 Year 12 Mathematics Standard 1

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Unit title

MS-S3 Further Statistical Analysis

Duration

3 weeks

Rationale

An understanding of the statistical process will enable students to be global citizens. Students who understand statistics will be able to use statistics and mathematics at home, in the community and in the workplace.

Topic focus

The principal focus of this subtopic is the development of students’ understanding of the purpose and process of statistical investigation, taking into account appropriate basic design principles.

Students develop understanding of the complex nature of questionnaire design and potential misconceptions in statistical representations and reasoning.

Within this subtopic, schools have the opportunity to identify areas of Stage 5 content which may need to be reviewed to meet the needs of students.

Prior knowledge required

MS-S1 Data Analysis (Year 11 Mathematics Standard), MS-A3 Types of Relationships (Year 12 Mathematics Standard 1)

Language considerations

* Bias
* Bivariate dataset
* Bivariate scatterplot
* Dependent variable
* Extrapolation
* Independent variable
* Interpolation
* Line of best fit
* Linear relationship
* Non-linear
* Population

Outcomes

A student:

* MS1-12-2 analyses representations of data in order to make predictions and draw conclusions
* MS1-12-7 solves problems requiring statistical processes
* MS1-12-9 chooses and uses appropriate technology effectively and recognises appropriate times for such use
* MS1-12-10 uses mathematics argument and reasoning to evaluate conclusions, communicating a position clearly to others

Assessment (including formative and summative)

Formative assessment – pre-test, brainstorm, exit slips, bookmarking, class discussions, teacher observations

Summative assessment – formal assessment task

| Content | Teaching and learning strategies and evidence of learning | Resources |
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| S3.1 – The statistical investigation process for a survey | N/A | N/A |
| * Understand and use the statistical investigation process – identifying a problem and posing a statistical question, collecting or obtaining data, representing and analysing that data, then communicating and interpreting findings
	+ Identify the target population to be represented (ACMEM132)

(2 lessons) | Introduce the statistical investigation process:1. Identify a problem
2. Pose a statistical question
3. Collect or obtain data
4. Representing and analysing data
5. Communicating and interpreting findings

Refer back to this process throughout the topic to relate to a problem chosen by the class. Possible ideas to be investigated include:* A school wants to make a decision about its transition to high school program. What information needs to be collected before decisions can be made?
* The local council has donated money to build a facility for use by teenagers in the local region. Discussion could be facilitated around what the council needs to know to spend the money effectively.
 | [Data Investigation and Interpretation](http://amsi.org.au/teacher_modules/Data_Investigation_and_interpretation5.html#Initial_questions_that_can_motivate_an_investigation)* Possible problems that could be posed can be found at this website.
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| * + Investigate questionnaire design principles, such as simple language, unambiguous questions, consideration of number of choices, how data may be analysed to address the original question, issues of privacy and bias, ethics, and responsiveness to diverse groups and cultures AAM

(2 lessons) | Classroom discussion on provided examples of good and bad questionnaires.Issues that need to be addressed in designing good questionnaires include:* Simple Language
* Unambiguous questions
* Consideration of number of choices
* How data may be analysed to address the original question
* Issue of privacy and bias
* Ethics
* Responsiveness to diverse groups

Students could analyse some surveys, such as from Census At School, to see whether they meet the standards outlined above.Students write a questionnaire and distribute the survey to collect data on the statistical problem identified above from at least two populations. For example, is Year 12 the fittest group in the school? | [Census At School Australian Questionnaires](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CensusAtSchool%2BPast%2BQuestionnaires) (ABS)[Principles for Adequate Questionnaire Design](https://education.ufl.edu/educational-research/files/2014/10/Principles-of-Questionnaire-Design.pdf)[Poor questionnaire questions](http://www.bbc.co.uk/schools/gcsebitesize/maths/statistics/questionnairesrev2.shtml)[5 common survey question mistakes that’ll ruin your data](https://www.surveymonkey.com/mp/5-common-survey-mistakes-ruin-your-data/) (Survey Monkey)[Leading Questions – Yes Prime Minister](https://www.youtube.com/watch?v=G0ZZJXw4MTA)* This video provides an example of how questionnaires can be set up to give the results you want and to skew results of public opinion.
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| * Review summary statistics and statistical displays
 | In order for students to analyse the data they have collected, they may need to revise some or all of the following:* Mean
* Median
* Mode
* Range
* Standard deviation
* IQR
* Box and whisker plots (and other graphs)
 | Use the data you have collected to do this process. Guide students through making calculations and drawing graphs using the data from previous lessons.* Students could also investigate graphing their data from a spreadsheet, such as Microsoft Excel.
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| * + Implement the statistical investigation process to answer questions that involve comparing the data across two or more groups

(2-3 lessons) | Model how to put it altogether using the original question and the data with its analysis that has been done in previous lesson. | N/A |
| S3.2 – Exploring and describing data arising from two quantitative variables | N/A | N/A |
| * Construct a bivariate scatterplot to identify patterns in the data that suggest the presence of an association (ACMGM052) AAM

(2 lessons) | Divide the class into groups and have them measure and graph different types of bivariate data, such as height and foot length or number of siblings and shoe size, to determine if a relationship exists.Students could test the ratios identified by da Vinci in his Vitruvian Man by comparing them with measurements taken from within the class:* Ratio of height to arm span (1:1)
* Ratio of height to hand span (10:1)
* Ratio of height to the distance from the top of the head to the bottom of the chin (8:1)
* Ratio of height to the distance from the elbow to the armpit (8:1)
* Ratio of height to the distance from the elbow to the tip of the hand (5:1)
* Ratio of height to the maximum width of the shoulders (4:1)
 | [Vitruvian Man Gallery](https://mathconnections.wikispaces.com/Vitruvian%2BMan%2BGallery) |
| * Use bivariate scatterplots (constructing them when needed) to describe the patterns, features and associations of bivariate datasets, justifying any conclusions AAM
	+ Describe bivariate datasets in terms of form (linear or non-linear) and, in the case of linear, the direction (positive or negative) and strength of any association (strong, moderate or weak)
	+ Identify the dependent and independent variables within bivariate datasets where appropriate
	+ Describe and interpret a variety of bivariate datasets involving two numerical variables using real world examples from the media, or freely available from government and business datasets
 | Provide students of examples of bivariate datasets that are linear and non-linear as well as strongly associated and weakly associated.From examples provided, have students identify dependent and independent variables. | [How to defend yourself against misleading statistics in the news](https://www.youtube.com/watch?v=mJ63-bQc9Xg)* Note – The start of the clip is useful for illustrating correlation and causality but the whole clip is good. The end point is useful and leads into the resources below.
* Statistical lies, as stated in the clip:
	+ The good-looking graph
	+ The polluted poll
	+ The overconfident decimal point
	+ The spectacular statistic
	+ Correlation versus causality

[The danger of missing up causality and correlation](https://www.youtube.com/watch?v=8B271L3NtAw)[Spurious Correlations](http://www.tylervigen.com/spurious-correlations)[Google Public Data](https://www.google.com/publicdata/directory)* This site provides lots of real world examples that you can use. You are able to narrow down by variable and country
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| * Model a linear relationship to the data by fitting a line of best fit by eye and by using technology (ACMEM141, ACMEM142) AAM
* Use the line of best fit to make predictions by either interpolation or extrapolation (ACMEM145) AAM
	+ Recognise the limitations of interpolation and extrapolation (ACMEM146)
 | Teach line of best fit by eye and using digital technology* Students could use the graphs they constructed at the beginning to construct lines of best fit by eye. Use these lines to make predictions by interpolating and extrapolating.
 | N/A |
| * Collect data, interpret and construct graphs using contexts, for example, sustainability, household finance and the human body AAM

(2 lessons) | Students to pick a topic and obtain data, then display it in a scatter plot and analyse the data. They are to then communicate and interpret their findings. | Human body – students to collect, graph and interpret the following bivariate datasets:* Height to arm span
* Head height to head width
* Height to stride

Sustainability – students to collect, graph and interpret the following bivariate datasets:* Wealth of countries and urbanisation
* Living conditions and impact on children
* Distance to coast and temperature
* Forest abundance to temperature

Household finance - students to collect, graph and interpret the following bivariate datasets:* Level of education to level of income
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Reflection and evaluation