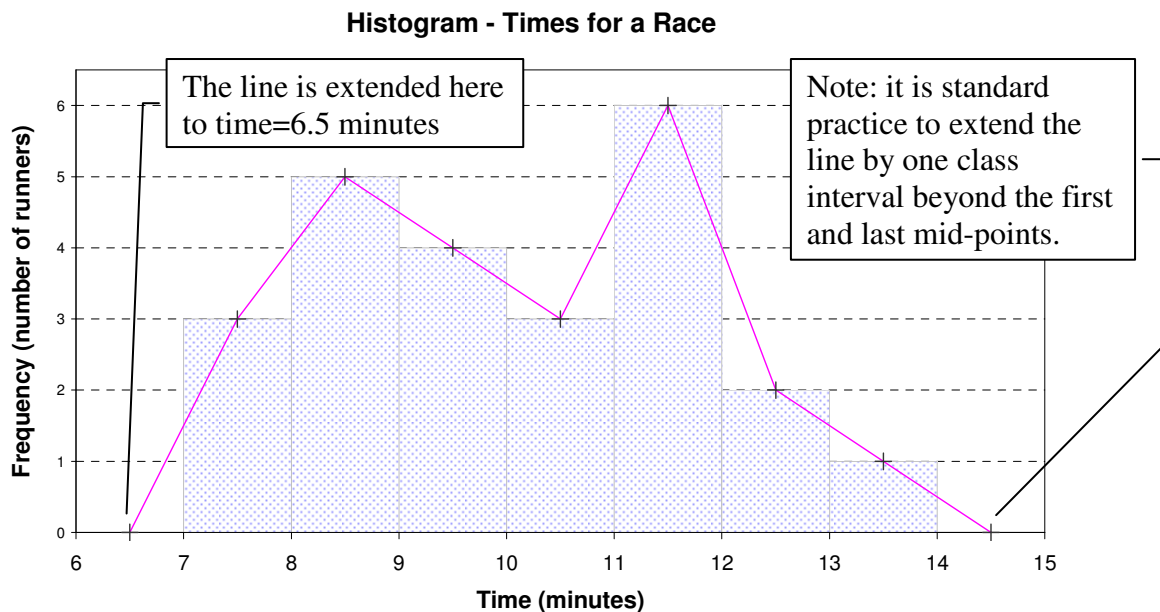


Frequency Polygons

Introduction

A frequency polygon is a frequency diagram of grouped data and is an alternative to a histogram. The bars of the histogram are replaced by straight lines joining the mid-points of the tops of the bars. We will use the earlier histogram, 'Times for a Race', as an example.

The diagram below shows the histogram and the frequency polygon combined. The mid-points are plotted, shown by '+'. The first point is plotted at $t = 7.5$ minutes, $f = 3$, half way between the class boundary divisions at 7 and 8 minutes. The next point is at 8.5 minutes.



In a question to draw a frequency polygon you are not expected to include the histogram. When you have plotted the points, don't forget to join them with straight lines. Take care to plot the mid-points correctly. You will be given a frequency table listing the frequencies and the class intervals. For example, here's part of the table for 'Times for a Race':

Time t (minutes)	Frequency f
$10 \leq t < 11$	3

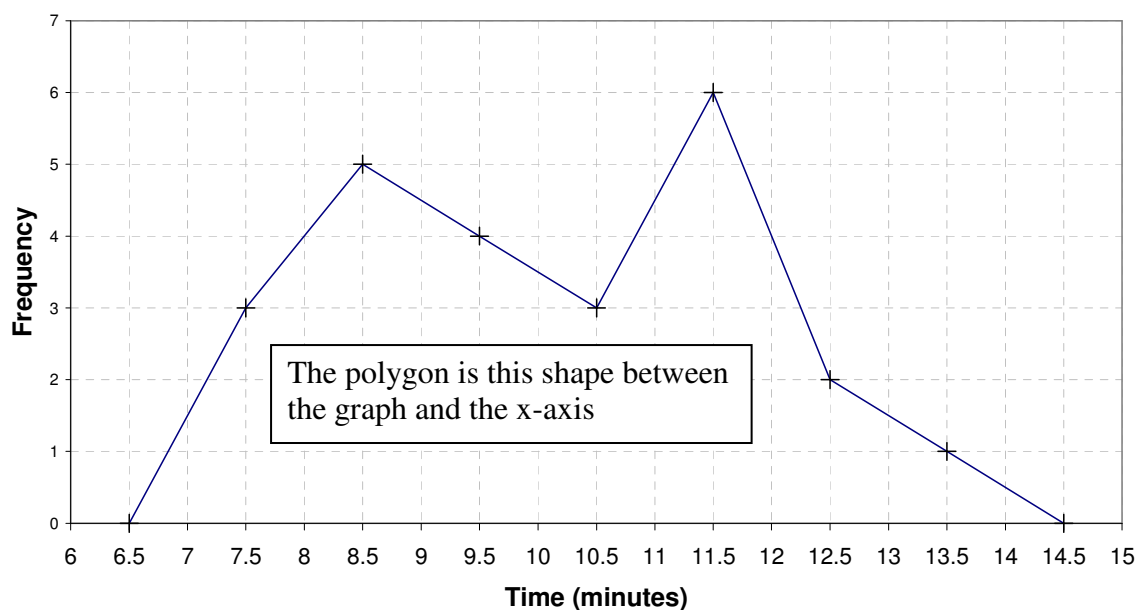
Some students mistakenly plot the frequency against one of the class boundaries (10 or 11). You must work out each mid-point. The mid-point of the $10 \leq t < 11$ class is half way between 10 and 11, at 10.5 minutes, and so the point is plotted at $t = 10.5$ minutes and $f = 3$.

It is conventional to extend the line of the graph by one class interval beyond the first and last mid-points, so that the graph touches the x-axis. This is not required for GCSE. In the graph above, a line from the mid-point at $t = 7.5$ minutes is drawn one class interval (in this example 1 minute) to the left, to hit the axis at $t = 6.5$ minutes. The polygon is the shape formed by the line of the x-axis below and the straight lines of the graph above.

In an exam question you may be given a table of grouped data and asked to draw a **frequency diagram**. You can choose to draw a frequency polygon **or** a histogram. Most people find it easier to draw a frequency polygon.

Below we show just the frequency polygon. The mid-point values are plotted (7.5, 8.5 etc). The x-scale was chosen so that the mid-point values and the class boundaries are shown. It resembles a conventional x-y line graph in which the frequency is plotted against time.

Frequency Polygon - Times for a Race

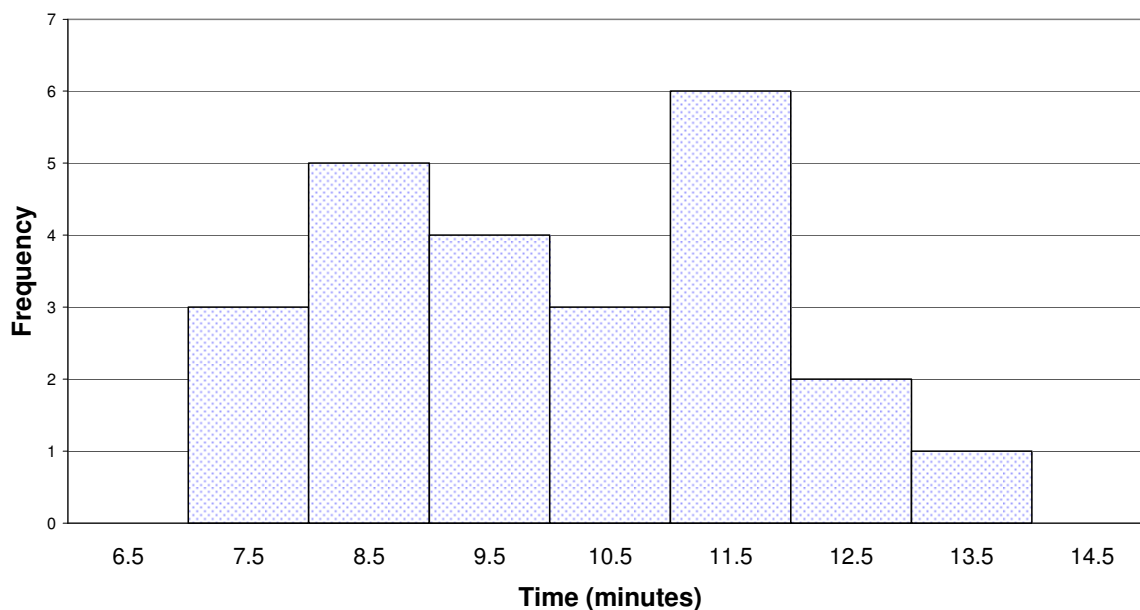


In an exam question you may be given an empty grid. Take care to label the scales correctly – you may prefer to label the mid-point values, not the class boundaries, on the x-scale, to assist in plotting the points at the correct positions.

Using Excel

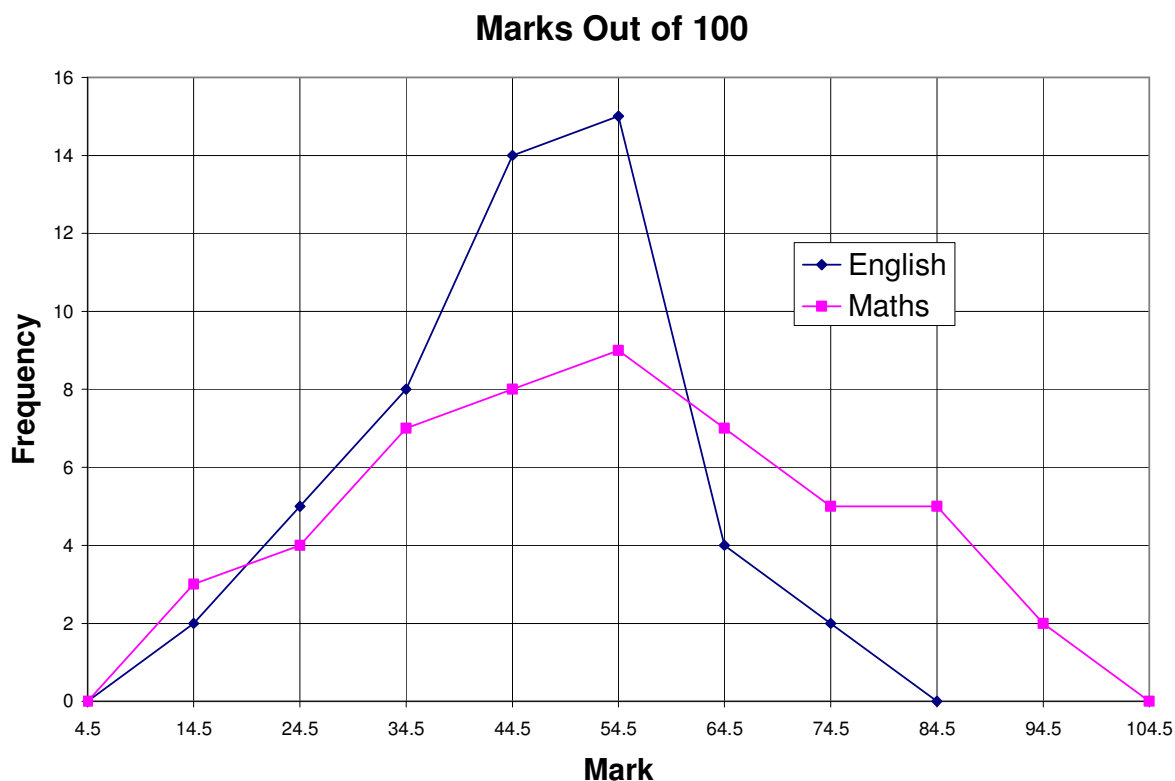
Using Excel to create charts may be of interest to the reader. The frequency polygon (above) used the XY (Scatter) chart type. The corresponding Excel histogram (below) uses the Column chart type. The x-axis should be a proper scale, such as 6, 7, 8, 9 etc. Instead the mid-point values are labelled in the style of a bar chart. It is clear, though, that the class boundaries are at 7, 8, 9, 10 etc. The combined histogram and frequency polygon (previous page) used both the Excel Column and the XY (Scatter) chart types, and the x-scale was changed from mid-points to a proper continuous scale.

Histogram - Times for a Race



Advantage of a Frequency Polygon

The main advantage of a frequency polygon, compared with a histogram, is that you can superimpose two or more frequency polygons on the same axes and make comparisons between the sets of data. The diagram shows two frequency polygons for the marks in two subjects, Maths and English, for the same group of 50 students. In this case it is quite easy to make a comparison between the two sets of marks.



Data for marks in tests are discrete. Therefore take care if you get a question on grouped, discrete data, when you work out the mid-points. The marks were grouped into classes 0-9, 10-19, 20-29, etc. The mid-point of the 10-19 group is 14.5, the mean of 10 and 19. Therefore the mid-points are 14.5, 24.5 etc. That's why the unusual scale was chosen – so that the mid-point positions correspond directly to the x-scale. A more standard scale could be used, such as 0, 10, 20, etc.

Some students did very well in maths – eight scored more than 80. You can see that the middle range of marks, about 40 to 60, is more common in the English results. The modal group is the same for both subjects (50-59, sometimes written $49.5 \leq \text{mark} < 59.5$).

Exercise 4 – Draw a Frequency Polygon

The table gives the times to run a race for 25 men and 25 women.

Time (minutes)	$30 \leq t < 40$	$40 \leq t < 50$	$50 \leq t < 60$	$60 \leq t < 70$	$70 \leq t < 80$
Frequency: men	0	4	3	8	10
Frequency: women	2	6	8	6	3

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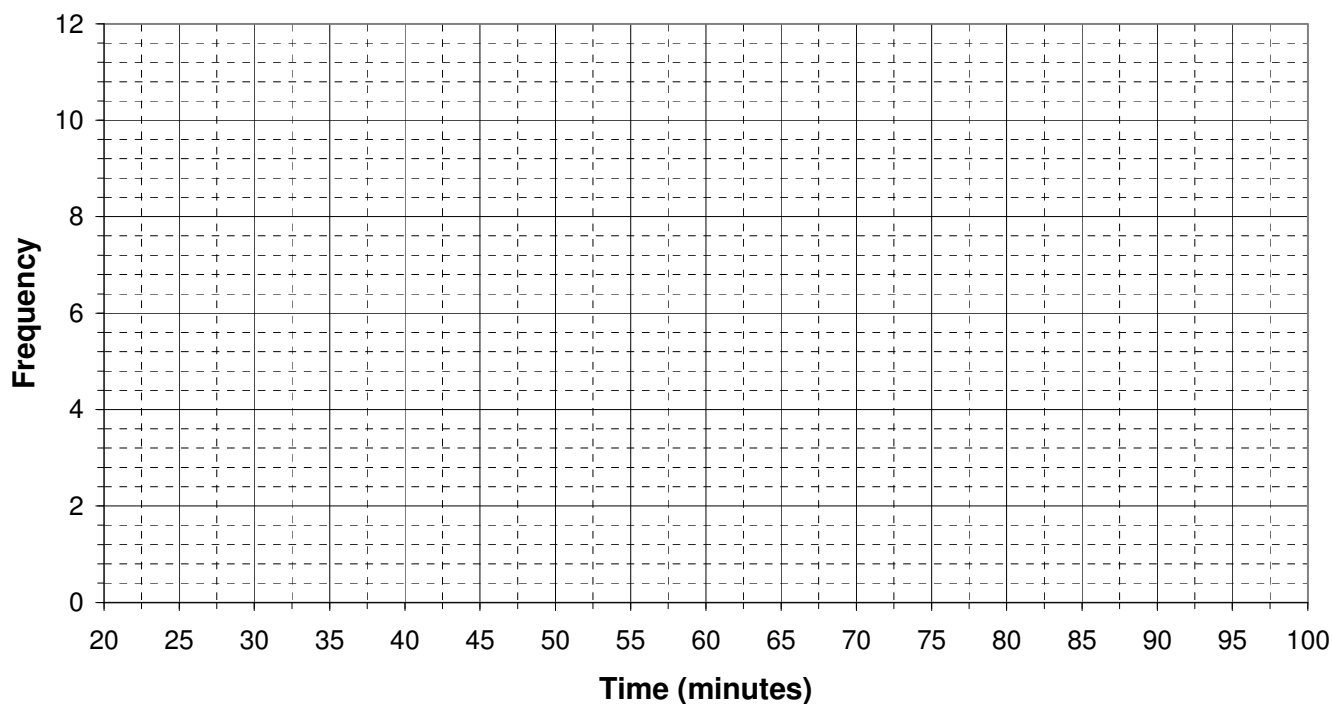
Exercise 4 continued

- Is the data continuous or discrete?
- On (a copy of) the grid provided below, draw separate frequency polygons for the men and the women. Label the diagram fully.

The solution is on page 26. Note: you may wish to use a copy of this table to record the mid-points before you plot the graph.

Time (minutes)	$30 \leq t < 40$	$40 \leq t < 50$	$50 \leq t < 60$	$60 \leq t < 70$	$70 \leq t < 80$
Frequency: men	0	4	3	8	10
Frequency: women	2	6	8	6	3
Mid-point					

Comparison: Times to Run a Race



Summary

The main points about a frequency polygon are that:

- a frequency polygon is a frequency diagram. It is called a polygon because of its shape.
- the frequencies are plotted against the mid-point values – the plotted points are then joined by straight lines – the result resembles an x-y line graph.
- it is normally used for grouped data and is an alternative to a histogram.
- the advantage of a frequency polygon is that you can easily compare two sets of related data on the same chart – for example, the marks in a test for 50 men and 50 women.
- not essential for GCSE – the line of the graph is extended to meet the x-axis and the area of the polygon equals the total area of the bars on the corresponding histogram.