Mathematics Stage 4 (Year 8) – unit of learning

Shape and skew

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# Rationale

The NSW Department of Education publishes a range of curriculum support materials, including samples of lesson sequences, scope and sequences, assessment tasks, examinations, student and teacher resource booklets, and curriculum planning and curriculum evaluation templates. The samples are not exhaustive and do not represent the only way to complete or engage in each of these processes. Curriculum design and implementation is a dynamic and contextually-specific process. While the mandatory components of syllabus implementation must be met by all schools, it is important that the approach taken by teachers is reflective of their needs, and faculty or school processes.

The NSW Education Standards Authority (NESA) defines [programming](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming) as ‘the process of selecting and sequencing learning experiences which enable students to engage with syllabus outcomes and develop subject specific skills and knowledge’ (NESA 2022). A program is developed collaboratively within a faculty. It differs from a unit in important ways, as outlined by NESA on their [Advice on units](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units) page. A unit is a contextually-specific plan for the intended teaching and learning for a particular class for a particular period. The organisation of the content in a unit is flexible and it may vary according to the school, the teacher, the class and the learning space. They should be working documents that reflect the thoughtful planning and reflection that takes place during the teaching and learning cycle. There are mandatory components of programming and unit development, and this template provides one option for the delivery of these requirements. The NESA and department guidelines that have influenced this template are elaborated upon at the end of the document.

This resource has been developed to assist teachers in NSW Department of Education schools to create learning that is contextualised to their classroom. It can be used as a basis for the teacher’s own program, assessment, or scope and sequence, or be used as an example of how the new curriculum could be implemented. The resource has suggested timeframes that may need to be adjusted by the teacher to meet the needs of their students.

# Overview

**Description**: this program of learning addresses content from the focus areas of Data classification and visualisation and Data analysis. The lessons and sequences in this program of learning are designed to allow students to explore how to analyse frequency distribution graphs using measures of centre and spread, and shape and skew of a graph.

**Duration**: this program of learning is designed to be completed over a period of approximately 6 weeks but can be adapted to suit the school context.

**Explicit teaching**: suggested learning intentions and success criteria are provided. Learning intentions and success criteria are most effective when they are contextualised to meet the needs of students in the class. The examples provided in this document are generalised to demonstrate how learning intentions and success criteria could be created.

# Outcomes

## Core

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**

The identified Life Skills outcomes that relate to this unit are **MALS-REP-01** – represents number in everyday contexts**, MALS-COM-01** – compares and orders numbers**, MALS-DEP-01** – demonstrates knowledge of decimals and percentages in everyday contextsand **MALS-PAT-01** – recognises and applies patterns in everyday contexts.

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**Prior to planning for teaching and learning, please consider the following**:

**Engagement**

* How will I provide authentic, relevant learning opportunities for students to personally connect with lesson content?
* How will I support every student to grow in independence, confidence, and self-regulation?
* How will I facilitate every student to have high expectations for themselves?
* How will I identify and provide the support each student needs to sustain their learning efforts?

**Representation**

* What are some different ways I can present content to enable every student to access and understand it?
* How will I identify and address language and/or cultural considerations that may limit access to content for students?
* How will I make lesson content and learning materials more accessible?
* How will I plan learning experiences that are relevant and challenging for the full range of students in the classroom?

**Expression**

* How will I provide multiple ways for students to respond and express what they know?
* What tools and resources can students use to demonstrate their understanding?
* How will I know every student has understood the concepts and language presented in each lesson?
* How will I monitor if every student has achieved the learning outcomes and learning growth?

# Lesson sequence and details

## Learning episode 1 – broccoli soup

### Teaching and learning activity

Students will explore the first steps of a statistical investigation by considering when a census is needed and how to avoid bias when selecting a sample to collect data.

### Syllabus content

* Define a census as a study of every unit, everyone or everything in a population
* Define a sample as a subset of units in a population selected to represent all units in a population of interest

Table 1 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Broccoli soup (DOCX 430.7 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l01-broccoli-soup.docx)  Duration**:** 1 lesson  Learning intention   * To be able to understand factors to consider when collecting data.   Success criteria   * I can explain the difference between a census and a sample. * I can identify when a census is needed in data collection. * I can avoid bias when selecting a sample to collect data. | * Class set of Appendix A and C, printed * Appendix B, printed (one per pair of students) * Appendix D, printed and cut into individual cards (one card per pair of students) * [*Broccoli soup* (PPTX 3.0 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l01-broccoli-soup-slideshow.pptx) PowerPoint |  |

## Learning episode 2 – goal-free soccer

### Teaching and learning activity

Students learn how to draw and interpret histograms and polygons in reference to statistics in sport.

### Syllabus content

* Represent single datasets using graphs, including frequency histograms and polygons, dot plots, stem-and-leaf plots, divided bar graphs, column graphs, line graphs, sector graphs and pictograms, with or without digital tools
* Select the type of graph best suited to represent various single datasets and justify the choice of graph

Table 2 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Goal-free soccer (DOCX 1.0 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l02-goal-free-soccer.docx)  Duration**:** 1 lesson  Learning intention   * To be able to draw and interpret a frequency histogram and polygon.   Success criteria   * I can draw a frequency histogram from a dataset. * I can draw a frequency polygon from a dataset. * I can interpret a frequency histogram and polygon to draw conclusions. | * Appendix A and Appendix B, printed (one per pair of students) * [*Goal-free soccer* (PPTX 4.1 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l02-goal-free-soccer-slideshow.pptx) PowerPoint |  |

## Learning episode 3 – the big sick

### Teaching and learning activity

Students determine whether a company should pay for the flu vaccine by analysing data to determine the mean number of sick days used by staff each year.

### Syllabus content

* Define a variable in the context of statistics as any characteristic, number or quantity that can be measured or counted
* Describe and interpret data displays using mean, median and range
* Compare simple datasets using the mean, median, mode and range

Table 3 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [The big sick (DOCX 571.7 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l03-the-big-sick.docx)  Duration**:** 1 lesson  Learning intention   * To be able to find the mean from a frequency table and graphs.   Success criteria   * I can record data in a frequency. * I can create and complete an column in a frequency table. * I can find the mean from a frequency table. * I can use the mean from a dataset to inform decisions. | * Class set of Appendix A, B, and C, printed * [*The big sick* (PPTX 2.3 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l03-the-big-sick-slideshow.pptx) PowerPoint |  |

## Learning episode 4 – shooting hoops

### Teaching and learning activity

Students learn how to find median and range from a frequency table and graphs by testing their skills of throwing scrunched paper into a bin from a distance.

### Syllabus content

* Describe and interpret data displays using mean, median and range
* Compare simple datasets using the mean, median, mode and range

Table 4 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Shooting hoops (DOCX 1.4 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l04-shooting-hoops.docx)  Duration**:** 1–2 lessons  Learning intention   * To be able to find the median and range from a frequency graph.   Success criteria   * I can draw a dot plot from a frequency table. * I can find the range from a frequency table and graph. * I can find the median from a frequency graph. | * Class sets of Appendix A, B and C, printed * [*Shooting hoops* (XLSX 104.2 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l04-shooting-hoops-spreadsheet.xlsx) Excel Spreadsheet * Waste bin (one per 4–5 students) * Masking tape (one per 4–5 students) * Tape measures (one per 4–5 students) * A piece of A4 paper (one per student) |  |

## Learning episode 5 – footy fit

### Teaching and learning activity

Students will draw a stem-and-leaf plot using data from NRL player statistics. They will then analyse the data using the range, mode, median and mean and draw conclusions based on their findings.

### Syllabus content

* Describe and interpret data displays using mean, median and range
* Compare simple datasets using the mean, median, mode and range

Table 5 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Footy fit (DOCX 442.4 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l05-footy-fit.docx)  Duration**:** 1 lesson  Learning intention   * To be able to analyse data in a stem-and-leaf plot.   Success criteria   * I can draw a stem-and-leaf plot. * I can calculate the range, mode, median and mean from a stem-and-leaf plot. * I can use data from a stem-and-leaf plot to justify a decision. | * Appendix A, B and D, printed (one per group of 3) * Appendix C, printed A3 (one per group of 3) * [*Footy fit* (PPTX 3.8 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l05-footy-fit-slideshow.pptx) PowerPoint * Adhesive putty * A3 plastic pockets (one per group of 3) |  |

## Learning episode 6 – picture perfect

### Teaching and learning activity

Students describe the skewness of frequency histograms and polygons in reference to exposure in photographs.

### Syllabus content

* Identify and interpret data displayed on graphs
* Identify features of graphical representations to draw conclusions
* Describe and interpret data displays using mean, median and range
* Identify and describe the shape and distribution of a dataset using the terms symmetrical, negatively skewed and positively skewed

Table 6 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Picture perfect (DOCX 4.5 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l06-picture-perfect.docx)  Duration**:** 1–2 lessons  Learning intention   * To know about the shape of a frequency graph.   Success criteria   * I can describe the skewness of a frequency graph. * I can explain whether to use the median or mean as a measure of centre for different shaped frequency graphs. * I can interpret a frequency graph to draw conclusions. | * Appendix A, printed (one per pair of students) * Appendix B, printed in colour (one per pair of students) * [*Picture perfect* (PPTX 10.5 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l06-picture-perfect-slideshow.pptx) PowerPoint |  |

## Learning episode 7 – pass it on graph style

### Teaching and learning activity

Students play a game of ‘Pass it on’, using different graphs to highlight the need for shared terminology of the features to describe them.

### Syllabus content

* Identify and interpret data displayed on graphs
* Identify features of graphical representations to draw conclusions
* Identify and describe datasets as having no modes (uniform), one mode (unimodal), 2 modes (bimodal) or multiple modes (multimodal)
* Informally identify clusters, gaps and outliers in datasets and give reasons for their occurrence in the context of the data

Table 7 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Pass it on graph style (DOCX 678.2 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l07-pass-it-on-graph-style.docx)  Duration**:** 1 lesson  Learning intention   * To be able to describe the features of a graph.   Success criteria   * I can identify clusters, gaps and outliers in graphs. * I can describe a dataset as having no modes, one mode, 2 modes or multiple modes. | * Appendix A, printed and cut into individual cards (one per pair of students) (if not using technology) * [*Pass it on graph style* (XLSX 227.5 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l07-pass-it-on-graph-style-spreadsheet.xlsx) Excel Spreadsheet * Digital device per pair of students (optional) |  |

## Learning episode 8 – wisdom of the crowd

### Teaching and learning activity

Students explore the effect on measures of centre and spread when data is added or removed.

### Syllabus content

* Identify and explain the impact of adding or removing data values that are clustered at one end of a dataset on the measures of centre
* Identify and explain the impact of outliers on the measures of centre and range

Table 8 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Wisdom of the crowd (DOCX 416.1 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l08-wisdom-of-the-crowd.docx)  Duration**:** 1 lesson  Learning intention   * To understand how data affects the mean, median, range and mode.   Success criteria   * I can explain what happens to the mean, median, range and mode when an outlier is added. * I can explain what happens to the mean, median, range and mode when a cluster of numbers is added or removed from a dataset. * I can add or remove data to increase or decrease the mean, median and mode. | * Class set of Appendix A and B, printed * [*Wisdom of the crowd* (PPTX 1.9 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l08-wisdom-of-the-crowd-slideshow.pptx) PowerPoint |  |

## Learning episode 9 – the best centre

### Teaching and learning activity

Students explore how the location of the mean, median and mode in frequency graphs to determine the best measure of centre.

### Syllabus content

* Describe and interpret data displays using mean, median and range
* Determine and justify the most appropriate measure of centre to summarise the data in its context

Table 9 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [The best centre (DOCX 773.8 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l09-the-best-centre.docx)  Duration**:** 1 lesson  Learning intention   * To be able to select the best measure of centre to represent a dataset.   Success criteria   * I can explain how an outlier affects the measure of centre of a dataset. * I can explain how a cluster affects the measure of centre of a dataset. * I can select and explain the best measure of centre given the graph of its data. | * Class set of Appendix A, printed. * Appendix B, printed and cut into individual cards (one per 5 students) * Appendix C and D, printed (one per 3 students) * [*The best centre* (PPTX 1.4 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l09-the-best-centre-slideshow.pptx) PowerPoint |  |

## Learning episode 10 – random samples

### Teaching and learning activity

Students explore why we can trust sample data and how collection bias can appear when using samples.

### Syllabus content

* Describe and interpret data displays using mean, median and range
* Compare simple datasets using the mean, median, mode and range
* Draw conclusions and make informed decisions about data gathered using data-collection techniques, including census and sampling, which is then presented in tables, graphs and charts

Table 10 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Random samples (DOCX 718.5 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l10-random-samples.docx)  Duration**:** 1–2 lessons  Learning intention   * To understand how to use sample data to represent a population.   Success criteria   * I can explain the potential bias that can occur when using a sample. * I can explain why a variation in measures of centre occur when using a sample. * I can justify why I can draw valid conclusions from sample data. | * Appendix A, printed (one per 3 students) * Appendix B, printed and cut into 3 pieces (one per 3 students) * Appendix C, printed (one per pair of students) * [*Random samples* (PPTX 1.5 MB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l10-random-samples-slideshow.pptx) PowerPoint |  |

## Learning episode 11 – survival of the fittest

### Teaching and learning activity

Students revise measures of centre and spread by splitting people into teams for the television show ‘Survivor’.

### Syllabus content

* Select the type of graph best suited to represent various single datasets and justify the choice of graph
* Calculate and describe the mean, median, mode and range of a dataset
* Compare simple datasets using the mean, median, mode and range

Table 11 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| [Survival of the fittest (DOCX 444 KB)](https://education.nsw.gov.au/content/dam/main-education/documents/teaching-and-learning/curriculum/mathematics/mathematics-s4-unit-09-l11-survival-of-the-fittest.docx)  Duration**:** 1 lesson  Learning intentions   * To be able to use data displays to compare datasets. * To be able to use measures of centre and spread to compare datasets.   Success criteria   * I can find the measures of centre and spread. * I can create data displays from data to help inform decisions. * I can explain the decisions I make using mathematical evidence. | * Appendix A and B, printed (one per 3 students) |  |

# References

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NESA (NSW Education Standards Authority) (2022) ‘[Programming](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units)’, Understanding the curriculum, NESA website, accessed 26 March 2024.

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