Mathematics Stage 5 (Year 10) – unit of learning

Bivariate relationships

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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 analysis B, Data analysis C and Linear relationships B. The lessons and sequences in this program of learning are designed to allow students to explore bivariate data and correlation.

**Duration**: this program of learning is designed to be completed over a period of approximately 2 to 4 weeks but can be adapted to suit the school context.

**Explicit teaching**: suggested learning intentions and success criteria are available for some lessons 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.

**Accessing the resources**: this program of learning includes a range of student-facing and teacher resources. All resources can be accessed from the [Stage 5 Unit 13 – bivariate relationships](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-7-10-resources/year-10-unit-13-bivariate-relationships) catalogue page.

# 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**
* displays and interprets datasets involving bivariate data **MA5-DAT-C-02**
* graphs and interprets linear relationships using the gradient/slope-intercept form **MA5-LIN-C-02**

## Path

A student:

* plans, conducts and reviews a statistical inquiry into a question of interest **MA5-DAT-P-01**

The identified Life Skills outcome related to this unit is **MALS-DAT-02** – interprets information from data displays.

[Mathematics K**–**10 Syllabus](https://curriculum.nsw.edu.au/learning-areas/mathematics/mathematics-k-10-2022/overview) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2022.

**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 – introduction to scatter plots

### Teaching and learning activity

Students collect data and explore how a scatter plot can be used to compare bivariate data.

### Syllabus content

* Distinguish between situations involving 1-variable and 2-variable (bivariate) data and explain when each is needed
* Gather data on a topic of interest involving 2 numerical variables
* Represent the data using a scatter plot

Table 1 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| **Introduction to scatter plots****Duration:** 1–2 lessons**Learning intention*** To be able to use a scatter plot to determine if there is an association between 2 variables.

**Success criteria*** I can explain the difference between 1-variable and 2-variable data.
* I can explain when it is appropriate to represent data using a scatter plot.
* I can represent bivariate data in a scatter plot.
 | * *Introduction to scatter plots* Excel
* Appendix A, B and D, printed, (one per pair)
* A piece of A4 paper (one per pair), to scrunch into a ball
* A ruler or measuring tape (one per pair)
* A receptacle to throw a paper ball into (one per pair)
* Appendix C, printed (one per student)
* Digital device (one per pair)
 |  |

## Learning episode 2 – flame vs time

### Teaching and learning activity

Students will predict when a candle burns out by looking at data on the height of the candle and the time the candle has been burning.

### Syllabus content

* Gather data on a topic of interest involving 2 numerical variables
* Represent the data using a scatter plot
* Describe informally the association between 2 numerical variables and apply terminology about form (linear), strength (strong, moderate or weak) and direction (positive or negative)
* Identify and describe the independent variable and dependent variable in relationships with possible cause and effect

Table 2 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| **Flame vs time** **Duration:** 1–2 lessons**Learning intentions*** To understand the relationship between independent and dependent variables.
* To be able to describe the association between 2 variables.

**Success criteria*** I can determine which variable is the independent variable.
* I can plot bivariate data on a scatter plot.
* I can describe the strength of the association between 2 variables using the terms ‘weak’, ‘moderate’ and ‘strong’.
* I can describe the direction of the association between 2 variables using the terms ‘positive’ and ‘negative’.
 | * *Flame vs time* PowerPoint
* Appendix A, printed A3 (one per group of 3)
* Appendix A, class set (optional)
* Appendix B and C, printed (one per pair)
* A3 sheet of graph paper (one per group)
* A3 plastic sleeves and adhesive putty
 |  |

## Learning episode 3 – lines of best fit

### Teaching and learning activity

Students develop the idea of placing a line of best fit by eye on a scatter plot to make more accurate predictions and use the terminology of interpolation and extrapolation.

### Syllabus content

* Represent the data using a scatter plot
* Create a line of best fit, by eye, on an existing scatter plot
* Use the line of best fit, by eye, to make predictions between known data values (interpolation) and what might happen beyond known data values (extrapolation)
* Explain the limitations of the model when making predictions
* Determine the gradient and y-intercept of a straight line from its graph and apply these values to determine the equation of the line
* Recognise and describe linear relationships in real-life contexts

Table 3 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| **Lines of best fit** **Duration:** 2–3 lessons**Learning intention*** To be able to draw, interpret, and make predictions using a line of best fit by eye.

**Success criteria*** I can draw a line of best fit by eye.
* I can explain what the gradient and $y$-intercept of a line of best fit represent.
* I can define interpolation and extrapolation.
* I can use a line of best fit to interpolate and extrapolate information.
 | * *Lines of best fit* PowerPoint
* Digital device (one per pair)
* Appendix A and B, printed (one per student)
 |  |

## Learning episode 4 – causation

### Teaching and learning activity

Students will investigate a series of correlations to develop an understanding that correlation does not imply causation. Through this investigation, students will develop their ability to explain the difference between correlation and causation.

### Syllabus content

* Explain the difference between variables that have an association and variables that have a causal relationship

Table 4 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| **Causation** **Duration:** 1 lesson**Learning intentions*** To know the difference between association and causation.

**Success criteria*** I can define the terms ‘association’ and ‘causation’.
* I can explain why association does not imply causation.
* I can give reasons why an association is not causal.
 | * *Causation* PowerPoint
* Digital device (one per pair)
* Appendix A, printed (one per group of 3)
* Adhesive putty
* Appendix B and C, printed, (one per student)
 |  |

## Learning episode 5 – doll bungee

### Teaching and learning activity

Students will conduct an experiment by creating a simulated bungee system and using it to launch a small plastic doll. Students will aim to determine the minimum number of elastic bands necessary to make the doll's bungee experience safe.

### Syllabus content

* Identify and describe the independent variable and dependent variable in relationships with possible cause and effect
* Gather data on a topic of interest involving 2 numerical variables
* Represent the data using a scatter plot
* Use the line of best fit, by eye, to make predictions between known data values (interpolation) and what might happen beyond known data values (extrapolation)
* Explain the limitations of the model when making predictions
* Interpret the coefficient of $x$ ($m$) as the gradient/slope, and the constant ($c$) as the $y$-intercept for equations of the form $y=mx+c$

Table 5 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| **Doll bungee****Duration:** 1–3 lessons**Learning intention*** To know how to create and use mathematical models.

**Success criteria*** I can use collected data to construct a scatter plot.
* I can generate a line of best fit from a scatter plot.
* I can extrapolate information from a mathematical model.
* I can recognise the limitations of a mathematical model.
 | * Appendix A, printed (one per group of 3)
* Appendix B, printed A3 (one per group of 3)
* A3 plastic sleeves (one per group of 3)
* Masking tape
* Rubber bands, 15–20 per group all the same size and type
* Measuring tape
* Large sheets of paper
* Small plastic doll
* Different types of dolls, different size rubber bands
 |  |

## Learning episode 6 – Where are the bees?

### Teaching and learning activity

Students look at the relationship between variables to determine what might be causing the disappearance of bees.

### Syllabus content

* Represent the data using a scatter plot
* Create a line of best fit, by eye, on an existing scatter plot
* Describe informally the association between 2 numerical variables and apply terminology about form (linear), strength (strong, moderate or weak) and direction (positive or negative)
* Use the line of best fit, by eye, to make predictions between known data values (interpolation) and what might happen beyond known data values (extrapolation)
* Explain the limitations of the model when making predictions
* Interpret the coefficient of $x$ ($m$) as the gradient/slope, and the constant ($c$) as the $y$-intercept for equations of the form $y=mx+c$
* Find the equation of a straight line in the form $y=mx+c$, given the gradient/slope and the $y$-intercept of the line
* Determine the gradient and $y$-intercept of a straight line from its graph and apply these values to determine the equation of the line
* Recognise and describe linear relationships in real-life contexts

Table 6 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| **Where are the bees?** **Duration:** 1–2 lessons**Learning intention*** To be able to model and analyse data involving 2 numerical variables.

**Success criteria*** I can describe the relationship between 2 variables.
* I can draw a line of best fit by eye.
* I can explain the limitations of a model.
* I can justify the conclusions I draw from a model.
 | * *Where are the bees?* PowerPoint
* Appendix A, printed (one per pair)
* Digital device (one per pair)
 |  |

## Learning episode 7 – mobile phone battery

### Teaching and learning activity

Students investigate the percentage charge of a mobile phone over time to predict its battery life.

### Syllabus content

* Gather data on a topic of interest involving 2 numerical variables
* Represent the data using a scatter plot
* Create a line of best fit, by eye, on an existing scatter plot
* Interpret the coefficient of $x$ ($m$) as the gradient/slope, and the constant ($c$) as the $y$-intercept for equations of the form $y=mx+c$
* Find the equation of a straight line in the form $y=mx+c$, given the gradient/slope and the $y$-intercept of the line
* Determine the gradient and $y$-intercept of a straight line from its graph and apply these values to determine the equation of the line
* Design an aim and hypothesis based on a question of interest
* Critically review surveys, polls and media reports for accuracy and/or bias

Table 7 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| **Mobile phone battery****Duration:** 1–3 lessons (students will need time to collect data for an investigation during this lesson sequence)**Learning intention*** To be able to plan and conduct a statistical inquiry.

**Success criteria*** I can write an aim and a hypothesis based on a question of interest.
* I can plan how, when and where to collect data.
* I can draw conclusions from data.
* I can interpolate and extrapolate data.
 | * Appendix A, printed (one per student)
* Graph paper, printed A3 in a plastic sleeve (2 per group of 3)
 |  |

## Learning episode 8 – methods of sampling

### Teaching and learning activity

Students explore different sampling methods and the impact that sample size can have on predictions.

### Syllabus content

* Create a line of best fit, by eye, on an existing scatter plot
* Use the line of best fit, by eye, to make predictions between known data values (interpolation) and what might happen beyond known data values (extrapolation)
* Graph equations of the form $y=mx+c$ by using the gradient and the $y$ -intercept
* Explain the effect of increasing or decreasing the gradient with or without digital tools
* Recognise and describe linear relationships in real-life contexts
* Examine and evaluate the appropriateness of sampling methods and sample size in reports with statements about a population and how they can affect the results of a survey

Table 7 – lesson sequence and details

|  |  |  |
| --- | --- | --- |
| Teaching and learning activities | Required resources | Registration, adjustments and evaluation notes |
| **Methods of sampling** **Duration:** 1–2 lessons**Learning intention**To understand the difference between sampling techniques.**Success criteria*** I can graph a line of the form $y = mx+c$.
* I can explain the impact of changes in the gradient.
* I can describe different sampling techniques.
* I can evaluate a choice in sampling technique.
 | * Appendix A and D, printed (one per student)
* Plastic pocket (one per student)
* Appendix B and C, printed (one per pair)
* Digital device (one per pair)
* Appendix E, printed (one per pair if a digital device is not being used)
 |  |

# References

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NESA holds the only official and up-to-date versions of the NSW Curriculum and syllabus documents. Please visit the NSW Education Standards Authority (NESA) website <https://educationstandards.nsw.edu.au/> and the NSW Curriculum website [https://curriculum.nsw.edu.au/home](https://curriculum.nsw.edu.au/).

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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 6 November 2024.

NESA (NSW Education Standards Authority) (n.d.) ‘[Advice on units](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units)’, Programming, NESA website, accessed 6 November 2024.

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