Advanced Mathematics Support Programme®

How fast can you run?

Fun facts

*Usain Bolt ran 100m in **9.58** seconds in 2009 which is still the world record for men.*
*Florence Griffith-Joyner holds the world record for women in which she ran 100 in **10.49** seconds in 1988.*
That's as fast as an average elephant or almost as fast as a rhino, bear or rabbit!

Normally, teenagers would expect to run 100m in 13 – 17 seconds depending on their age; so, an average 13 year-old would expect to take 16 or 17 seconds and an average 19 year-old 13 or 14 seconds.

How fast can you run 100m?
What about your friends?
Are you and your friends average? or better than average? or worse than average?
If you like running, practice every day and see if your time improves – think about how you might track your progress visually.

Here are the times for a group of teenagers, running 100m:

Time, t, seconds	Frequency
$12.0 \le t < 13.0$	3
$13.0 \le t < 13.5$	15
$13.5 \le t < 14.0$	22
$14.0 \le t < 14.5$	35
$14.5 \le t < 15.0$	48
$15.0 \le t < 15.5$	24
$15.5 \le t < 16.0$	18
$16.0 \le t < 16.5$	14
$16.5 \le t < 17.0$	12
$17.0 \le t < 18.0$	9

Time, t, seconds	Cumulative Frequency
< 13.0	3
< 13.5	18
< 14.0	40
< 14.5	75
< 15.0	
< 15.5	
< 16.0	
< 16.5	
< 17.0	
< 18.0	

1. Explain what $13.5 \le t < 14.0$ means. Why is the data grouped like this?

2. How would you explain to your friend what cumulative frequency means?

3. Complete the cumulative frequency column

4. How many teenagers were in this running group?

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The running times have been shown in three different types of graph:

A histogram:
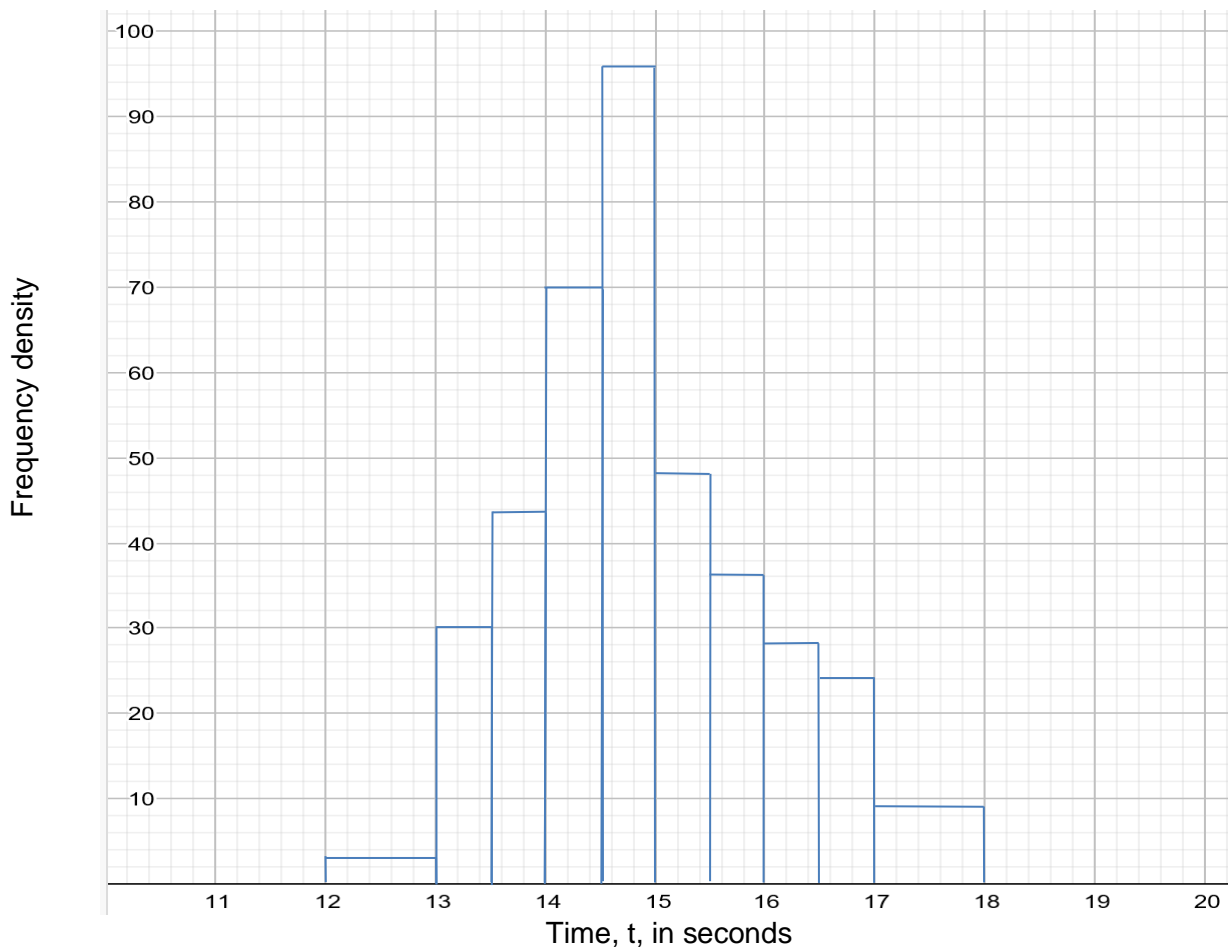
5.   What does frequency density mean?

6.   How has the frequency density been calculated?

7.   Why has frequency density been used instead of frequency?

The **range** is the difference between the largest and smallest values.

The **median** is the middle value – if you lined all the runners in a line from the fastest to the slowest, the median would be the time of the one right in the middle, or if there are two right in the middle it's the value exactly half way between them.
The **lower quartile** and **upper quartile** are the ¼ and ¾ way values – if you line all the runners up in order from the fastest to the slowest, the lower quartile is the time for the runner ¼ the way along, and the upper quartile is the time for the runner ¾ the way along.
The **interquartile range** is the difference between the upper and lower quartiles

The Range and interquartile range are both useful ways to describe the spread of the data and are also useful for comparing different groups of data. The median is one way you can describe the average.

A Cumulative frequency graph:

Cumulative Frequency

Time, t, seconds

Box Plot

Time, t, seconds
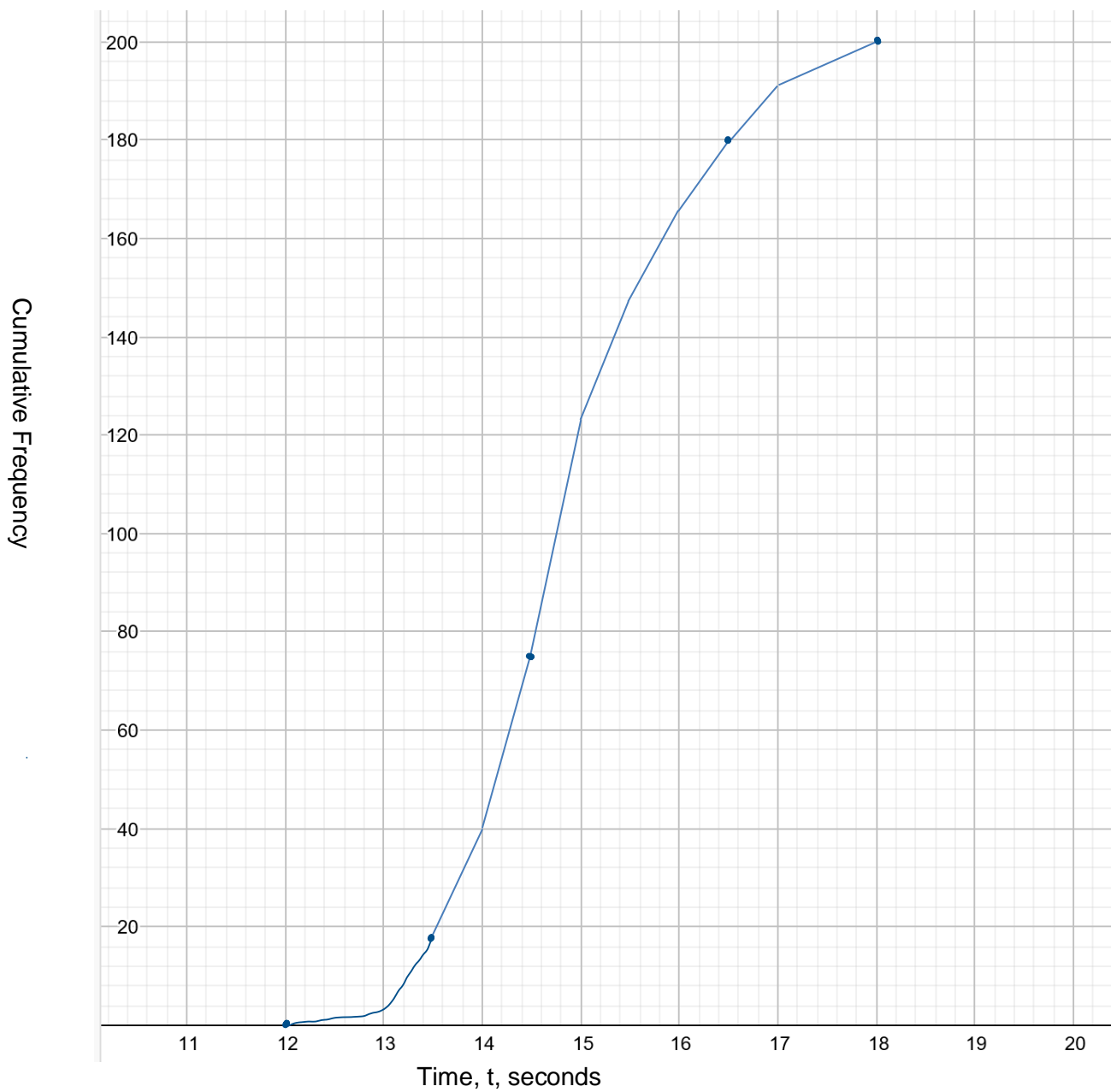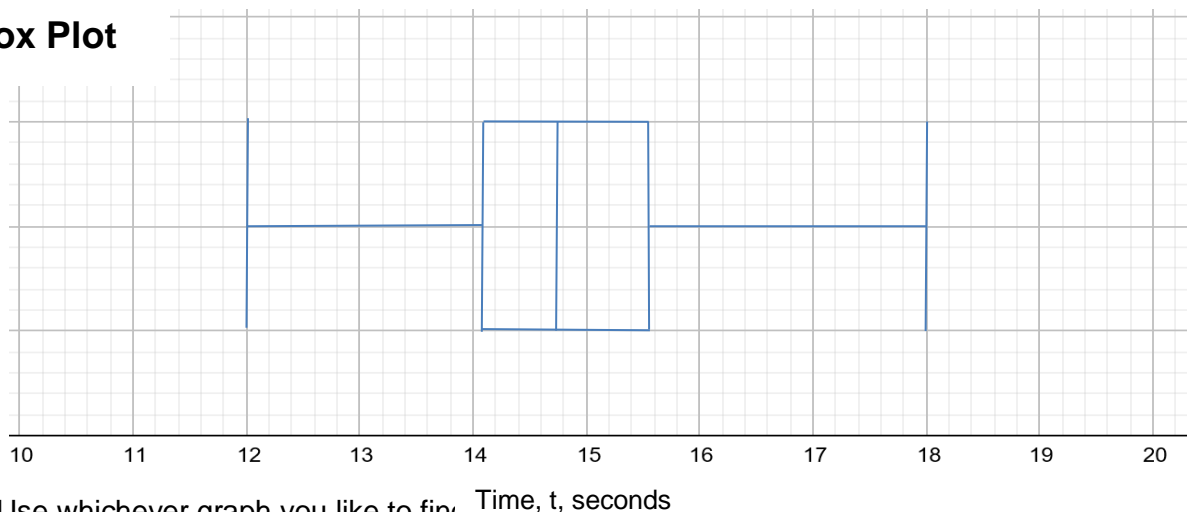
8. Use whichever graph you like to find

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a. The median running time

b. The range

c. The lower quartile

d. The upper quartile

e. The interquartile range

9. Explain why your answers to question 8, can only be estimates.

Here is a set of data for another group of teenage runners, also running 100m:

Time, t, seconds	Frequency
$10.0 \leq t < 11.0$	8
$11.0 \leq t < 11.5$	17
$11.5 \leq t < 12.0$	43
$12.0 \leq t < 12.5$	28
$12.5 \leq t < 13.0$	19
$13.0 \leq t < 13.5$	14
$13.5 \leq t < 14.5$	6
$14.5 \leq t < 16.0$	6

| Time, t, seconds	Cumulative Frequency
< 11.0	
< 11.5	
< 12.0	
< 12.5	
< 13.0	
< 13.5	
< 14.5	
< 16.0	

10. Complete the cumulative frequency table for these runners.

11. How many runners are in this group?

12. On the graph paper below, draw:

a. A histogram for the runners' times

b. A cumulative frequency graph

c. A box plot

Remember to label your axes for each graph

Histogram for the runners in group 2
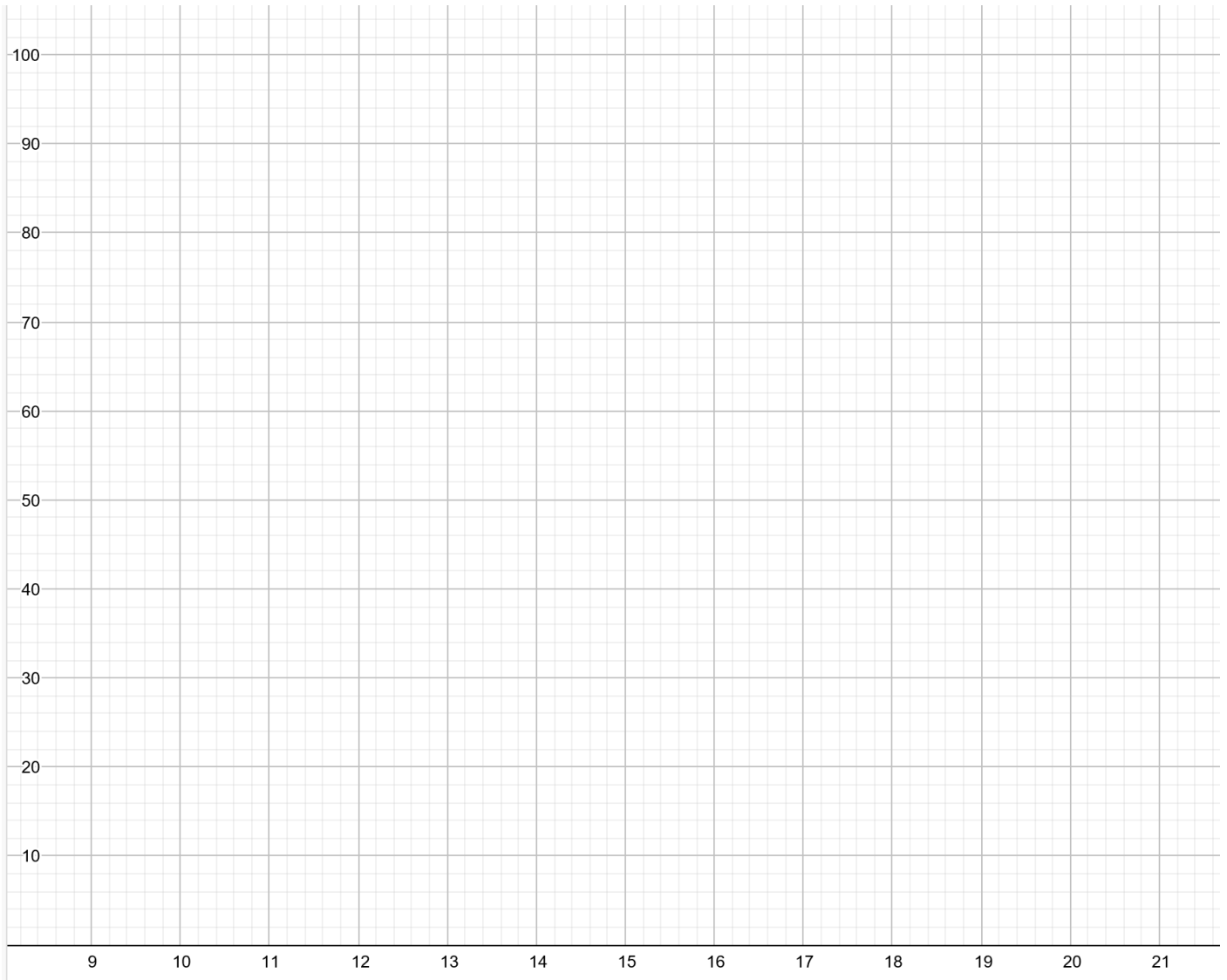
Cumulative Frequency graph for runners in group 2
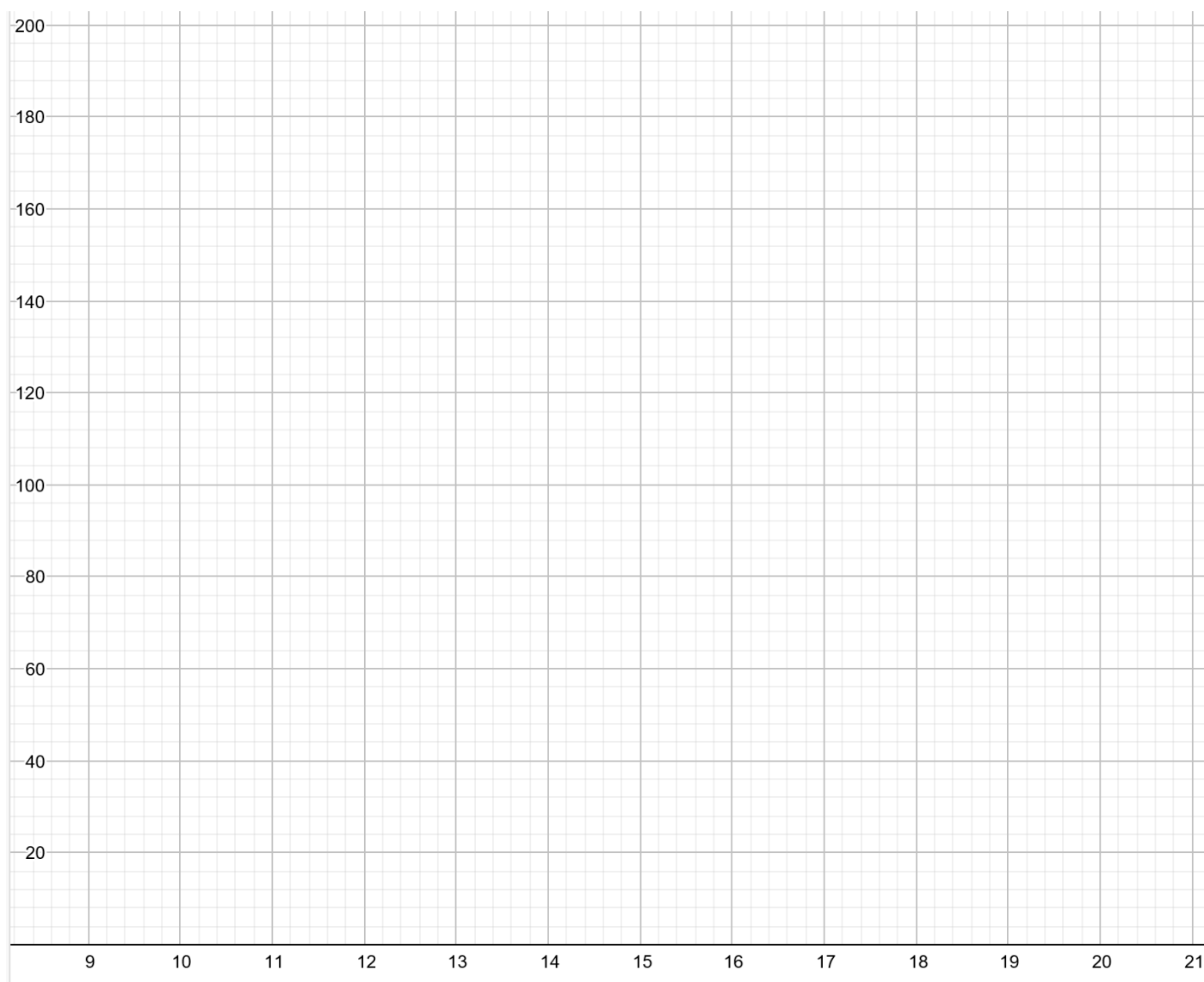
Box plot for runners in group 2

13. Using any of your graphs find the following values:

a. The median running time

b. The range

c. The lower quartile

d. The upper quartile

e. The interquartile range

f. Make some comparisons between the two running groups (you can call them group1 & group 2)

g. One of the running groups were members of a running club, who compete on a regular basis. The data for the other runners was taken during PE lessons at school.

   State with reasons, which group you think were the professional runners

Challenge questions: What world records for speed did Usain Bolt and Florence Griffith-Joyner set? (Give your answers in Km/h)

If you enjoy running, where do you fit in these graphs? Have you set yourself any personal goals for the next few months?