# Breaking the code

Students collect data to determine commonly used letters, to assist in breaking a code.

## Visible learning

### Learning intentions

* To be able to represent and interpret a dataset using graphs and frequency tables.
* To be able to identify and describe the mode/s of a dataset.

### Success criteria

* I can represent a dataset in a frequency table.
* I can represent a dataset in an appropriate graph.
* I can use the terms uniform, unimodal, bimodal, and multimodal to describe datasets.

### Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing, and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* classifies and displays data using a variety of graphical representations
**MA4-DAT-C-01**
* analyses simple datasets using measures of centre, range, and shape of the data **MA4-DAT-C-02**

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## Activity structure

### Launch

You have been given the following message from a friend. Can you work out what it says?

‘HSOGQZWJR WV ZDH LJVZ TJMHUCOF MHQTJR MDWGD PJO GQR OVH ZJ GDQRIH ZDH MJUFS’

1. Display the message for the class to see.
2. Brainstorm with the class how it may have been created. What ciphers and codes have they seen before?

### Explore

This activity uses spreadsheet software to organise data and create graphs. Students can record and graph the data manually using [Appendix A](#_Appendix_A).

‘HSOGQZWJR WV ZDH LJVZ TJMHUCOF MHQTJR MDWGD PJO GQR OVH ZJ GDQRIH ZDH MJUFS’

The phrase above is a quote from a famous person. Each of the letters has been replaced by another letter to create a code. The aim of this activity is to break the code and reveal the quote.

#### Analysing the frequency of letters

1. Students use an article from a newspaper or a page in a book to complete a frequency table of the letters of the alphabet using the Letter frequency tab in the spreadsheet Breaking the code.
2. Discuss the type of data they have collected, for example, Categorical, Ordinal.
3. Students are to display their data using the spreadsheet software to create a suitable graph. You could show students the video [Creating Charts (2:53)](https://bit.ly/Graphs_Excel365) ([bit.ly/Graphs\_Excel365](https://bit.ly/Graphs_Excel365)) to teach them how to graph in Microsoft Excel.
4. Ask students to informally describe the shape of their data. They might talk about there being peaks or higher points in their graphs.
5. Use the Breaking the code PowerPoint to explicitly teach students about the types of mode: no modes (uniform), one mode (unimodal), 2 modes (bimodal) or multiple modes (multimodal).
6. Ask them to again describe the shape of their data using the new terminology.

#### Analysing small words

1. Using the same page of the newspaper or book, students list all the **2** and **3** lettered words in a frequency table using the *Small word frequencies* tab of the *Breaking the code* spreadsheet.
2. They will again display their results using a suitable graph.
3. Students will then describe the shape of this data.
4. Ask students to explain why it doesn’t make sense to calculate the median or mean of this data.

### Summarise

1. Discuss, as a whole class, their findings. Did all letters appear evenly? Which letter is the most common? Which is the least? How many modes did they have?

This is a good opportunity to revise the students’ probability knowledge. Students could find the relative frequency of each letter and use the observed probability to determine which letter will appear the most in the code.

1. Using the insights gained from the analysis above, students should try to break the code to reveal the famous quote. They will need to use strategies such as determining the modal letter in the code and matching it to the modal letter they found in their analysis (or observed probability). They should also look for 2 and 3 letter words in the code and match them with the modal words for their analysis.
2. Students are asked to explain, in writing, to a friend how they cracked the code. This should be shared as a whole class discussion to help those who are struggling, whilst successful students move on to creating their own code.

### Apply

1. Students will now use their analysis of the alphabet and two and three letter words to create their own code and message.
2. They should give their message to another student in the class for them to try and crack.

## Assessment and Differentiation

### Suggested opportunities for differentiation

**Launch**

* There are no correct answers during the launch and all students should be encouraged to participate and share their thoughts and reasoning.

**Explore**

* The length of text that is used in the analysis could be lengthened or shortened to suit the needs of individual students.
* Students from non-English speaking backgrounds could be encouraged to analyse a text in their own language and to compare the frequency of letter usage with an English text. Likewise, teachers could use Google translate to translate the code into an alternative language.

**Summarise**

* Students who have difficulty applying their text analysis to the code, could be given the cipher to decode the text.

### Suggested opportunities for assessment

* Teachers should monitor student responses during class discussions to ass student understanding.
* Teachers could collect student’s explanation of how they cracked the code from the Summarise section to check for understanding.

## Appendix A

### Breaking the code

‘HSOGQZWJR WV ZDH LJVZ TJMHUCOF MHQTJR MDWGD PJO GQR OVH ZJ GDQRIH ZDH MJUFS’

The phrase above is a quote from a famous person. Each of the letters has been replaced by another letter to create a code. The aim of this activity is to break the code and reveal the quote.

#### Analysing the frequency of letters

1. Using a page of a newspaper or a book, complete the frequency table below. For each letter record its frequency on the page.

|  |  |  |
| --- | --- | --- |
| Letter | Tally | Frequency |
| A |  |  |
| B |  |  |
| C |  |  |
| D |  |  |
| E |  |  |
| F |  |  |
| G |  |  |
| H |  |  |
| I |  |  |
| J |  |  |
| K |  |  |
| L |  |  |
| M |  |  |
| N |  |  |
| O |  |  |
| P |  |  |
| Q |  |  |
| R |  |  |
| S |  |  |
| T |  |  |
| U |  |  |
| V |  |  |
| W |  |  |
| X |  |  |
| Y |  |  |
| Z |  |  |

1. Represent the information in the frequency table in a suitable graph.
2. Describe the shape of your data i.e. How many modes does it have? Is the data all clustered at one end or spread evenly? What is the most common letter?

#### Analysing small words

1. Using the same page of the newspaper or book, list all of the **2** and **3** lettered words in the frequency table below and complete the frequency table. For each word record its frequency on the page.

|  |  |  |
| --- | --- | --- |
| Word | Tally | Frequency |
| as |  |  |
| is |  |  |
| to |  |  |
| the |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

1. Represent the information in the frequency table in a suitable graph.
2. Describe the shape of your data i.e. How many modes does it have? Is the data all clustered at one end or spread evenly? What is the most common small word?

#### Using the analysis

1. Using the insights gained from the analysis above, break the code to reveal the famous quote.
2. Your friend is having trouble cracking the code. Write a couple of sentences to explain to them how you cracked the code.
3. Again, using the insights you gained from your analysis, create your own code and secret message. Give your secret message to a friend and see if they can crack your code.

#### Solution – Breaking the code

"Education is the most powerful weapon which you can use to change the world" (Nelson Mandela)

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