 Year 11 Mathematics Standard (Rhombus)

Unit title

Data Analysis (MS-S1)

Duration

6 x 50 minute periods

Rationale

Statistical analysis involves the collection, exploration, display, analysis and interpretation of data to identify and communicate key information. Knowledge of statistical analysis enables the careful interpretation of situations and raises awareness of contributing factors when presented with information by third parties, including the possible misrepresentation of information. Study of statistics is important in developing students’ appreciation of the contribution that statistical thinking makes to decision-making in society and in the professional and personal lives of individuals.

Topic focus

* The principal focus of this subtopic is the 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.
* 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

* MA4-5NA Operates with fractions, decimals and percentages
* MA5.1-12SP Uses statistical displays to compare sets of data, and evaluates statistical claims made in the media

Language considerations

* Arithmetic mean
* Blood alcohol content
* Categorical data
* Categorical variable
* Continuous
* Cumulative frequency graphs
* Cumulative frequency table
* Deciles
* Depreciation
* Discrete
* Interquartile range
* Mean
* Measures of central tendency
* Measures of spread
* Median
* Modality
* Mode
* Nominal
* Numerical data
* Numerical datasets
* Numerical variable
* Ordinal
* Outliers
* Parameters
* Pareto charts
* Percentiles
* Population
* Quartiles
* Random variable
* Range
* Sample
* Sampling
* Standard deviation
* Summary statistics

Outcomes

A student:

* MS11-2 represents information in symbolic, graphical and tabular form
* MS11-7 develops and carries out simple statistical processes to answer questions posed
* MS11-9 uses appropriate technology to investigate, organise and interpret information in a range of contexts
* MS11-10 justifies a response to a given problem using appropriate mathematical terminology and/or calculations

Assessment

Some strategies for formative assessment could include:

* Reflecting on students’ responses to a class discussion
* Beginning the lesson with a few questions on content from previous lessons before progressing
* Having students write their own questions on a topic or having them write a specific number of questions with the same answer
* [3-2-1 Exit slips](http://www.theteachertoolkit.com/index.php/tool/3-2-1)
* [Chalk Talk Routine](http://www.santeesd.net/cms/lib/CA01000468/Centricity/Domain/12/VT_ChalkTalk.pdf)
* [Red, Yellow, Green Cups](http://www.sstr2.org/Downloads/Cups%20as%20student%20feedback.pdf); students could also indicate beside the questions their level of understanding using the letters, R, Y or G.
* [Mindmaps](https://emedia.rmit.edu.au/learninglab/content/how-create-mind-map)

| Outcomes and content | Teaching and learning strategies and evidence of learning | Resources |
| --- | --- | --- |
| S1.1 Classifying and representing data (grouped and ungrouped) | N/A | N/A |
| Describe and use appropriate data collection methods for a population or samples* 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
* Investigate the advantages and disadvantages of each type of sampling
* Describe the potential faults in the design and practicalities of data collection processes, such as surveys, experiments and observational studies, misunderstandings and misrepresentations, including examples from the media
 | Teaching strategies:* Teacher to introduce the steps in the statistical investigation process:
	+ Identifying a problem
	+ Posing a statistical question
	+ Collecting or obtaining data
	+ Representing and analysing that data
	+ Communicating and interpreting findings
* Teacher to help students with the identification of a problem out of which they will conduct a statistical investigation around a question that they construct themselves. Students can be supported in coming up with a question for a statistical investigation by giving them a dataset
	+ For example, use the ABS’ Random Sampler to create a random sample of 30 students. They look at the dataset and come up with a question that starts with “I wonder…”

Student activities:* When students have completed their statistical question, students can complete a jigsaw activity around the four different sampling methods to be considered: systematic, self-selected, simple random and stratified. They then choose a sampling method to collect data to answer their own statistical question.
* To complete the jigsaw:
	+ Arrange students into groups of four and assign a sampling method to each person.
	+ Students who have been assigned the same sampling method meet together to read material on the method and become experts in the method.
	+ The original groups reform and each person takes a turn to explain the sampling method they investigated.
	+ Each student completes a graphic organiser of the results.
 | [Sampling Techniques Quiz](http://www.cobblearning.net/stevenwilson/files/2017/02/Sampling-Techniques-Worksheet-1kly8ij.pdf)[Census at School – Random Sampler](http://www.cas.abs.gov.au/cgi-local/cassampler.pl) (ABS) |
| Classify data relating to a single random variable* Classify a categorical variable as either ordinal, such as income level (low, medium, high) or nominal, such as place of birth (Australia, overseas)
* Classify a numerical variable as either discrete, such as the number of rooms in a house, or continuous, such as the temperature in degrees Celsius
 | Teaching strategies:* Give students a selection of questions from the 2016 Australian Census.
* Ask them to organise the questions into groups with justification for their formation of groups.
* Teacher introduces the different types of data – categorical (ordinal or nominal) or numerical (discrete or continuous).
* Students then reorganise questions based on type of data – categorical (ordinal or nominal) or numerical (discrete or continuous).

Student activities:* Students can evaluate the survey they wrote in previous lessons and indicate which questions produce which data type.
 | [Sample Census Household Form](http://www.abs.gov.au/ausstats/abs%40.nsf/Lookup/2901.0Main%20Features802016/%24FILE/2016%20Census%20Sample%20Household%20Form.pdf) |
| Review how to organise and display data into appropriate tabular and/or graphical representations AAM* Display categorical data in tables and, as appropriate, in both bar charts or Pareto charts
* 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)
* 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, hourly temperature, household and personal water usage
 | Teaching strategies:* Teachers will need to introduce students to Pareto charts – how they are constructed and how they are interpreted.
* Direct students to Singapore’s Public Data website. Students are to look at the different data displays, name the data display and explain why this is a preferable choice of data display for the data set (for example, why use a line graph for the birth rate over time?). Teacher to emphasise that different types of data are suited to particular types of graphs.

Student activities:* Students use the Graph Investigator to research the different types of graphs and the types of data they are suitable for.
* Students use one dataset from their survey and display it in a range of graphs, providing justification for the best type of graph to display the dataset.
* Students use the datasets and displays from the Centre for Road Safety’s (Transport for NSW) Interactive Crash Statistics to interpret statistics for their local government area.
 | [The 80-20 Rule Explained (Pareto Principle)](https://youtu.be/F-I-BVqMiNI)[Creating Pareto Charts in Excel](https://www.lynda.com/Excel-tutorials/Creating-Pareto-charts/135358/144271-4.html?org=tafeillawarra.edu.au) (required DoE login)[Singapore’s Public Data](https://data.gov.sg/)[Graph Investigator](http://splash.abc.net.au/res/i/L5904/index.html) (ABC Splash)[Centre for Road Safety – Interactive Crash Statistics](http://roadsafety.transport.nsw.gov.au/statistics/interactivecrashstats/index.html) (Transport for NSW) |
| Interpret and compare data by considering it in tabular and/or graphical representations AAM* 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, such as a heat map to illustrate climate change data or the median house prices across suburbs
 | Teaching strategies:* Guide students in using the ABS QuickStats tool to look up census data for a location in the 2016, 2011, 2006 and 2001 censuses. Students can display the data for different variables over time in tabular and graphical form.

Student activities:* Students look at examples of heat maps, such as land surface temperature (Earth Science Data Visualisations) or Sydney house values by suburb, and discuss the effectiveness of this type of display for the data.
 | [ABS Quickstats](http://abs.gov.au/websitedbs/censushome.nsf/home/quickstats?opendocument&navpos=220)[Earth Science Data Visualisations – How to read a heat map (NASA)](https://www.jpl.nasa.gov/edu/teach/activity/earth-science-data-visualizations-how-to-read-a-heat-map/)[Sydney house values by suburb (2011 and 2016) heat map](http://cdn.newsapi.com.au/image/v1/855f18b4fa3634a4e471a169b5a3dc8a) |
| S1.2 Summary statistics | N/A | N/A |
| Describe the distinguishing features of a population and sample* Define notations associated with population values (parameters) and sample-based estimates (statistics), including population mean , population standard deviation , sample mean and sample standard deviation
 | Teaching strategies:* Collect data from the class (representing the population), such as the number of minutes taken to get to school, and calculate the population mean  and population standard deviation
* Take a sample of the class using one of the sampling techniques introduced earlier and calculate sample mean  and sample standard deviation  and compare to the population mean  and population standard deviation

Student activities:* Students conduct internet research to find the advantages and disadvantages of a census and a sample
	+ The ABS’ Statistical Language for Census and Sample is a good starting point
 | [Statistical Language – Census and Sample](http://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical%2Blanguage%2B-%2Bcensus%2Band%2Bsample) (ABS) |
| Summarise and interpret grouped and ungrouped data through appropriate graphs and summary statistics AAM* Discuss the mode and determine where possible
* 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
* 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 are only required by using technology)
 | Teaching strategies:* Using an ABS Census at School Random Sample or class data, collect two data sets – one that can be displayed and interpreted as ungrouped data (such as the number of TVs in the house) and another that can be displayed and interpreted as grouped data (such as height). Calculate summary statistics for each set.

Student activities:* Students use an ABS Census at School Random Sample and select a dataset that can be displayed and interpreted as ungrouped data and another dataset that can be displayed and interpreted as grouped data and calculate summary statistics for each set.
 | [Measures of Average](http://www.bbc.co.uk/bitesize/ks3/maths/handling_data/measures_average/revision/8/) (BBC Bitesize) |
| 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  and  as the criteria, recognising and justifying when each approach is appropriate
* Investigate and recognise the effect of outliers on the mean and median
 | Teaching strategies:* As students enter the classroom, have them put a post-it note on a dot plot scale indicating their shoe size. Use this as a discussion to start the lesson about outliers. If there are no outliers present, then add one and demonstrate different approaches for identifying outliers.

Student activities:* Students use two datasets (one with an outlier at the lower extreme and the other with an outlier at the upper extreme) to calculate and record the effect of outliers on the mean and median in a table.
 | N/A |
| Describe, compare and interpret the distributions of graphical displays and/or numerical datasets and report findings in a systematic and concise manner AAM* 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
 | Teaching strategies:* Give students a very simple quiz, such as the addition of two single digit numbers on Google Forms, where the results will be graphed automatically. Then give students a harder quiz on Google Forms and compare the graphs (the simpler one should be negatively-skewed and the harder one should be more symmetrical or positively-skewed).

Student activities:* Students conduct internet research to find datasets that are symmetrical (such as height), positively-skewed (such as income) and negatively-skewed (such as age at death).
 | N/A |

Reflection and evaluation