Probability and Statistics 1

5.1 Representation of Data - Easy

Subject:	**Mathematics**
Syllabus Code:	**9709**
Level:	**AS Level**
Component:	**Probability and Statistics 1**
Topic:	**5.1 Representation of Data**
Difficulty:	**Easy**

Questions

1. For n values of the variable x, it is given that

$$\Sigma(x-50)=144 \quad \text{and} \quad \Sigma x=944$$

Find the value of n. (9709/52/M/J/20 number 1)

2. A driver records the distance travelled in each of 150 journeys. These distances, correct to the nearest km, are summarised in the table. (9709/52/F/M/21 number 5)

Distance (km)	$0-4$	$5-10$	$11-20$	$21-30$	$31-40$	$41-60$
Frequency	12	16	32	66	20	4

   (a) Draw a cumulative frequency graph to illustrate the data.

   (b) For 30% of these journeys the distance travelled is $d$km or more. Use your graph to estimate the value of d.

   (c) Calculate an estimate of the mean distance travelled for the 150 journeys.

3. The times taken by 200 players to solve a computer puzzle are summarised in the following table. (9709/51/M/J/21 number 5)

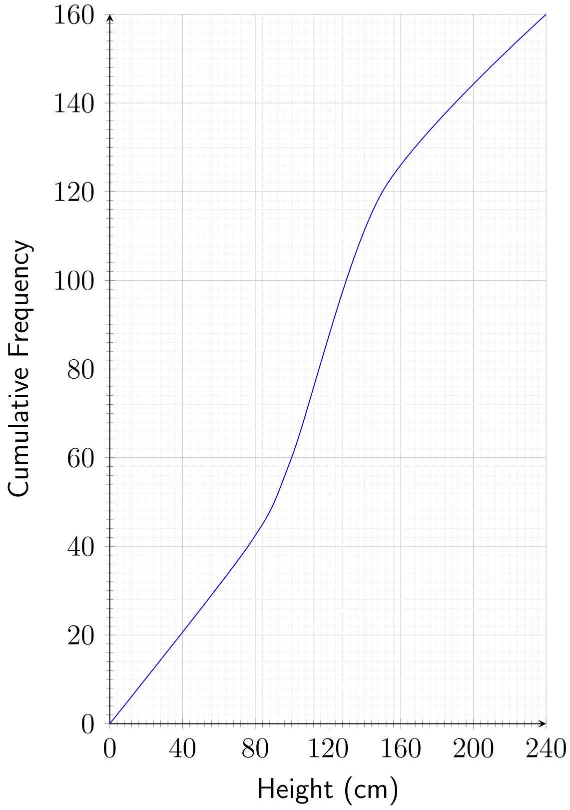
Time (t seconds)	$0 \le t < 10$	$10 \le t < 20$	$20 \le t < 40$	$40 \le t < 60$	$60 \le t < 100$
No. of players	16	54	78	32	20

   (a) Draw a histogram to represent this information.

   (b) Calculate an estimate of the mean time taken by these 200 players.

   (c) Find the greatest possible value of the interquartile range for these times.

4. The heights in cm of 160 sunflowers plants were measured. The results are summarised on the cumulative frequency curve. (9709/53/M/J/21 number 1)



(a) Use the graph to estimate the number of plants with heights less than 100 cm.

(b) Use the graph to estimate the 65th percentile of the distribution.

(c) Use the graph to estimate the interquartile range of the heights of these plants.

5. A sports club has a volleyball team and a hockey team. The heights of the 6 members of the volleyball team are summarised by $\Sigma x = 1050$ and $\Sigma x^2 = 193\ 700$, where x is the height of a member in cm. The heights of the 11 members of the hockey team are summarised by $\Sigma y = 1991$ and $\Sigma y^2 = 366\ 400$, where y is the height of a member in cm. (9709/53/M/J/21 number 3)

(a) Find the mean height of all 17 members of the club.

(b) Find the standard deviation of the heights of all 17 members of the club.

6. A summary of 40 values of x gives the following information:

$$\Sigma(x-k) = 520, \qquad \Sigma(x-k)^2 = 9640,$$

where k is a constant. (9709/51/O/N/21 number 2)

(a) Given that the mean of these 40 values of x is 34, find the value of k.

(b) Find the variance of these 40 values of x.

7. For n values of the variable x, it is given that

$$\Sigma(x-200) = 446 \quad \text{and} \quad \Sigma x = 6846$$

Find the value of n. (9709/52/M/J/22 number 1)

8. The time taken, t minutes, to complete a puzzle was recorded for each of 150 students. These times are summarised in the table. (9709/53/M/J/22 number 1)

Time (t minutes)	$t \leq 25$	$t \leq 50$	$t \leq 75$	$t \leq 100$	$t \leq 150$	$t \leq 200$
Cumulative frequency	16	44	86	104	132	150

   (a) Draw a cumulative frequency graph to illustrate the data.

   (b) Use your graph to estimate the 20th percentile of the data.

9. Twenty children were asked to estimate the height of the particular tree. Their estimates, in metres, were as follows. (9709/53/M/J/22 number 2)

4.1	4.2	4.4	4.5	4.6	4.8	5.0	5.2	5.3	5.4
5.5	5.8	6.0	6.2	6.3	6.4	6.6	6.8	6.9	19.4

   (a) Find the mean of the estimated heights.

   (b) Find the median of the estimated heights.

   (c) Give a reason why the median is likely to be a more suitable measure of the central tendency for this information.

10. 50 values of the variable x are summarised by

$$\Sigma(x - 20) = 35 \quad \text{and} \quad \Sigma x^2 = 25\ 036$$

Find the variance of these 50 values. (9709/53/O/N/22 number 1)

11. A summary of 50 values of x gives

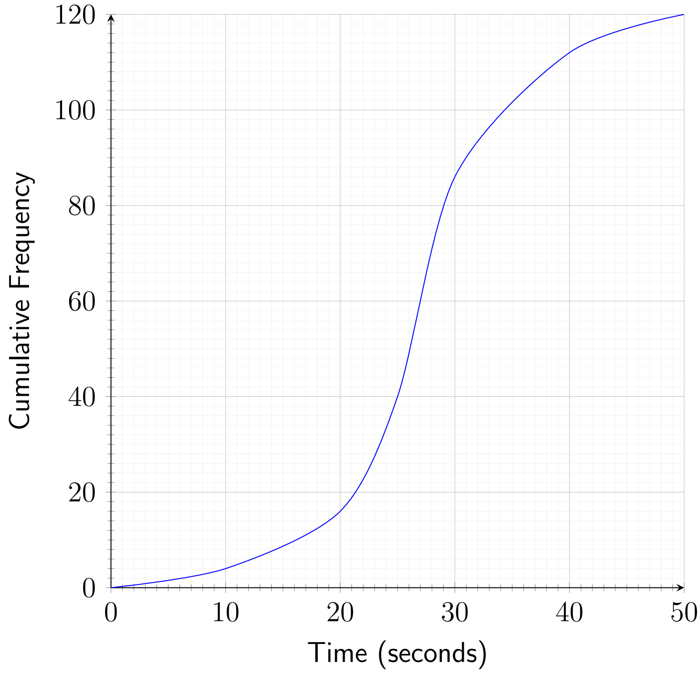
$$\Sigma(x - q) = 700, \quad \Sigma(x - q)^2 = 14\ 235,$$

where q is a constant. (9709/51/M/J/23 number 1)

   (a) Find the standard deviation of these values of x.

   (b) Given that $\Sigma x = 2865$, find the value of q.

12.



The times taken 120 children to complete a particular puzzle are represented in the cumulative frequency graph. (9709/51/O/N/23 number 1)

(a) Use the graph to estimate the interquartile range of the data. 35% of the children took longer than T seconds to complete the puzzle.

(b) Use the graph to estimate the value of T.

Answers

1. For n values of the variable x, it is given that

$$\Sigma(x-50)=144 \quad \text{and} \quad \Sigma x=944$$

Find the value of n. (9709/52/M/J/20 number 1)

$$\Sigma(x-50)=144 \quad \text{and} \quad \Sigma x=944$$

To solve this question, we will use the idea that,

$$\overline{x-c}=\overline{x}-c$$

We can create two equations using the formula for the mean,

$$\overline{x-50}=\frac{\Sigma(x-50)}{n} \qquad \overline{x}=\frac{\Sigma x}{n}$$

Substitute in the values of $\Sigma(x-50)$ and Σx,

$$\overline{x-50}=\frac{144}{n} \qquad \overline{x}=\frac{944}{n}$$

Now let's use the idea that,

$$\overline{x-c}=\overline{x}-c$$

In the first equation,

$$\overline{x-50}=\frac{144}{n} \qquad \overline{x}=\frac{944}{n}$$

$$\overline{x}-50=\frac{144}{n} \qquad \overline{x}=\frac{944}{n}$$

Now we can solve the two equations simultaneously,

$$\overline{x}-50=\frac{144}{n} \qquad \overline{x}=\frac{944}{n}$$

Substitute $\overline{x}$ in the second equation, into the first equation,

$$\overline{x}-50=\frac{144}{n}$$

$$\frac{944}{n}-50=\frac{144}{n}$$

Multiply through by n to get rid of the denominator,

$$944-50n=144$$

Make n the subject of the formula,

$$50n = 944 - 144$$

$$50n = 800$$

$$n = 16$$

Therefore, the final answer is,

$$n = 16$$

2. A driver records the distance travelled in each of 150 journeys. These distances, correct to the nearest km, are summarised in the table. (9709/52/F/M/21 number 5)

Distance (km)	$0-4$	$5-10$	$11-20$	$21-30$	$31-40$	$41-60$
Frequency	12	16	32	66	20	4

(a) Draw a cumulative frequency graph to illustrate the data.

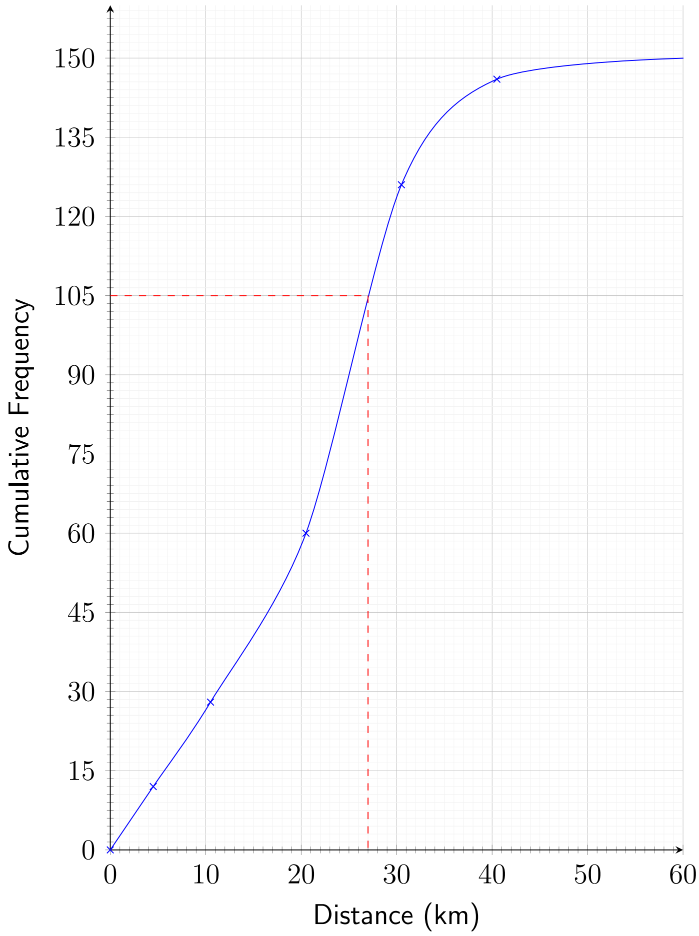
Notice that there gaps between classes in our table i.e $0-4$ then $5-10$, there is gap between 4 and 5. To fix this we apply continuity correction. This means that you should subtract 0.5 from the lower bounds and add 0.5 to the upper bounds,

Distance (km)	$0-4.5$	$4.5-10.5$	$10.5-20.5$	$20.5-30.5$	$30.5-40.5$	$40.5-60.5$
Frequency	12	16	32	66	20	4

Remember that we want to plot a cumulative frequency graph, so we need to use the frequency to find the cumulative frequency for each class,

Distance (km)	$0-4.5$	$4.5-10.5$	$10.5-20.5$	$20.5-30.5$	$30.5-40.5$	$40.5-60.5$
Cumulative Frequency	12	28	60	126	146	150

Label the y-axis as cumulative frequency and the x-axis as distance in km. Plot the upper bounds against the cumulative frequency. Join the points to form an s-shaped curve,



(b) For 30% of these journeys the distance travelled is $d$km or more. Use your graph to estimate the value of d.

This means that 70% of the journeys have a distance less than $d$km. Let's find 70% of 150,

$$\frac{70}{100} \times 150 = 105$$

Draw construction lines at a cumulative frequency of 105 and read off the distance,

$$d = 27$$

Therefore, the final answer is,

$$d = 27$$

(c) Calculate an estimate of the mean distance travelled for the 150 journeys.

Distance (km)	$0 - 4.5$	$4.5 - 10.5$	$10.5 - 20.5$	$20.5 - 30.5$	$30.5 - 40.5$	$40.5 - 60.5$
Frequency	12	16	32	66	20	4

Find the midpoint of each class,

Midpoint	2.25	7.5	15.5	25.5	35.5	50.5
Frequency	12	16	32	66	20	4

Calculate the mean using the formula,

$$\overline{x} = \frac{\Sigma xf}{\Sigma f}$$

Substitute into the formula,

$$\overline{x} = \frac{(2.25 \times 12) + (7.5 \times 16) + (15.5 \times 32) + (25.5 \times 66) + (35.5 \times 20) + (50.5 \times 4)}{150}$$

Simplify,

$$\overline{x} = \frac{3238}{150}$$

Therefore, the final answer is,

$$\overline{x} = \frac{3238}{150}$$

3. The times taken by 200 players to solve a computer puzzle are summarised in the following table. (9709/51/M/J/21 number 5)

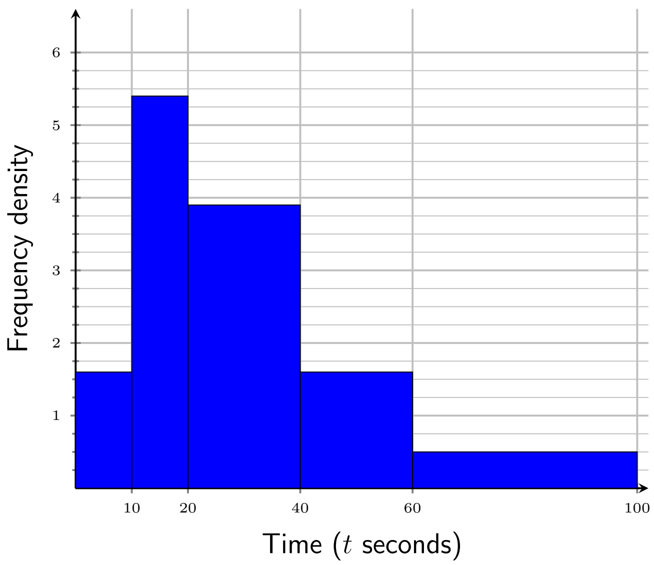
Time (t seconds)	$0 \le t < 10$	$10 \le t < 20$	$20 \le t < 40$	$40 \le t < 60$	$60 \le t < 100$
No. of players	16	54	78	32	20

(a) Draw a histogram to represent this information.

We first need to find the class width and the frequency density,

Class width	10	10	20	20	40
Frequency Density	1.6	5.4	3.9	1.6	0.5

Label the y-axis with frequency density and x-axis with time in t seconds. Plot the time classes against the frequency density, ensuring each class has the respective class width,



(b) Calculate an estimate of the mean time taken by these 200 players.

Time (t seconds)	$0 \le t < 10$	$10 \le t < 20$	$20 \le t < 40$	$40 \le t < 60$	$60 \le t < 100$
No. of players	16	54	78	32	20

Let's start by finding the midpoints of each class,

Midpoint	5	15	30	50	80
No. of players	16	54	78	32	20

Calculate the mean, using the formula,

$$\overline{x} = \frac{\Sigma xf}{\Sigma f}$$

Substitute into the formula,

$$\overline{x} = \frac{(16 \times 5) + (54 \times 15) + (78 \times 30) + (32 \times 50) + (20 \times 80)}{200}$$

Simplify,

$$\overline{x} = \frac{6430}{200}$$

Therefore, the final answer is,

$$\overline{x} = \frac{6430}{200}$$

(c) Find the greatest possible value of the interquartile range for these times.

To find the greatest possible value of the interquartile range we need to find the maximum value of the upper quartile and the minimum value of the lower quartile,

$$q_3 = \frac{3}{4}n$$

$$q_3 = \frac{3}{4} \times 200$$
$$q_3 = 150$$

When we add up the frequencies, we notice that 150 **lies in the class,**

$$40 \leq t < 60$$

The maximum value in the class is 60**,**

$$q_3 = 60$$

Let's find the minimum value of the lower quartile,

$$q_1 = \frac{1}{4}n$$

$$q_1 = \frac{1}{4} \times 200$$
$$q_1 = 50$$

When we add up the frequencies, we notice that 50 **lies in the class,**

$$10 \leq t < 20$$

The minimum value in this class is 10**,**

$$q_1 = 10$$

The formula for interquartile range is,

$$IQR = q_3 - q_1$$

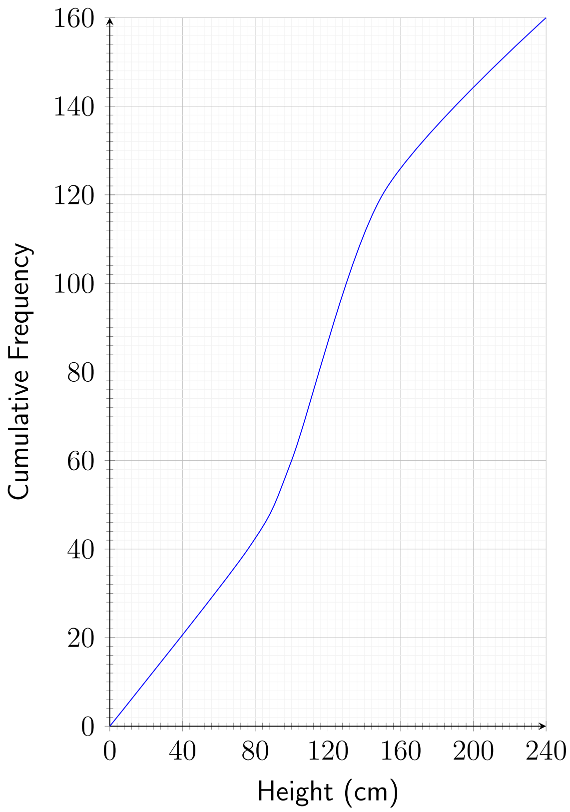
Substitute into the formula,

$$IQR = 60 - 10$$
$$IQR = 50$$

Therefore, the final answer is,

$$IQR = 50$$

4. The heights in cm of 160 sunflowers plants were measured. The results are summarised on the cumulative frequency curve. (9709/53/M/J/21 number 1)



(a) Use the graph to estimate the number of plants with heights less than 100 cm.

Draw construction lines at a height of 100**cm, and read off the respective cumulative frequency,**

$$60$$

Therefore, the final answer is,

$$60$$

(b) Use the graph to estimate the 65th percentile of the distribution.

We have a total of 160 sunflowers. Let's find 65% of that,

$$\frac{65}{100} \times 160 = 104$$

Draw construction lines at a cumulative frequency of 104, and read off the respective height,

$$136\text{cm}$$

Therefore, the final answer is,

$$136\text{cm}$$

(c) Use the graph to estimate the interquartile range of the heights of these plants.

The formula for interquartile range is,

$$IQR = q_3 - q_1$$

Let's start by finding the upper quartile,

$$q_3 = \frac{3}{4}n$$

$$q_3 = \frac{3}{4} \times 160$$
$$q_3 = 120$$

Draw construction lines at the cumulative frequency 160 and read off the height,

$$q_3 = 76$$

Now let's find the lower quartile,

$$q_1 = \frac{1}{4}n$$

$$q_1 = \frac{1}{4} \times 160$$
$$q_1 = 40$$

Draw construction lines at the cumulative frequency 160 and read off the height,

$$q_1 = 150$$

Now let's go back to the formula for interquartile range,

$$IQR = q_3 - q_1$$

Substitute into the formula,

$$IQR = 150 - 76$$

$$IQR = 74\text{cm}$$

Therefore, the final answer is,

$$IQR = 74\text{cm}$$

5. A sports club has a volleyball team and a hockey team. The heights of the 6 members of the volleyball team are summarised by $\Sigma x = 1050$ and $\Sigma x^2 = 193\ 700$, where x is the height of a member in cm. The heights of the 11 members of the hockey team are summarised by $\Sigma y = 1991$ and $\Sigma y^2 = 366\ 400$, where y is the height of a member in cm. (9709/53/M/J/21 number 3)

   (a) Find the mean height of all 17 members of the club.

   $$\Sigma x = 1050 \quad n_x = 6 \quad \Sigma y^2 = 366\ 400 \quad n_y = 11$$

   The formula for the combined mean is,

   $$\hat{\mu} = \frac{\Sigma x + \Sigma y}{n_x + n_y}$$

   Substitute into the formula,

   $$\hat{\mu} = \frac{1050 + 1991}{6 + 11}$$

   Simplify,

   $$\hat{\mu} = \frac{3041}{17}$$

   $$\hat{\mu} = 178.9$$

   Therefore, the final answer is,

   $$\hat{\mu} = 178.9$$

   (b) Find the standard deviation of the heights of all 17 members of the club.

   $$\Sigma x^2 = 193\ 700 \quad n_x = 6 \quad \Sigma y^2 = 366\ 400 \quad n_y = 11 \quad \hat{\mu} = \frac{3041}{17}$$

   The formula for the combined standard deviation is,

   $$\sigma_{x+y} = \sqrt{\frac{\Sigma x^2 + \Sigma y^2}{n_x + n_y} - \hat{\mu}^2}$$

   Substitute into the formula,

   $$\sigma_{x+y} = \sqrt{\frac{193\ 700 + 366\ 400}{6 + 11} - \left(\frac{3041}{17}\right)^2}$$

   Simplify,

   $$\sigma_{x+y} = 30.8$$

Therefore, the final answer is,

$$\sigma_{x+y} = 30.8$$

6. A summary of 40 values of x gives the following information:

$$\Sigma(x-k) = 520, \quad \Sigma(x-k)^2 = 9640,$$

where k is a constant. (9709/51/O/N/21 number 2)

(a) Given that the mean of these 40 values of x is 34, find the value of k.

$$\overline{x} = 34 \quad \Sigma(x-k) = 520 \quad n = 40$$

The formula for the mean of $(x-k)$ values is,

$$\overline{x-k} = \frac{\Sigma(x-k)}{n}$$

We will use the idea that,

$$\overline{x-k} = \overline{x} - k$$

Our equation becomes,

$$\overline{x-k} = \frac{\Sigma(x-k)}{n}$$
$$\overline{x} - k = \frac{\Sigma(x-k)}{n}$$

Substitute in the values,

$$34 - k = \frac{520}{40}$$

Solve for k,

$$34 - k = 13$$
$$k = 34 - 13$$
$$k = 21$$

Therefore, the final answer is,

$$k = 21$$

(b) Find the variance of these 40 values of x.

$$\Sigma(x-k)^2 \quad n = 40 \quad k = 21 \quad \overline{x} = 34$$

The variance σ_x is the same as the variance σ_{x-k}. In this case we are given more information of $x-k$. So let's find the σ_{x-k},

$$\sigma_{x-k} = \sqrt{\frac{\Sigma(x-k)^2}{n} - (\overline{x-k})^2}$$

We need to find $\overline{x-k}$. Remember the idea we used above,

$$\overline{x-k} = \overline{x} - k$$

$$\overline{x-k} = 34 - 21$$
$$\overline{x-k} = 13$$

Now let's go back to our formula for variance,

$$\sigma_{x-k} = \sqrt{\frac{\Sigma(x-k)^2}{n} - (\overline{x-k})^2}$$

Substitute into the formula,

$$\sigma_{x-k} = \sqrt{\frac{9640}{40} - (13)^2}$$

Simplify,

$$\sigma_{x-k} = 72$$

We said that $\sigma_{x-k} = \sigma_x$,

$$\sigma_x = 72$$

Therefore, the final answer is,

$$\sigma_x = 72$$

7. For n values of the variable x, it is given that

$$\Sigma(x-200) = 446 \quad \text{and} \quad \Sigma x = 6846$$

Find the value of $n.$ (9709/52/M/J/22 number 1)

To solve this question, we will use the idea that,

$$\overline{x-c} = \overline{x} - c$$

We can create two equations using the formula for the mean,

$$\overline{x-200} = \frac{\Sigma(x-200)}{n} \qquad \overline{x} = \frac{\Sigma x}{n}$$

Substitute in the values of $\Sigma(x-200)$ and Σx,

$$\overline{x-200} = \frac{446}{n} \qquad \overline{x} = \frac{6846}{n}$$

Now let's use the idea that,

$$\overline{x-c} = \overline{x} - c$$

In the first equation,

$$\overline{x - 200} = \frac{446}{n} \qquad \overline{x} = \frac{6846}{n}$$

$$\overline{x} - 200 = \frac{446}{n} \qquad \overline{x} = \frac{6846}{n}$$

Now we can solve the two equations simultaneously,

$$\overline{x} - 200 = \frac{446}{n} \qquad \overline{x} = \frac{6846}{n}$$

Substitute $\overline{x}$ in the second equation, into the first equation,

$$\overline{x} - 200 = \frac{446}{n}$$

$$\frac{6846}{n} - 200 = \frac{446}{n}$$

Multiply through by n to get rid of the denominator,

$$6846 - 200n = 446$$

Make n the subject of the formula,

$$200n = 6846 - 446$$

$$200n = 6400$$

$$n = 32$$

Therefore, the final answer is,

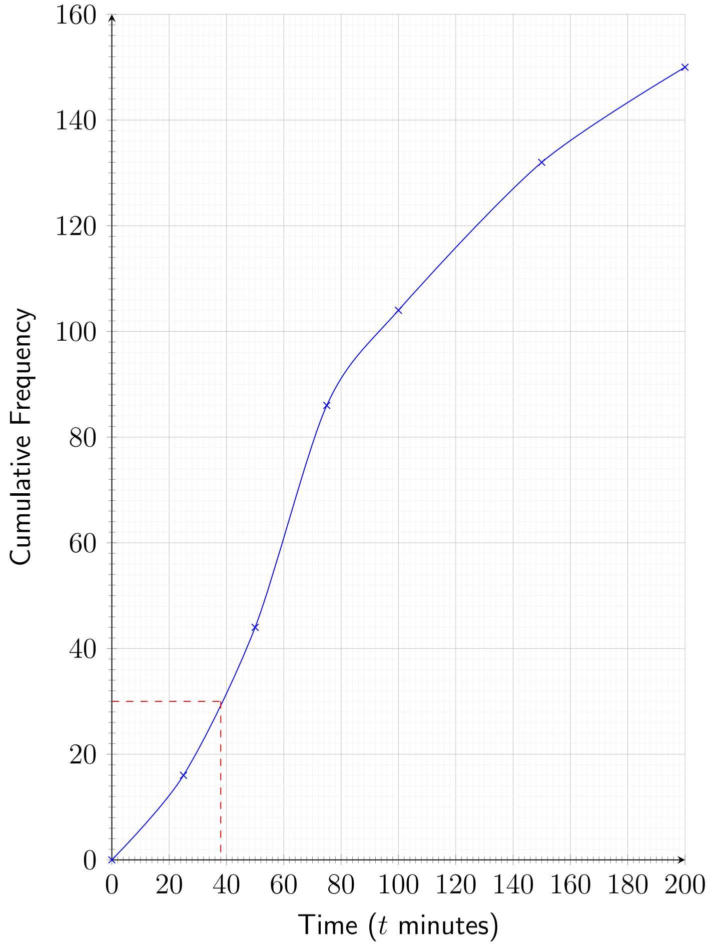
$$n = 32$$

8. The time taken, t minutes, to complete a puzzle was recorded for each of 150 students. These times are summarised in the table. (9709/53/M/J/22 number 1)

Time (t minutes)	$t \leq 25$	$t \leq 50$	$t \leq 75$	$t \leq 100$	$t \leq 150$	$t \leq 200$
Cumulative frequency	16	44	86	104	132	150

(a) Draw a cumulative frequency graph to illustrate the data.

Label the y-axis as cumulative frequency and the x-axis as time taken (t minutes). Plot the upper bounds of the time taken against the cumulative frequency. Join dots to form an s-shaped curve,



(b) Use your graph to estimate the 20th percentile of the data.

Let's start by finding 20% of the students,

$$\frac{20}{100} \times 150 = 30$$

Draw construction lines at a cumulative frequency of 30 and read off the respective time taken,

$$t = 38$$

Therefore, the final answer is,

$$t = 38$$

9. Twenty children were asked to estimate the height of the particular tree. Their estimates, in metres, were as follows. (9709/53/M/J/22 number 2)

4.1	4.2	4.4	4.5	4.6	4.8	5.0	5.2	5.3	5.4
5.5	5.8	6.0	6.2	6.3	6.4	6.6	6.8	6.9	19.4

(a) Find the mean of the estimated heights.

Let's use the formula for mean,

$$\overline{x} = \frac{\Sigma x}{n}$$

We know that n is 20. Let's find Σx,

$$\Sigma x = 4.1 + 4.2 + 4.4 + 4.5 + 4.6 + 4.8 + 5.0 + 5.2 + 5.3 + 5.4 + 5.5$$
$$+5.8 + 6.0 + 6.2 + 6.3 + 6.4 + 6.6 + 6.8 + 6.9 + 19.4$$

Simplify,

$$\Sigma x = 123.4$$

Substitute into the formula,

$$\overline{x} = \frac{123.4}{20}$$
$$\overline{x} = 6.17$$

Therefore, the final answer is,

$$\overline{x} = 6.17$$

(b) Find the median of the estimated heights.

We have a total of 20 values and the data is already arranged in rank order. The median must lie between the 10 and 11 data point,

$$q_2 = \frac{n+1}{2}$$
$$q_2 = \frac{20+1}{10.5}$$

The 10th and 11th data point are 5.4 and 5.5 respectively. The median is the average of those two points,

$$q_2 = \frac{5.4 + 5.5}{2}$$
$$q_2 = 5.45$$

Therefore, the final answer is,

$$q_2 = 5.45$$

(c) Give a reason why the median is likely to be a more suitable measure of the central tendency for this information.

If you analyse the data that we are given. You will notice that we have an anomalous value 19.4 i.e a value that doesn't follow the trend. This value will inflate the mean and make it seem bigger than it actually is.

Therefore, the final answer is,

The mean is unduly affected by the extreme (anomalous) value, 19.4

10. 50 values of the variable x are summarised by

$$\Sigma(x-20) = 35 \quad \text{and} \quad \Sigma x^2 = 25\ 036$$

Find the variance of these 50 values. (9709/53/O/N/22 number 1)

$$\Sigma(x-20) = 35 \quad \Sigma x^2 = 25\ 036 \quad n = 50$$

The formula for variance is,

$$\sigma = \sqrt{\frac{\Sigma x^2}{n} - \overline{x}^2}$$

We need to find $\overline{x}$. Let's do that by first finding $\overline{x-20}$,

$$\overline{x-20} = \frac{\Sigma(x-20)}{n}$$

Substitute into the formula,

$$\overline{x-20} = \frac{35}{50}$$

$$\overline{x-20} = 0.7$$

To find $\overline{x}$, we will use the idea that,

$$\overline{x-c} = \overline{x} - c$$

$$\overline{x-20} = 0.7$$

$$\overline{x} - 20 = 0.7$$

Make $\overline{x}$ the subject of the formula,

$$\overline{x} = 20 + 0.7$$

$$\overline{x} = 20.7$$

Now let's go back to our formula for variance,

$$\sigma = \sqrt{\frac{\Sigma x^2}{n} - \overline{x}^2}$$

Substitute into the formula,

$$\sigma = \sqrt{\frac{25\ 036}{50} - (20.7)^2}$$

Simplify,

$$\sigma = 72.23$$

Therefore, the final answer is,

$$\sigma = 72.23$$

11. A summary of 50 values of x gives

$$\Sigma(x-q) = 700, \quad \Sigma(x-q)^2 = 14\ 235,$$

where q is a constant. (9709/51/M/J/23 number 1)

(a) Find the standard deviation of these values of x.

$$\Sigma(x-q) = 700, \quad \Sigma(x-q)^2 = 14\ 235, \quad n = 50$$

Let's start by finding σ_{x-q},

$$\sigma_{x-q} = \sqrt{\frac{\Sigma(x-q)^2}{n} - \bar{(}x-q)^2}$$

We need to find $\overline{x-q}$,

$$\overline{x-q} = \frac{\Sigma(x-q)}{n}$$
$$\overline{x-q} = \frac{700}{50}$$
$$\overline{x-q} = 14$$

Now let's go back to our formula for variance,

$$\sigma_{x-q} = \sqrt{\frac{\Sigma(x-q)^2}{n} - \bar{(}x-q)^2}$$

Substitute into the formula,

$$\sigma_{x-q} = \sqrt{\frac{14\ 235}{50} - (14)^2}$$

Simplify,

$$\sigma_{x-q} = 9.42$$

σ_{x-q} is the same as σ_x,

$$\sigma_x = 9.42$$

Therefore, the final answer is,

$$\sigma_x = 9.42$$

(b) Given that $\Sigma x = 2865$, find the value of q.

$$\Sigma x = 2865 \quad n = 50 \quad \overline{x-q} = 14$$

To find q we will use the idea that,

$$\overline{x-q} = \overline{x} - q$$

Let's find $\overline{x}$,

$$\overline{x} = \frac{\Sigma x}{n}$$

$$\overline{x} = \frac{2865}{50}$$

$$\overline{x} = 57.3$$

Now let's go back to the idea,

$$\overline{x-q} = \overline{x} - q$$

Substitute and solve for q,

$$14 = 57.3 - q$$

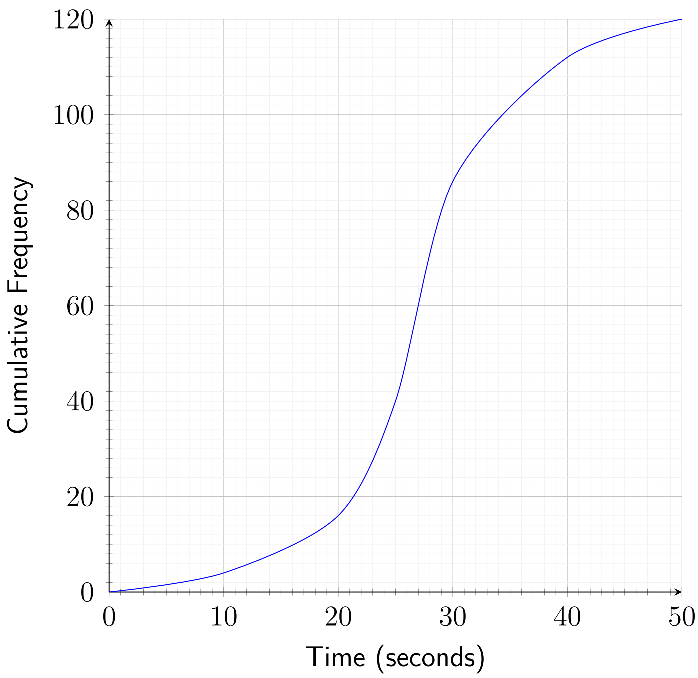
$$q = 57.3 - 14$$

$$q = 43.3$$

Therefore, the final answer is,

$$q = 43.3$$

12.



The times taken 120 children to complete a particular puzzle are represented in the cumulative frequency graph. (9709/51/O/N/23 number 1)

(a) Use the graph to estimate the interquartile range of the data.

The formula for interquartile range is,

$$IQR = q_3 - q_1$$

Let's start by finding the upper quartile,

$$q_3 = \frac{3}{4}n$$
$$q_3 = \frac{3}{4} \times 120$$
$$q_3 = 90$$

Draw construction lines at a cumulative frequency of 90 and read off the time,

$$q_3 = 31$$

Now let's find the lower quartile,

$$q_1 = \frac{1}{4}n$$
$$q_1 = \frac{1}{4} \times 120$$
$$q_1 = 30$$

Draw construction lines at a cumulative frequency of 30 and read off the time,

$$q_1 = 23.7$$

Now let's go back to the formula for interquartile range,

$$IQR = q_3 - q_1$$

Substitute into the formula,

$$IQR = 31 - 23.7$$
$$IQR = 7.3$$

Therefore, the final answer is,

$$IQR = 7.3$$

35% of the children took longer than T seconds to complete the puzzle.

(b) Use the graph to estimate the value of T.

This means 65% of the children took less than T seconds to complete the puzzle. Let's find 65% of 120,

$$\frac{65}{100} \times 120 = 78$$

Draw construction lines at a cumulative frequency of 78 and read off the time. This is the value of T,

$$T = 28.5$$

Therefore, the final answer is,

$$T = 28.5$$