# Sample Unit – Mathematics Standard – Year 11

***Sample for implementation for Year 11 from 2018***

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| **Unit title** | Classifying and Representing Data | **Duration** | 15 hours |
| **Topic** | Statistical Analysis | **Subtopic** | MS-S1: Data Analysis |
| **Subtopic focus**The principal focus of this subtopic is planning and management of data collection, classification and representation of data, calculation of summary statistics for single datasets and their use in the interpretation of data.Students develop awareness of the importance of statistical processes and inquiry in society. | **Resources**Access for teacher and student to spreadsheet technology.Access for teacher and student to the internet.Australia Bureau of Statistics (ABS): [www.abs.gov.au](http://www.abs.gov.au) CensusAtSchool Australia: <http://www.abs.gov.au/censusatschool>Numeracy in the News: <http://www.mercurynie.com.au/mathguys/mercury.htm>AAMT Top Drawer Teachers: <http://topdrawer.aamt.edu.au/Statistics/Good-teaching>Other [www.nss.gov.au](http://www.nss.gov.au), [www.statisticsworldwide.com](http://www.statisticsworldwide.com), [www.usa.gov/statistics](http://www.usa.gov/statistics)  |

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| **Outcomes** | **Assessment Strategies** |
| A student:* represents information in symbolic, graphical and tabular form MS11-2
* develops and carries out simple statistical processes to answer questions posed MS11-7
* uses appropriate technology to investigate, organise and interpret information in a range of contexts MS11-9
* justifies a response to a given problem using appropriate mathematical terminology and/or calculations MS11-10
 | Informal Assessment:* Students respond to prompts of key words related to the unit to establish what prior knowledge they have, either vocally as a class, as a class brainstorm, or in groups on paper. The ‘Chalk Talk’ Routine from ‘Visible Thinking’ is one method of doing this.
* Students read some questions on prior and early knowledge in the topic, and traffic light the questions as green (I understand), amber (I understand bits or I sort of understand) or red (I don’t understand). This can be done by showing a card of that colour, colouring in, or simply writing a G, A or R next to each question.
* Student responses to a class discussion can inform the teacher of the learning required.
* Students work either individually or in small groups, to draw a mind map, poster or summary of their prior learning in the topic.
* The teacher starts each lesson with a number of brief questions that reviews the key concepts of previous lessons and/or key skills that will be required in the lesson that will follow.
* As a plenary to a lesson ask students to summarise the core ideas they have learnt in their book, on a piece of paper to hand in, or orally.
* Run a ‘micro-lab’ where students bring a question they were unable to answer. Students work in groups of three, to discuss the questions and share their ideas. Emphasise that a minute of silence to consider each question is important, to establish that thinking time is necessary in mathematics.

Formal Assessment:An investigative task based on students using the knowledge, understanding and skills they have developed in this topic to analyse data from government websites, for example, the Australian Bureau of Statistics, The Bureau of Meteorology or Graduate Careers Australia.  |

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| **Content** | **Teaching, learning and assessment strategies** |
| * describe and use appropriate data collection methods for samples and population ◊
	+ investigate whether a sample obtained from a population may or may not be representative of the population by considering different kinds of sampling methods: systematic sampling, self-selected sampling, simple random sampling and stratified sampling (ACMEM130)
	+ investigate the advantages and disadvantages of each type of sampling (ACMEM131)
	+ describe the potential faults in the design and practicalities of data collection processes, for example, surveys, experiments and observational studies, misunderstandings and misrepresentations, including examples from the media (ACMEM134, ACMEM135, ACMEM136, ACMEM137)
 | The teacher conducts a class discussion about the ways in which surveys can be conducted and consider possible flaws in the methods of data collection. Questions to prompt discussion could include: What is the difference between a census and a sample? How can a sample be selected so that it most accurately reflects the entire population?Students conduct a census/sampling experiment where the entire class responds to a simple survey question and then explore the differences that arise when various samples are taken. Students explore the effect of different random samples on the understanding of the population. For example, use a mini pack of coloured lollies to count the number of each colour, in order to predict the proportion of each colour that was intended in the factory settings.Students use a random sample generator to explore the differences that arise when different samples or different sizes of samples are taken. For example: <http://www.cas.abs.gov.au/cgi-local/cassampler.pl>Students consider when the selection of a stratified sample by age could be used. For example, can the gender ratio in Year 11 across NSW be estimated from the number of boys and girls in a particular Year 11 class?Students design and construct a questionnaire: They consider the number of choices in a question, for example if only an even number of choices is given, this may force an inaccurate opinion from the respondents in relation to a particular question, while for some questions it may be appropriate to allow a neutral choice. Students also consider different ways of presenting questions in a survey, for example open questions, yes/no questions, tick boxes or response scales versus continuum scales.Students collect, display and discuss a variety of graphs sourced from the media and answer the following questions for each graph: Is the graph misleading? How was the data collected? Is the story that accompanies the graph based on fact? What other data could be collected to clarify the issue?The teacher conducts a class discussion which includes: * the importance of collecting data for decision-making by governments
* the reasonableness of drawing conclusions about populations from particular samples, for example whether it is appropriate to draw conclusions about the whole school from data based on a single class
* possible bias, such as how representative the sample chosen is, and other issues that may affect the interpretation of the results.

The teacher issues a formal investigative assessment task based on the analysis of data from various government websites. The teacher discusses the nature and scope of the task, the marking criteria and way in which the students can access feedback and support.  |
| * classify data relating to a single random variable ◊
	+ classify a categorical variable as either ordinal, for example income level (low, medium, high) or nominal, for example place of birth (Australia, overseas) (ACMGM027)
	+ classify a numerical variable as either discrete, for example the number of rooms in a house, or continuous, for example the temperature in degrees Celsius (ACMGM028)
 | Students explore the 2016 Census questions and classify the data collected: [http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/2901.0Main%20Features802016/$FILE/2016%20Census%20Sample%20Household%20Form.pdf](http://www.abs.gov.au/ausstats/abs%40.nsf/Lookup/2901.0Main%20Features802016/%24FILE/2016%20Census%20Sample%20Household%20Form.pdf)Students explore the similarities and differences between different types of data. For example, students use the CensusAtSchool Australia activities: [http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSQ+3A+WHAT'S+THE+DIFFERENCE+BETWEEN+NUMERICAL+AND+CATEGORICAL+DATA](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSQ%2B3A%2BWHAT%27S%2BTHE%2BDIFFERENCE%2BBETWEEN%2BNUMERICAL%2BAND%2BCATEGORICAL%2BDATA)and[http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSQ+3B+NUMERICAL+DATA:+WHAT'S+THE+DIFFERENCE+BETWEEN+DISCRETE+AND+CONTINUOUS](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSQ%2B3B%2BNUMERICAL%2BDATA%3A%2BWHAT%27S%2BTHE%2BDIFFERENCE%2BBETWEEN%2BDISCRETE%2BAND%2BCONTINUOUS) |
| * review how to organise and display data into appropriate tabular and/or graphical representations **AAM**  Information and communication technology capability icon Literacy icon ◊
	+ display categorical data in tables and, as appropriate, in both bar charts or Pareto charts (ACMEM045)
	+ display numerical data as frequency distribution tables and histograms, cumulative frequency distribution tables and graphs, dot plots and stem and leaf plots (including back-to-back where comparing two datasets) (ACMEM046, ACMEM057)
	+ construct and interpret tables and graphs related to real-world contexts, including but not limited to motor vehicle safety including driver behaviour, accident statistics, blood alcohol content over time, running costs of a motor vehicle, costs of purchase and insurance, vehicle depreciation, rainfall graphs, hourly temperature, household and personal water usage Sustainability icon Civics and citizenship icon
* interpret and compare data by considering it in tabular and/or graphical representations **AAM**  Information and communication technology capability icon Literacy icon ◊
	+ choose appropriate tabular and/or graphical representations to enable comparisons
	+ compare the suitability of different methods of data presentation in real-world contexts, including their visual appeal, for example a heat map to illustrate climate change data or the median house prices across suburbs (ACMEM048) Sustainability icon Ethical understanding icon Difference and diversity icon
 | The teacher reviews Stage 5 methods of organising and displaying data. Students discuss the suitability of various types of graphical display to the data. For example, why is it inappropriate to use a line graph to display categorical data?; why is it inappropriate to use a pie chart to explore trends in numerical data? Students use spreadsheets to organise and display the data they have collected through a self-designed survey. They evaluate the merits and failings of different graphical displays. Students gather data associated with the real-world context of driving. They display the data in a variety of appropriate graphical forms. Students interpret, compare and contrast the graphs and tables as they respond to guided questions. For example: A lobby group is proposing that NSW introduces ‘triple demerit’ days. What evidence supports their proposition? What days should be declared ‘triple demerit’ days? Students prepare a report that includes graphs with visual impact. Students design a survey, collect data and display the data in a variety of appropriate and visually appealing forms in order to provide the school principal with evidence to support or refute this claim.  |
| * describe the distinguishing features of a population and sample ◊
	+ define notations associated with population values (parameters) and sample-based estimates (statistics), including population mean $μ$, population standard deviation $σ$, sample mean $\overbar{x}$ and sample standard deviation $s$
 | Students are provided with a pack of cards that include at least five groups comprising a table or graphical display of a dataset; the population mean; the population standard deviation; the sample mean; and the sample standard deviation. Students sort the cards into matching ‘set’s of the same dataset. Students then design a version of this game themselves, working in small groups to analyse a single dataset before duplicating each set to form the set of cards. |
| * summarise and interpret grouped and ungrouped data through appropriate graphs and summary statistics (ACMGM030) **AAM** ◊
	+ discuss the mode and determine where possible (ACMEM049)
	+ calculate measures of central tendency, including the arithmetic mean and the median (ACMEM050)
	+ investigate the suitability of measures of central tendency in real-world contexts and use them to compare datasets (ACMEM051) Critical and creative thinking icon Civics and citizenship icon
	+ calculate measures of spread including the range, quantiles (including but not limited to quartiles, deciles and percentiles), interquartile range (IQR) and standard deviation (calculations for standard deviation only required using digital technology) (ACMEM053, ACMEM055)  Information and communication technology capability icon
 | Students measure the lengths of their lower and upper legs. The teacher coordinates the collection and analysis of data from all students in the class. Students use their knowledge about measures of central tendency to decide on the best measurements for a chair specifically designed for young people in their age group.Students solve problems involving measures of central tendency. For example:1. If the class were to calculate the mean and variance of their ages now, in 10 years’ time how would they have changed?
2. A sample of size 20 has a mean of 2.2. Another two values are added to the sample, both being 3.3. What is the new mean?
	1. If the word ‘mean’ was replaced by the word ‘median’, what can be said about the new median?
	2. If the word ‘mean’ was replaced by the word ‘mode’, what can be said about the new mode?
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| * investigate and describe the effect of outliers on summary statistics ◊
	+ use different approaches for identifying outliers, including consideration of the distance from the mean or median, or the use of $Q1-1.5×IQR$ and $Q3+1.5×IQR$ criteria, recognising and justifying when each approach is appropriate (ACMEM047)
	+ investigate and recognise the effect of outliers on the mean and median (ACMEM052)
 | Students use a spreadsheet to explore the effect of outliers on the summary statistics and the shape of the display. Students solve simple problems involving the comparative size of the mean and median. For example, add one score to a set of scores so that the median remains unchanged but the mean decreases or decreases; the mean remains unchanged but the median increases or decreases. Students analyse the effect of outliers on a dataset by first identifying outliers in a set of data, then constructing a graphical display of the data with and without the outlier(s) and discussing the effect of removing the outlier on the five-figure summary, the mean, median and the shape of the display. |
| * investigate real-world examples from the media illustrating appropriate and inappropriate use or misuse of measures of central tendency and spread (ACMEM056) **AAM**
 | The teacher sources a recent article from the media that has a number of different data displays accompanying the text. Students respond to the article through key questions such as: Which organisation collected the data? Is the data display a reasonable choice of graphic? Students write a paragraph of approximately 100 words comparing the data display with the text of the article – are the conclusions made in the article reasonable? Students create different graphical displays of the data in the article. If the article misrepresents or misuses the data, students correct the misrepresentation and rewrite the relevant sections of the article. |
| * describe, compare and interpret the distributions of graphical displays and/or numerical datasets and report findings in a systematic and concise manner (ACMGM029, ACMGM032) **AAM** Critical and creative thinking icon  Information and communication technology capability icon Literacy icon ◊
	+ identify modality (unimodal, bimodal or multimodal)
	+ identify shape (symmetric or positively or negatively skewed)
	+ identify central tendency, spread and outliers, using and justifying appropriate criteria
	+ calculate measures of central tendency or measures of spread where appropriate
 | Students explore the different shapes of the graphical display of data. For example, complete the CensusAtSchool activity: [http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSQ+1D+NUMERICAL+DATA+USING+GRAPHS+TO+DESCRIBE+DISTRIBUTION](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSQ%2B1D%2BNUMERICAL%2BDATA%2BUSING%2BGRAPHS%2BTO%2BDESCRIBE%2BDISTRIBUTION)or<https://www.geogebra.org/m/UhM6eEyq> |
| * construct and compare parallel box-plots (ACMEM059) **AAM**  Information and communication technology capability icon
	+ complete a five-number summary for different datasets (ACMEM058)
	+ compare groups in terms of central tendency (median), spread (IQR and range) and outliers (using appropriate criteria) (ACMGM031)
	+ interpret and communicate the differences observed between parallel box-plots in the context of the data
 | The teacher enables students to link taking samples with creating box-plots: <http://www.scootle.edu.au/ec/viewing/L2342/index.html>Students compare parallel box-plots to ‘Fix the Matchbox Machine’: <http://www.scootle.edu.au/ec/viewing/L2336/index.html>Students use graphing technologies to construct and compare box-plots. They make changes to the data and observe the subsequent changes in the box-plot. Students comment on the effect of the change in data to the shape of the display.The teacher prepares a set of cards that includes a box-plot, the five-number summary and the simple dataset for about five different datasets. Students work in small groups with a mixed set of cards to determine the matching datasets. The teacher may provide in-class time for students to finalise their response to the formal assessment task and assist with the submission of any digital files. |

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| **Prior knowledge** | **Questions and prompts for Working Mathematically** | **Summary of technology opportunities** |
| Some experience in reading graphs and interpreting visual displays will be beneficial. | What would happen if …?What is the same and different about …?Explain why …How can we be sure that …?Of what is this a special case …?Give me an example of …What information has been lost?What else can be concluded? | Use spreadsheets to collate, analyse and display data efficiently.Use online survey forms and data-collection tools, such as Google Forms or Survey Monkey, to assist in the process of data collection and management. Generate random numbers using calculators or online to select random samples or datasets. Use graphing technologies such as *GeoGebra* or *Desmos* to construct parallel box-plots and compare datasets.Use the internet to research media articles, find data displays or find data sourced from real-world situations. |

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| Reflection on learning and evaluation – to be completed by teacher during or after teaching the unit. |