Mathematics Stage 5 (Year 10) – teacher information

Bivariate data

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# About this resource

## Purpose of resource

The following task is designed to complement the department’s Stage 5 unit of learning ‘Unit 13 – bivariate relationships’.

## Target audience

This resource can be used by mathematics faculties to support teachers with effective syllabus implementation.

## When and how to use

This task is designed to be used during or after the completion of the department’s Stage 5 unit of learning ‘Unit 13 – bivariate relationships’. Teachers may modify this task to suit their school’s context or use this task to guide the creation of their own assessment task.

# Task description

**Type of task**: Investigation

**Outcomes being assessed**

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

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The following content in this task comes from the focus area Data analysis C (Path):

* Design an aim and hypothesis based on a question of interest
* 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
* Critically review surveys, polls and media reports for accuracy and/or bias

You are required to investigate 2 variables that you believe have a causal relationship and create a report on your findings using the Investigation scaffold.

## Submission details

You are required to submit a report which answers the questions in the Investigation scaffold. You can submit this task digitally or as a hard copy.

Technology is required for this task, including spreadsheets and access to data sources. Teachers may facilitate the task in class to enable students access to technology.

# Student support material

## Investigation scaffold

### Part 1 – setting up your investigation

1. Identify 2 variables that you believe have a relationship.

A collection of possible data sources has been provided in Appendix A – possible data sources.

1. Define your variables

* Identify which variable is the independent variable and which is the dependent variable, explaining your reasoning.
* Write a brief hypothesis about the relationship you expect to see between the 2 variables.

### Part 2 – data collection and visualisation

1. Explain where your data was sourced from and how it was collected.
2. Evaluate the reliability of the data source by considering:

* Was it collected by you or sourced online? If online, is the source credible? If collected by you, what were the limitations of your collection method?
* Are there missing or incomplete values?
* Was the data collected in a way that could introduce bias?

### Part 3 – data visualisation

1. Organise your data in a spreadsheet

* Present the data in a table with clear headings.
* Remove any unnecessary information.

1. Create a visual representation of your data using your spreadsheet

* Create a scatter plot to show the relationship between the 2 variables.
* Print your scatterplot and draw a line of best fit by eye.

### Part 4 – data analysis

1. Identify the relationship

* State whether the relationship is positive, negative or if there is no relationship.
* Discuss the strength of the relationship and use mathematical language to explain what this means in the context of your data.

1. Determine the type of relationship

* Identify if the relationship is linear, nonlinear or if there is no clear pattern. Support your choice by referencing the overall shape or trend of the scatter plot.
* Justify your observations by referencing specific features of the scatter plot, such as clusters, gaps or outliers.

1. Predict a set of values outside your data range for your independent variable.
2. Predict a set of values outside your data range for your independent variable.
3. Use mathematical terms (for example, gradient, -intercept) to explain how the line of best fit is used for these predictions.

### Part 5 – limitations of your model

1. Evaluate how well the line of best fit represents the relationship between the 2 variables.

* Does it pass through most of the data points, or are there significant deviations?
* Are there outliers that distort the line?
* Would a nonlinear model (for example, quadratic, exponential) fit better?

1. Discuss how reliable your predictions are, based on:

* the strength of the relationship
* the range of your data
* external variables that could affect predictions.

## Appendix A – possible data sources

You could create and conduct your own survey to collect data, or a list of potential sources is provided for you to investigate.

* Domestic work, global warming, plastic in oceans, and more ([gapminder.org/data/](https://www.gapminder.org/data/))
* Global emissions data ([bit.ly/co2emissionsdata](https://bit.ly/co2emissionsdata))
* Titanic dataset ([bit.ly/titanicsurvivaldata](https://bit.ly/titanicsurvivaldata))
* Global climate report ([bit.ly/NOAAglobaltemperature](https://bit.ly/NOAAglobaltemperature))
* World happiness report ([worldhappiness.report](https://worldhappiness.report/))
* Global education data ([data.un.org](https://data.un.org/))
* Sample retail dataset ([bit.ly/sampleretaildata](https://bit.ly/sampleretaildata))
* Student lifestyle dataset ([bit.ly/studentlifestyledata](https://bit.ly/studentlifestyledata))
* Government expenditure on Education (% of GDP), literacy rate, primary completion rate, and more ([bit.ly/gdpsecondary](https://bit.ly/gdpsecondary))
* Movie audience reviews, critic reviews, run time ([bit.ly/moviereviewsdata](https://bit.ly/moviereviewsdata))

# What is the teacher looking for?

This outline uses the criteria points from the marking guidelines to articulate the features required in the task to best demonstrate your skills and knowledge.

The teacher is looking to see how well you:

* accurately describe the relationship between variables (for example, type of relationship, linear or nonlinear)
* use features of the graph, such as clusters, gaps or outliers, to support your answers
* clearly explain your thinking and use mathematical language to justify your conclusions
* discuss how reliable the data is and any limitations of your findings.

# Marking guidelines

The following marking guidelines will provide the teacher with the opportunity to give feedback on your response to this assessment. Teachers will use this table to assign you an overall grade and provide feedback on why they assigned that grade, what you did well and how you can improve. The rubric is designed to be cumulative, meaning that as you meet more requirements for the criteria your grade will increase.

Table 1 – assessment marking guidelines

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Criteria | Working towards developing | Developing | Developed | Well developed |
| Part 1 – setting up your investigation | Identifies 2 variables from the sourced dataset. | Identifies the independent and dependent variables and provides some reasoning. | Clearly explains the reasoning behind the choice of the independent and dependent variables. | Creates a hypothesis that clearly states the predicted relationship between the 2 variables. |
| Part 2 – data collection and visualisation | Data is collected with minimal reflection on and consideration of the reliability of the data collected. | Data is collected with some consideration of the reliability of the data collected. | Considers and communicates the reliability of the collected data, considering bias and extensiveness of the dataset. | Considers, in detail, the ethics and comprehensiveness of the data collection process or the aims of the organisation that collected the data and identifies ways that the process could have been refined to improve the reliability and accuracy of the dataset. |
| Part 3 – data visualisation | Gathers and presents data. | Clearly organises and presents data with appropriate scales, labels and titles. |  |  |
| Part 4 – data analysis | Informally describes the association between 2 numerical variables.  Uses the scatter plot to predict information outside the range of data. | Describes the association between 2 numerical variables using strength **or** direction.  Uses the line of best fit to predict information outside the range of the data. | Describes the association between 2 numerical variables using strength **and** direction.  Uses the equation for the line of best fit to predict information outside the range of the data. | Uses the line of best fit to predict information outside the range of the data and explains what it means in the context of the variables using mathematical terms such as ‘gradient’ and -intercept’. |
| Part 5 – limitations of your model | Identifies a possible limitation of the line of best fit. | Identifies a possible limitation of the line of best fit with reference to factors that may affect the accuracy and reliability of the model. | Uses mathematical language to explain the limitations and reliability of the line of best fit by considering more than one factor that could affect the reliability. | Uses mathematical language to provide a detailed explanation of the accuracy and limitations of the line of best fit. The explanation considers multiple factors including the shape of the dataset, the strength of the relationship and the range of data. |

**Feedback:**

# Teacher support material

## Launching the task

As an introduction to this assessment task it is suggested that teachers explain the task description, marking rubric and investigation scaffold to students. Alternatively, teachers could co-create an investigation scaffold with students that would support them in completing the task.

## Technology requirements and adjustments

Parts 1 and 2 require technology for students to be able to source, organise and display data. Parts 3–5 could be completed without access to technology.

The syllabus only requires students to know how to draw a line of best fit by eye.

## Suggestions for differentiation

### Path content

The following content in this task comes from the focus area Data analysis C (Path):

* Design an aim and hypothesis based on a question of interest
* 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
* Critically review surveys, polls and media reports for accuracy and/or bias

To modify this task to not include Stage 5 outcome Data analysis C – **MA5-DAT-P-01**, it is suggested that you remove question 2 from Part 2 and remove references to creating a hypothesis from the task and the rubric.

### Data collection

The teacher can model the use of a website with a data source to collect the datasets needed to start the task. Alternatively, teachers can model how to create a reliable survey.

Teachers could collect and organise data for students to enable them to complete the task.

## Example sentences

Example sentences that may help students write their report include:

* The scatter plot shows a positive linear relationship because most data points trend upwards from left to right.
* The data includes outliers, such as point , which does not follow the general trend.
* There is a clear cluster between = \_ and = \_, suggesting that values are concentrated in this range.
* The relationship appears nonlinear because the data points form a curved pattern.

# Support and alignment

**Resource evaluation and support**: all curriculum resources are prepared through a rigorous process. Resources are periodically reviewed as part of our ongoing evaluation plan to ensure currency, relevance and effectiveness. For additional support or advice, or to provide feedback, contact the Mathematics Curriculum team by emailing [mathematics7-12@det.nsw.edu.au](mailto:mathematics7-12@det.nsw.edu.au).

**Differentiation**: further advice to support Aboriginal and/or Torres Strait Islander students, EAL/D students, students with a disability and/or additional needs and High Potential and gifted students can be found on the [Planning, programming and assessing 7–12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage. This includes the [Inclusion and differentiation advice 7–10](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12/inclusion-and-differentiation-advice-7-10) webpage.

**Assessment**: further advice to support formative assessment is available on the [Planning, programming and assessing 7–12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage. This includes the [Classroom assessment advice 7–10](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12/classroom-assessment-advice-7-10-). For summative assessment tasks, the [Assessment task advice 7–10](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12/assessment-task-advice-7-10) webpage is available.

**Explicit teaching:** further advice to support explicit teaching is available on the [Explicit teaching](https://education.nsw.gov.au/teaching-and-learning/curriculum/explicit-teaching) webpage. This includes the CESE [Explicit teaching – Driving learning and engagement](https://education.nsw.gov.au/about-us/education-data-and-research/cese/publications/research-reports/what-works-best-2020-update/explicit-teaching-driving-learning-and-engagement) webpage.

**Consulted with**: Mathematics Growth Team, Strategic Delivery, HSC Strategy, Numeracy.

**Alignment to system priorities and/or needs**: [School Excellence Policy](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468), [Our Plan for NSW Public Education](https://education.nsw.gov.au/about-us/strategies-and-reports/plan-for-nsw-public-education).

**Alignment to the School Excellence Framework**: this resource supports the [School Excellence Framework](https://education.nsw.gov.au/about-us/strategies-and-reports/school-excellence-and-accountability/school-excellence/about-sef) elements of curriculum (curriculum provision) and effective classroom practice (lesson planning, explicit teaching).

**Alignment to Australian Professional Teaching Standards**: this resource supports teachers to address [Australian Professional Teaching Standards](https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/meeting-requirements/the-standards/proficient-teacher) 3.2.2, 3.3.2.

**Creation date: 18 December 2024**

# Evidence base

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