    |

**( b )**

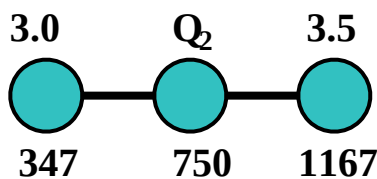
$$\begin{aligned}
 \text{mean} &= \frac{4841}{1500} \quad (\text{exeat}) \\
 &= 3.227\,333\,333\ldots \\
 &= 3.227 \text{ kg}
 \end{aligned}$$

**( c )**

$$\begin{aligned}
 \text{standard deviation} &= \sqrt{\frac{15\,889.5}{1500} - \left(\frac{4841}{1500}\right)^2} \\
 &= 0.421\,093\,286\ldots \\
 &= 0.421 \text{ kg}
 \end{aligned}$$

**( d )**

$$\text{For } Q_2 : \frac{1500 \times 2}{4} = 750 \text{ which is in the class } 3.0 - 3.5$$



$$\begin{aligned}
 \frac{Q_2 - 3.0}{3.5 - 3.0} &= \frac{750 - 347}{1167 - 347} \Rightarrow Q_2 = 3.245731707\ldots \\
 &\Rightarrow \text{median} = 3.246 \text{ kg}
 \end{aligned}$$

**( e )** Technically, the mean is less than the median and so the skew is negative.

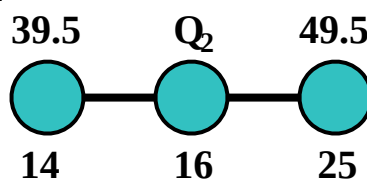
However, you could argue that the mean and the median are almost the same in which case there isn't much skew and the distribution is better described as being symmetrical.

**Answer 8**

| Time, $t$            | Number of students | Cumulative frequency |
|----------------------|--------------------|----------------------|
| $9.5 \leq t < 19.5$  | 2                  | 2                    |
| $19.5 \leq t < 29.5$ | 4                  | 6                    |
| $29.5 \leq t < 39.5$ | 8                  | 14                   |
| $39.5 \leq t < 49.5$ | 11                 | 25                   |
| $49.5 \leq t < 69.5$ | 5                  | 30                   |
| $69.5 \leq t < 79.5$ | 2                  | 32                   |

**(a)**

For  $Q_2$  :  $\frac{32 \times 2}{4} = 16$  which is in the class 39.5 - 49.5



$$\frac{Q_2 - 39.5}{49.5 - 39.5} = \frac{16 - 14}{25 - 14} \Rightarrow Q_2 = 41.31818182\dots$$

$\Rightarrow \text{median} = 41.3 \text{ minutes}$

**(b)**

$$\text{mean} = \frac{1414}{32}$$

$= 44.1875 \text{ minutes}$  (exact)

That is, 44 minutes 11 seconds

$$\text{standard deviation} = \sqrt{\frac{69\,378}{32} - 44.1875^2}$$

$= 14.68 \text{ minutes}$

That is, 14 minutes 41 seconds

**(c)**

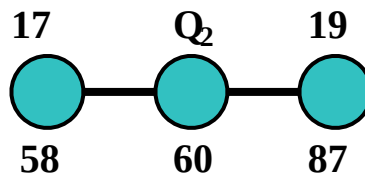
$\text{mean} > \text{median}$

$\therefore$  positive skew

**Answer 9****( a )** No gaps in the table !

| Foot length, $l$ , (cm) | Number of children | Cumulative Frequency |
|-------------------------|--------------------|----------------------|
| $10 \leq l < 12$        | 5                  | 5                    |
| $12 \leq l < 17$        | 53                 | 58                   |
| $17 \leq l < 19$        | 29                 | 87                   |
| $19 \leq l < 21$        | 15                 | 102                  |
| $21 \leq l < 23$        | 11                 | 113                  |
| $23 \leq l < 25$        | 7                  | 120                  |

For  $Q_2$  :  $\frac{120 \times 2}{4} = 60$  which is in the class 17 - 19



$$\frac{Q_2 - 17}{19 - 17} = \frac{60 - 58}{87 - 58} \Rightarrow Q_2 = 17.13793103 \Rightarrow \text{median} = 17.1 \text{ cm}$$

**( b )**

| Foot length, $l$ , (cm) | Number of children, $f$ | Mid-interval value, $x$ | $fx$   | $x^2$  | $fx^2$   |
|-------------------------|-------------------------|-------------------------|--------|--------|----------|
| $10 \leq l < 12$        | 5                       | 11                      | 55     | 121    | 605      |
| $12 \leq l < 17$        | 53                      | 14.5                    | 768.5  | 210.25 | 11143.25 |
| $17 \leq l < 19$        | 29                      | 18                      | 522    | 324    | 9396     |
| $19 \leq l < 21$        | 15                      | 20                      | 300    | 400    | 6000     |
| $21 \leq l < 23$        | 11                      | 22                      | 242    | 484    | 5324     |
| $23 \leq l < 25$        | 7                       | 24                      | 168    | 576    | 4032     |
|                         | 120                     |                         | 2055.5 |        | 36500.25 |

$$\begin{aligned}
 \text{mean} &= \frac{2055.5}{120} \\
 &= \frac{4111}{240} \quad (\text{exact}) \\
 &= 17.12916667... \\
 &= 17.1 \text{ cm}
 \end{aligned}$$

$$\begin{aligned}
 \text{standard deviation} &= \sqrt{\frac{36\,500.25}{120} - \left(\frac{4111}{240}\right)^2} \\
 &= 3.280\,304\,758\dots \\
 &= 3.28 \text{ cm}
 \end{aligned}$$

( c )

$$\begin{aligned}
 \text{Coefficient of skewness} &= \frac{3 (\text{mean} - \text{median})}{\text{standard deviation}} \\
 &= \frac{3 \times (17.129\,166\,67 - 17.137\,931\,03)}{3.280\,304\,758} \\
 &= -0.008\,015\,438\,18
 \end{aligned}$$

The skew is negligible.

This means that the distribution of the foot length data is symmetrical.

Notice the loss of significant figures due to the subtraction.

Students who use rounded off earlier answers can get very strange answers to this final part of the question.