

Check-Up

40

Measures of spread, range and inter-quartile range

A teacher gave the same Year 10 science test, marked out of 100, to successive cohorts (A and B) and summarised their scores in the table below. The median scores were about the same for the two cohorts. But which had the greater range of scores? Compare the spread of scores using the inter-quartile ranges (IQRs).

	Minimum	Lower quartile	Median	Upper quartile	Maximum
Cohort A	23	45	56	63	91
Cohort B	40	46	57	78	90

Answers to check-up 40

Cohort A (range = 68 marks) had a greater range than Cohort B (range = 50 marks).

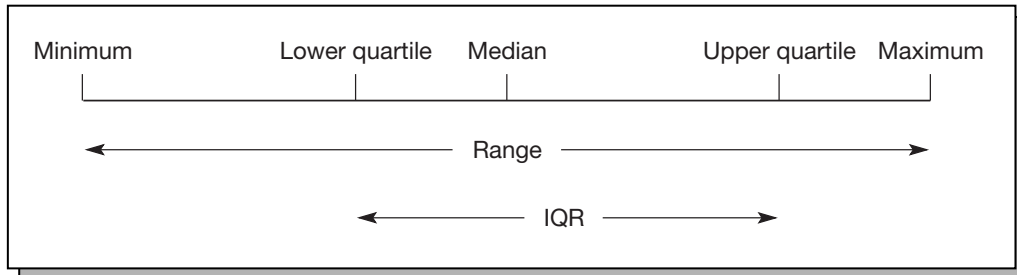
Cohort B (IQR = 32) had a greater IQR than Cohort A (IQR = 18).

Discussion and explanation of check-up 40

To compare sets of data like these, we need to look not just at 'average' figures like the median and the mean, but also at how the values in the sets are spread. In one case we might find that all the values are tightly clustered around the average compared to another in which they are much more greatly dispersed. There are four commonly-used measures of dispersion in statistics: the range, the inter-quartile range, the variance and the standard deviation. You may come across the last two, for example in data provided with standardised tests, but they are too technical for this book.

The difference between the minimum and the maximum is called the *range*. The *range* in Cohort A, for example, is $91 - 23 = 68$. Note also that sometimes we might just say that the range of values is from 23 to 91. The range is a useful starting point for discussing spread. The range in Cohort A is much greater than that in Cohort B, suggesting much more variability in performance in Cohort A. However, the larger range of scores in Cohort A might be due to just one or two unrepresentative individuals who scored exceptionally high or exceptionally low. Because of this, the *inter-quartile range* (IQR) is a better indicator of spread. The IQR is just the difference between the LQ and the UQ. Since this excludes the top 25% and bottom 25% of marks, it tells us how spread out are the scores of the middle 50% of pupils in the cohort. In our example, the IQR in Cohort A is $63 - 45 (= 18)$, and the IQR in Cohort B is $78 - 46 (= 32)$. This means that, excluding the pupils who scored high and those who scored low in the test, the scores of the middle 50% of pupils in Cohort B were more greatly spread out than those of the middle 50% of pupils in Cohort A.

The five statistics given in the table – the minimum, the LQ, the median, the UQ and the maximum – provide what is sometimes called a 'five-number summary' of the data. The diagram below shows these numbers represented on a number line, with the range and IQR being the lengths of the arrows indicated.



Summary of key ideas

- ◆ The range and the inter-quartile range (IQR) are two simple ways of measuring the extent to which data in a set is spread.
- ◆ The range is just the difference between the maximum and minimum values.
- ◆ The IQR is the difference between the upper and lower quartiles.
- ◆ The IQR is not affected by a few exceptionally high or low values at the extremes.

Further practice

40.1 A survey of a large sample of primary schools reports the following data about the number of hours devoted per week to PE and RE in their Key Stage 1 classes:

Hours per week	Minimum	Lower quartile	Median	Upper quartile	Maximum
PE	0.5	1.0	1.2	1.7	2.2
RE	0.5	0.9	1.1	1.3	1.8

Compare the ranges and inter-quartile ranges for this data.