S4 • Understanding mean, median, mode and range

Mathematical goals

To help learners to:

- understand the terms: mean, median, mode, range;
- explore the relationships between these measures and their relationship to the shape of a distribution.

Starting points

Most learners will have met the terms mean, median, mode and range but they may not have a clear understanding of their meaning and the relationships between them. One purpose of this session is to expose and discuss any misconceptions.

Materials required

An overhead or data projector, or an interactive whiteboard, can be very helpful during the early part of the session.

- OHT 1 – Recording data;

or

- computer program *Statistics 1* provided on the DVD-ROM/CD.

For each small group of learners you will need:

- Card set A – *Bar charts*;
- Card set B – *Statistics*;
- large sheet of paper for making a poster;
- glue stick;
- access to a computer loaded with the computer program *Statistics 1* (optional).

You may feel it appropriate for learners aiming at lower levels to be given just the first six cards in each set.

Time needed

Approximately 1–2 hours.

Make sure you leave plenty of time for the closing discussion on methods.

Suggested approach

Beginning the session

Ask the group to give you 11 numbers, or 'scores', between 1 and 6. As learners call them out, write them in the *Raw scores* box in OHT 1. Tell learners that these numbers could, for example, represent numbers that were thrown on rolls of a die or from some other experiment.

Ask learners to show you how a frequency table and then a bar chart can be drawn from this raw data. This should be fairly straightforward. Learners may like to come out and fill in some of the OHT for you.

Ask the group to explain the meaning of the terms 'mean', 'median', 'mode' and 'range'. As they do so, ask learners to come out and demonstrate the following calculations using the raw scores.

> The 'mean' is calculated by summing all the data and dividing by the number of terms.
>
> The 'median' is calculated by putting the scores in order of size and then finding the middle score.
>
> The 'mode' is found by looking for the most common score.
>
> The 'range' is found by calculating the difference between the greatest and least scores.

Hide the raw scores and the bar chart and ask learners how they might have calculated these statistics by looking only at the frequency table.

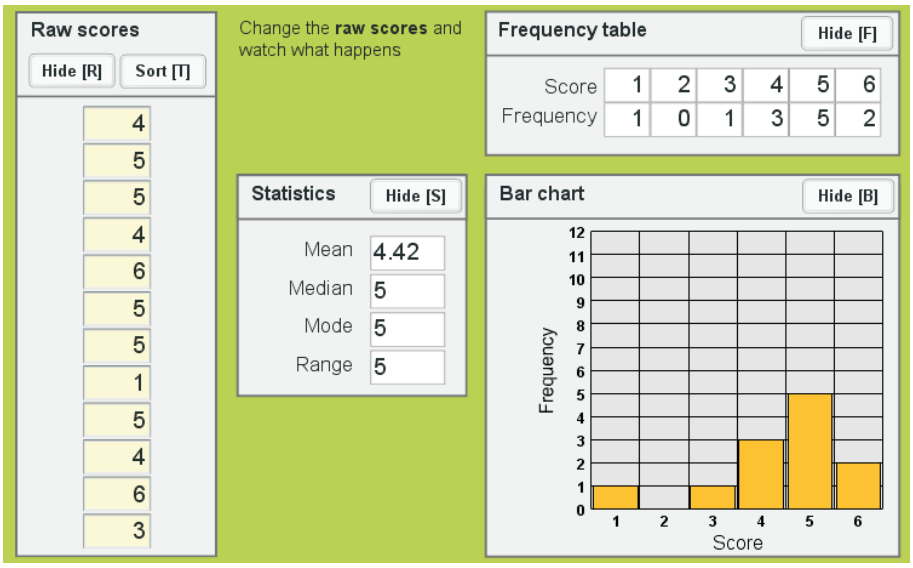
> When calculating the mean, what is wrong with just adding all the frequencies and dividing by 6?
>
> How can we find the median by looking only at the frequency table?

Finally, hide both the raw scores and the frequency table and ask the same questions, referring only to the bar chart.

> Without writing anything down, how can we calculate the median, the mode and the range from the bar chart?
>
> How can we calculate the mean?

Using an interactive whiteboard

A computer program is provided on the DVD-ROM to facilitate this discussion. To begin with, we suggest that you hide the frequency table, the bar chart and the statistics, and then reveal these in stages as the explanation proceeds.



Working in groups

Give Card set A – *Bar charts* and Card set B – *Statistics* to each pair of learners.

Ask learners to work together, trying to match pairs of cards. They will notice that some of the *Statistics* cards have gaps on them and one of the *Bar charts* cards is blank. Learners should try to work out what these blanks should be.

As they work on this task, encourage learners to take turns at explaining how they know that particular cards match. Allow learners a period of time to get to know the cards, and to think of a good approach to the problem.

Learners who struggle with the task may be helped by some strategic hints:

> Try sorting the two sets of cards into order first – from smallest to highest range.
> Now repeat this using the modal values . . .
> Now the medians . . .

If learners continue to struggle, encourage them to write out the raw scores from the bar chart and then sort and organise them in order to calculate the statistics.

During the discussion, the following questions may promote deeper thinking:

> Which two bar chart cards show a sample size of 12?
> (J and K).
>
> Can we tell how big the sample size is from the statistics?
> (No)
>
> How do we work out the median when there is no middle number?
> (This occurs on bar chart J, where the median is 3.5).

It may be worth stopping the session at some point to discuss these issues with the whole group.

Reviewing and extending learning

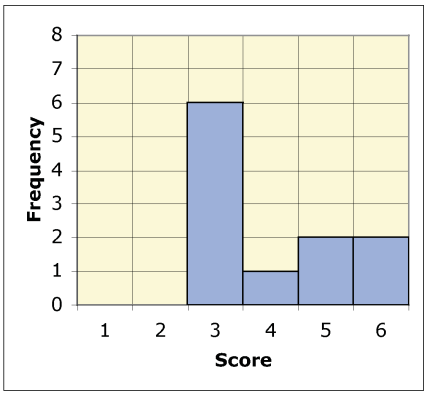
Learners may like to make posters of their finished work by pasting the cards onto a large sheet of paper.

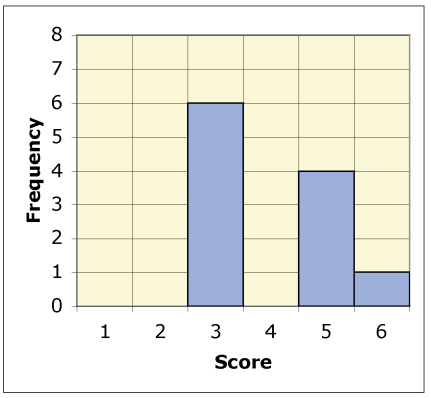
If you have the computer software available, learners could check their solutions by entering raw scores that correspond to a particular bar chart and then check to see that the mean, median and mode are correct.

In the whole group discussion, discuss some of the strategies that learners used to sort the cards.

> The mode was the easiest, so I put all the cards with the same mode together. I then looked at the range. I then looked at the median and finally the mean.

Finally, discuss how the missing bar chart may be constructed from the statistics on *Statistics* card Stats G. Learners may be surprised that there is more than one correct answer. For example, both these bar charts have mean = 4, median = 3, mode = 3, range = 3. In addition, we have no idea what the sample size is.





One approach might be:

> I first saw that the mode was 3, so there must be a tall bar by a score of 3. The fact that the median is also 3 means that the middle score is at 3. This made me think that there might be 6 scores at 3. If there were many lower than 3, I would have trouble getting a mean greater than 3. As the range is 3, then I thought that the scores would go from 3 to 6.

What learners might do next

When learners have reached a clear understanding of mean, median, mode and range, they may be ready to move on to another statistics session, **S5 Interpreting bar charts, pie charts, box and whisker plots**.

Further ideas

This activity uses multiple representations to deepen understanding of statistical measures. This type of activity can be used in any topic where a range of representations is used. Examples in this pack include:

- **N5 Understanding the laws of arithmetic;**
- **A1 Interpreting algebraic expressions;**
- **SS6 Representing 3D shapes.**

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S4 OHT 1 – *Recording data*

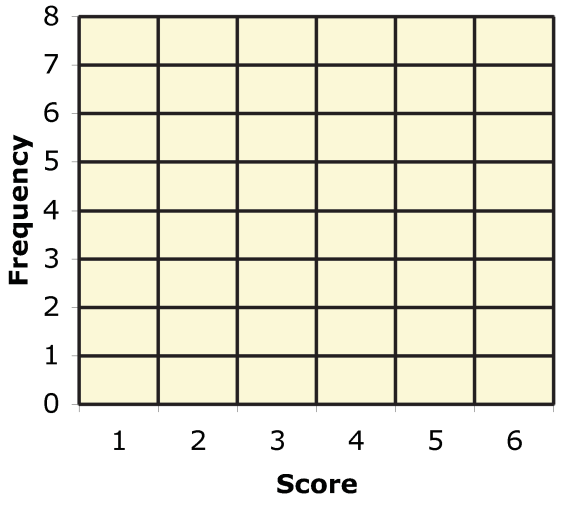
Raw scores

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

Frequency table

Score	1	2	3	4	5	6
Frequency						

Bar chart



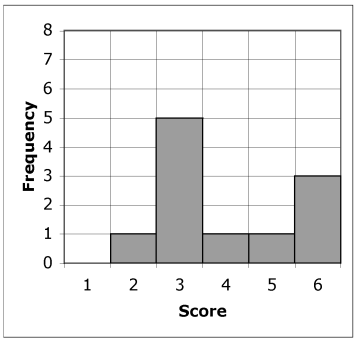
Statistics

Mean	
Median	
Mode	
Range	

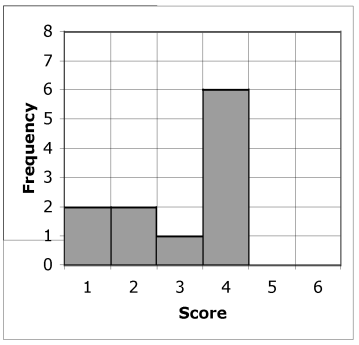
S4 Card set A – *Bar charts*

Bar chart A

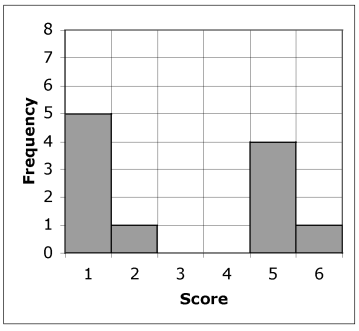
Bar chart B



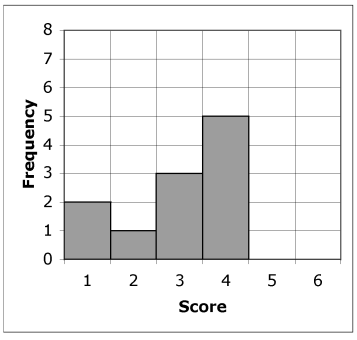
Bar chart C



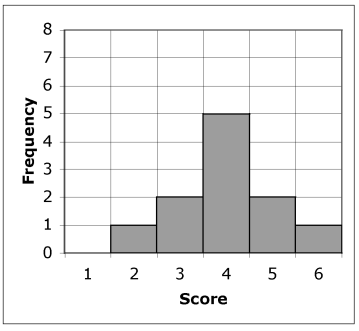
Bar chart D



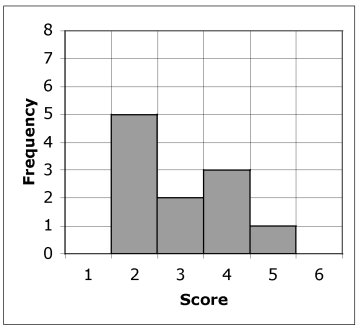
Bar chart E



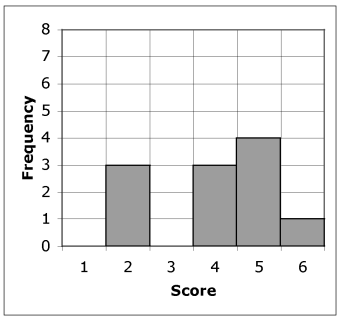
Bar chart F



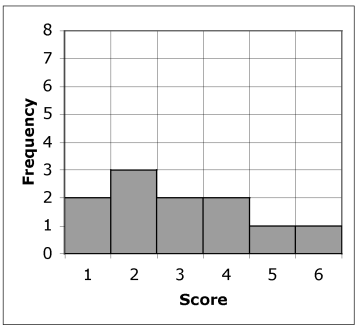
Bar chart G



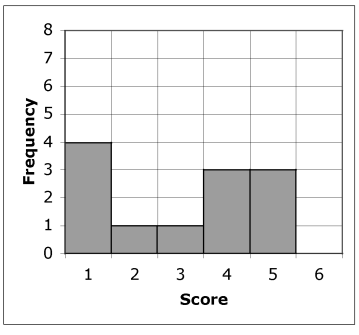
Bar chart H



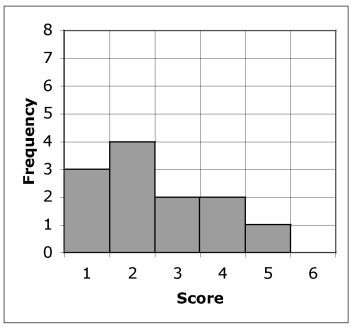
Bar chart I



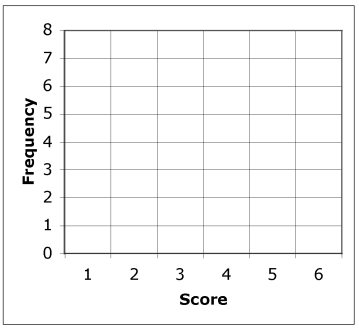
Bar chart J



Bar chart K



Bar chart L



S4 Card set B – *Statistics*

Stats A

Mean	3
Median	4
Mode	4
Range	3

Stats B

Mean	3
Median	3
Mode	3
Range	

Stats C

Mean	3
Median	2
Mode	
Range	5

Stats D

Mean	4
Median	4
Mode	4
Range	4

Stats E

Mean	3
Median	3
Mode	4
Range	3

Stats F

Mean	
Median	3
Mode	3
Range	4

Stats G

Mean	4
Median	3
Mode	3
Range	3

Stats H

Mean	
Median	2
Mode	2
Range	4

Stats I

Mean	3
Median	
Mode	2
Range	3

Stats J

Mean	3
Median	
Mode	1
Range	4

Stats K

Mean	3
Median	3
Mode	
Range	5

Stats L

Mean	4
Median	4
Mode	5
Range	