

1. (a) Describe the main features and uses of a box plot.

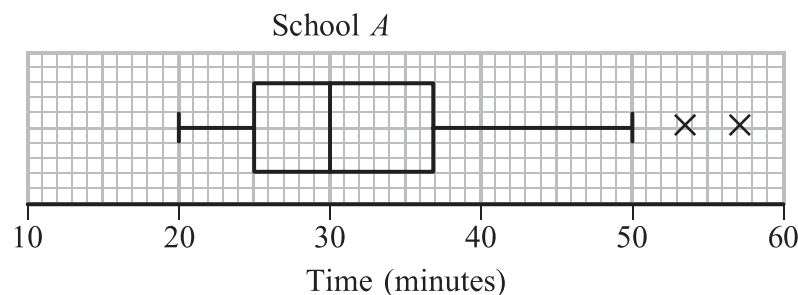
Indicates max / median / min / upper quartile/ lower quartile (2 or more)	Any 3 rows
Indicates outliers (or equivalent description)	
Illustrates skewness (or equivalent description e.g. shape)	
Allows comparisons	
Indicates range / IQR / spread	

B1
B1
B1

(3)

Children from schools *A* and *B* took part in a fun run for charity. The times, to the nearest minute, taken by the children from school *A* are summarised in Figure 1.

Figure 1



- (b) (i) Write down the time by which 75% of the children in school *A* had completed the run.

37 minutes

- (ii) State the name given to this value.

Upper Quartile Q_3

(2)

- (c) Explain what you understand by the two crosses (X) on Figure 1.

(2)

Outlier s
How to calculate correctly
'Observations that are very different from the other observations
and need to be treated with caution'
These two children probably walked / took a lot longer

Any 2

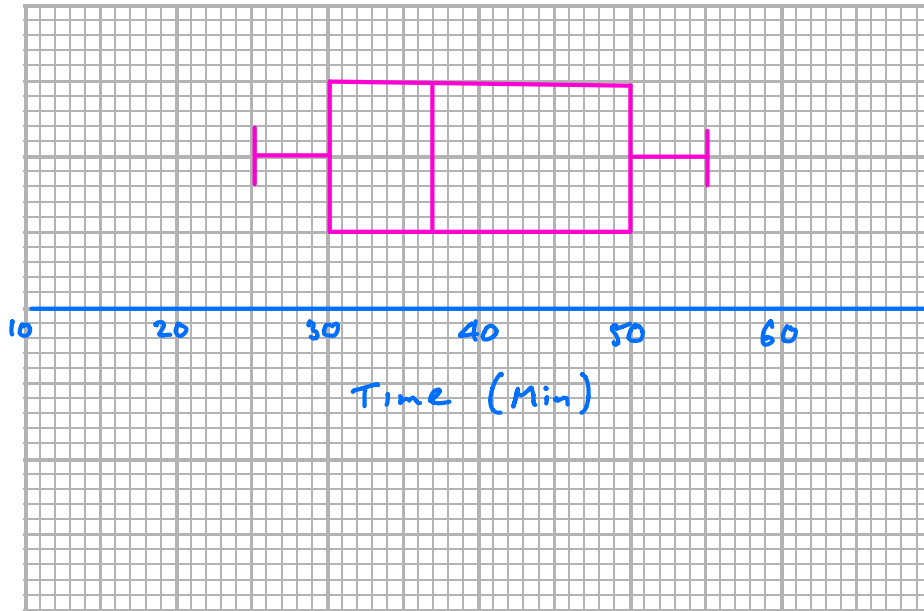
B1
B1
(2)



Question 1 continued

For school B the least time taken by any of the children was 25 minutes and the longest time was 55 minutes. The three quartiles were 30, 37 and 50 respectively.

(d) Draw a box plot to represent the data from school B.



(4)

(e) Compare and contrast these two box plots.

On average, children from school A were quicker as Median time for A (30) < Median time for B (37)

Times of children from school B were more varied IQR for B was 20 whereas IQR for A was only 12

(4)

Children from school A generally took less time
50% of B \leq 37 mins, 75% of A < 37 mins (similarly for 30)
Median/Q1/Q3 of A < median/Q1/Q3 of B (1 or more)
A has outliers, (B does not)
Both positive skew
IQR of A < IQR of B, range of A > range of B

Any correct 4 lines

B1
B1
B1
B1

Note that for 4 marks you need 4 comments

(Total 15 marks)

Q1



2. Sunita and Shelley talk to one another once a week on the telephone. Over many weeks they recorded, to the nearest minute, the number of minutes spent in conversation on each occasion. The following table summarises their results.

Time (to the nearest minute)	Number of Conversations
5–9	2
10–14	9
15–19	20
20–24	13
25–29	8
30–34	3

55

Two of the conversations were chosen at random.

- (a) Find the probability that both of them were longer than 24.5 minutes.

(2)

The mid-point of each class was represented by x and its corresponding frequency by f , giving $\Sigma fx = 1060$.

- (b) Calculate an estimate of the mean time spent on their conversations.

(2)

During the following 25 weeks they monitored their weekly conversations and found that at the end of the 80 weeks their overall mean length of conversation was 21 minutes.

- (c) Find the mean time spent in conversation during these 25 weeks.

(4)

- (d) Comment on these two mean values.

(2)

$$a) \quad P(\text{Both} > 24.5 \text{ min}) = \frac{11}{55} \times \frac{10}{54} = \frac{1}{27}$$

or 0.037

$$b) \quad \text{Estimate } \bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{1060}{55} = 19.27 \text{ min}$$



Question 2 continued

c)

80 weeks	$80 \times 21 =$	1680 min
55 weeks		1060 min —
25 weeks		<u>620 min</u>

Mean for these 25 weeks

$$= \frac{620}{25} = 24.8 \text{ min}$$

d) The lengths of conversation have shown an increase in the last 25 weeks compared with those in the first 55 weeks.



3. A metallurgist measured the length, l mm, of a copper rod at various temperatures, t °C, and recorded the following results.

t	l
20.4	2461.12
27.3	2461.41
32.1	2461.73
39.0	2461.88
42.9	2462.03
49.7	2462.37
58.3	2462.69
67.4	2463.05

The results were then coded such that $x = t$ and $y = l - 2460.00$.

- (a) Calculate S_{xy} and S_{xx} .

(You may use $\Sigma x^2 = 15965.01$ and $\Sigma xy = 757.467$)

Not on syllabus but can use calculator (5)

- (b) Find the equation of the regression line of y on x in the form $y = a + bx$.

By calc $y = 0.3244 + 0.0406x$ (5)

- (c) Estimate the length of the rod at 40 °C.

$x = 40 \Rightarrow y = 1.9484 \Rightarrow \text{Length} = 2461.95 \text{ mm}$ (3)

- (d) Find the equation of the regression line of l on t .

$l = 2460.3244 + 0.0406t$ (2)

- (e) Estimate the length of the rod at 90 °C.

$t = 90 \Rightarrow l = 2463.98$ (1)

- (f) Comment on the reliability of your estimate in part (e).

(2)

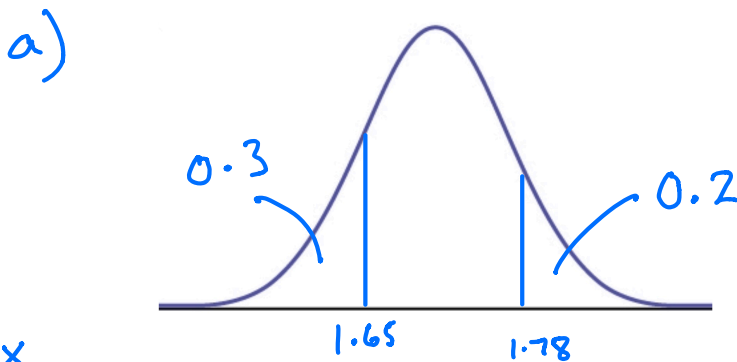
Extrapolating beyond range for which data available so estimate likely to be unreliable.



5. From experience a high-jumper knows that he can clear a height of at least 1.78 m once in 5 attempts. He also knows that he can clear a height of at least 1.65 m on 7 out of 10 attempts.

Assuming that the heights the high-jumper can reach follow a Normal distribution,

- (a) draw a sketch to illustrate the above information, (3)
- (b) find, to 3 decimal places, the mean and the standard deviation of the heights the high-jumper can reach, (6)
- (c) calculate the probability that he can jump at least 1.74 m. (3)



b)

x
 z

z_1, z_2

$$z = \frac{x - \mu}{\sigma}$$

$$\sigma z + \mu = x$$

$$\Phi^{-1}(0.3) = z_1 = -0.52440$$

$$\Phi^{-1}(0.2) = z_2 = 0.84162$$

$$0.84162\sigma + \mu = 1.78$$

$$-0.52440\sigma + \mu = 1.65$$

By calc $\sigma = 0.095$ $\mu = 1.70$

c) $X \sim N(1.70, 0.095^2)$

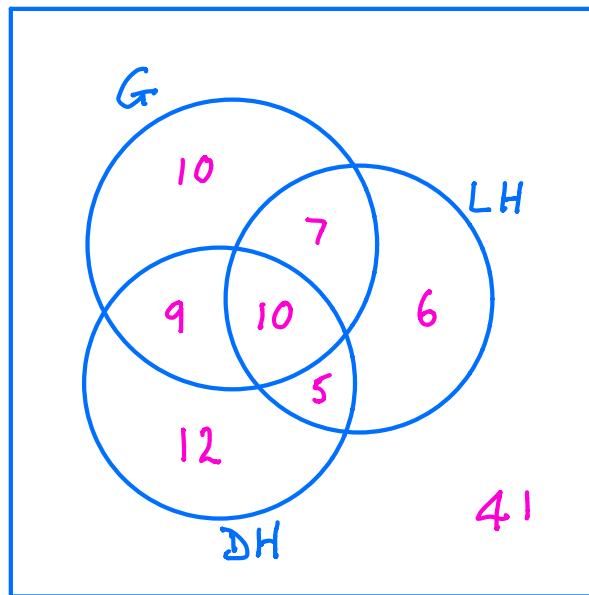
$$P(X > 1.74) = 0.337$$



6. A group of 100 people produced the following information relating to three attributes. The attributes were wearing glasses, being left handed and having dark hair. Glasses were worn by 36 people, 28 were left handed and 36 had dark hair. There were 17 who wore glasses and were left handed, 19 who wore glasses and had dark hair and 15 who were left handed and had dark hair. Only 10 people wore glasses, were left handed and had dark hair.

(a) Represent these data on a Venn diagram.

(6)



A person was selected at random from this group.

Find the probability that this person

- (b) wore glasses but was not left handed and did not have dark hair, $\frac{10}{100} = \frac{1}{10}$ (1)

- (c) did not wear glasses, was not left handed and did not have dark hair, $\frac{41}{100}$ (1)

- (d) had only two of the attributes, $\frac{9+7+5}{100} = \frac{21}{100}$ (2)

- (e) wore glasses given that they were left handed and had dark hair. (3)

$$\frac{10}{10+5} = \frac{10}{15} = \frac{2}{3}$$