

Exploring trends in temperature

Year Level:	11/12	Subject:	Mathematics: Unit 3	Topic:	Bivariate Data
Duration:	1x 50 minute lesson	Australian Curriculum:	<p>Content description codes:</p> <ul style="list-style-type: none"> ● ACMGM055: Identify the response variable and the explanatory variable ● ACMGM056: Use a scatterplot to identify the nature of the relationship between variables ● ACMGM057: Model a linear relationship by fitting a least-squares line to the data ● ACMGM059: Interpret the intercept and slope of the fitted line ● ACMGM061: Use the equation of a fitted line to make predictions ● ACMGM062: Distinguish between interpolation and extrapolation when using the fitted line to make predictions, recognising the potential dangers of extrapolation 	Climate Topic(s):	<ul style="list-style-type: none"> ● Temperature rise ● Climate data

Brief Overview

One key impact of climate change is the increase in global temperatures. Rising temperatures pose a significant threat to ecosystems and communities by driving extreme weather events, altering habitats, and intensifying extreme weather events like heatwaves and droughts. In this lesson, students will use temperature data from one of Australia's weather monitoring stations to investigate how temperatures have changed over time. This lesson sits within 'statistics' and focuses on bivariate data. Students will be provided with clear step-by-step instructions on how to import the data into Google Sheets, create a scatter plot, and interpret the results.

NOTE: Students require desktop computers or laptops to access the resources and to carry out the suggested learning activities.

Learning outcomes

Learning Intention

Students will be able to analyse temperature data using statistical methods to evaluate trends in climate change. They will use technology to construct scatter plots, interpret the line of best fit, and apply mathematical models to make predictions about future temperature changes.

Success Criteria

- Explain the meaning and significance (qualitatively) of the data by referencing the line of best fit.
- Use the equation line of best fit to make predictions and distinguish between interpolation and extrapolation.
- Use technology to construct a scatter plot using bivariate data and draw the line of best fit.

Introduced climate science concepts:	Presumed knowledge:
<ul style="list-style-type: none"> ● Temperature rise ● Global warming ● Climate data 	<ul style="list-style-type: none"> ● Understanding of the impacts of climate change ● ACMSP251: Use scatter plots to investigate and comment on relationships between two numerical variables ● ACMSP252: Investigate and describe bivariate numerical data where the independent variable is time ● ACMSP279: Use information technologies to investigate bivariate numerical data sets. Where appropriate use a straight line to describe the relationship allowing for variation

Teaching resources

Tool ID	Type of Tool	Name and web link	Overview	Credits
R1	Teacher	Glossary of climate	This document provides teachers with a glossary of key	Monash Climate Change

	resource	terms	terms relevant to this lesson plan. It is important that students are familiar with the meaning of these terms so they can complete the class activities.	Communication Research Hub
R2	Teacher / Student resource	Working with data in Google Sheets tutorial	This document provides step-by-step instructions describing how to: <ul style="list-style-type: none"> • Import the data into Google sheets. • Clean up and prepare the data. • Create a scatter plot using temperature data and plot the line of best fit. 	Monash Climate Change Communication Research Hub
R3	Teacher resource	NASA's Earth Minute: Earth Has a Fever [2min video]	Short video describing how even small amounts of warming can have impacts and what is causing these increases.	NASA
R4	Teacher / Student resource(s)	(R4.1) Introduction to bivariate data [13 min video] (R4.2) How to draw a scatter plot by hand/eye [18 min video] (R4.3) How to interpret a line of best fit [17 min video]	Short videos created as teaching tools for grades 7-10 Mathematics (ACARA) and Queensland syllabuses for senior students. Use is not required but may be valuable tools to keep on hand.	McClatchey Maths

Lesson activities

	Teacher activities	Student Tasks	Tool ID	Time
ENGAGE	<p>To begin the lesson and to introduce the topic, start by working through these three openers.</p> <p><i>If time is a concern, select any combination of the three</i></p> <ol style="list-style-type: none"> 1. Pose a question to students. Ask students "Why might we be concerned about rising temperatures?". <p>Encourage students to consider various impacts, such as extreme weather events, habitat alterations, effects on ecosystems and human communities.</p> <ol style="list-style-type: none"> 2. Play an informational video. Play R3 To the class. <p>The video covers the causes of rising temperatures and the potential future impacts of temperature increases.</p> <ol style="list-style-type: none"> 3. Short discussion on temperature data. Ask students: "How can temperature be measured, and what factors might influence this?" 	Students to participate in class discussion and pay attention to the video (R3).	R3	5 - 10 min

	<p>Guide students to consider factors such as: Location, shade, seasonal variations, weather conditions ect.</p>			
EXPLORE	<p>Distribute R2 to the class (either hardcopy or digital).</p> <p>Following the instructions provided, either on their own or in pairs, students should complete the following:</p> <ol style="list-style-type: none"> 1. Import Bureau of Meteorology historical recordings into google sheets. 2. Create a scatter plot using temperature data and plot the line of best fit of best fit. <p><i>Note the answers and examples are given for the Moorabbin Airport weather station, however, it is encouraged that you use a station near relevant to the school to increase relevance and engagement.</i></p>	<p>Students, either individually or in pairs, are to follow the instructions provided in R2 to:</p> <ol style="list-style-type: none"> 1. Import Bureau of Meteorology historical recordings into google sheets. 2. Create a scatter plot using temperature data and plot the line of best fit of best fit. 	R2	5 - 10 min
EXPLAIN	<p>Using the plots they generated, students are to answer a series of questions.</p> <p>Solutions for this section's questions:</p> <ol style="list-style-type: none"> 1. Year 	<p>Either individually or in pairs, students will refer to their generated plots to answer the following questions:</p> <ol style="list-style-type: none"> 1. What is the independent (or explanatory) variable? 		10 min

	<p>2. The daily maximum temperature for the first graph, and the average daily maximum temperature for the second graph.</p> <p>3. Due to the changing mean temperature caused by the altering of seasons and weather, the slight increase of average temperature is being overshadowed</p>	<p>2. What is the dependent (or response) variable in each of the graphs</p> <p>3. Why did plotting Date vs Temperature not produce a meaningful insight, while the plot of Year vs Average Temperature did?</p>		
ELABORATE	<p>Using the 2nd (Average vs Year) plots they generated, students are to answer a series of questions.</p> <p>Solutions for this section's questions: (<i>Note these are for Moorabbin airport from 1972 to 2024</i>)</p> <p>4. The gradient is 0.0174. Because the gradient is positive, the correlation is also positive. This means that the average daily maximum temperature increases with time, and the rate of increase is 0.0174 degrees per year.</p> <p>5. $R^2 = 0.214$. Since R^2 is below 0.5, the relation is weak.</p> <p>6. Algebraically, substitute $x=2050$ in the equation of the line of best fit: $y=$</p>	<p>Either individually or in pairs, students will refer to their 2nd (Average vs Year) generated plots to answer the following questions:</p> <p>4. What is the gradient (slope) of the line of best fit in the ? Explain what it means.</p> <p>5. What is the value of the coefficient of determination? What does it tell us about the strength of the relationship between the annual mean maximum temperature and the year?</p> <p>6. Use the equation of the line of best line of best fit to calculate the annual mean maximum temperature in 2050. Did you use interpolation or extrapolation?</p> <p>7. In which year(s) will the mean maximum</p>		15 min

	<p>$0.0174x - 14.9y = 20.77$. The annual mean Max Temperature in 2050 will be 20.77. This used extrapolation.</p> <p>7. In 1980, the average temperature was 20.26 Degrees, therefore, we want to find when $y=21.76$. Algebraically, substitute $y = 21.76$ in the equation of the line of best fit, $x = 2106.89$.</p>	<p>temperature be 1.5 degrees hotter than the temperature in 1980? Did you use interpolation or extrapolation? Explain your answer.</p>		
EVALUATE	<p>Display the 2nd (Average vs Year) plot via smart board or a data projector and go through the answers for questions 1-7 as a class.</p>	<p>Students to share answers as a class, and take notes on any that need to be corrected.</p>		10 min
Extension opportunity	<p>If more practice is needed, students can repeat the analysis using available data from another BOM station in Australia.</p>			