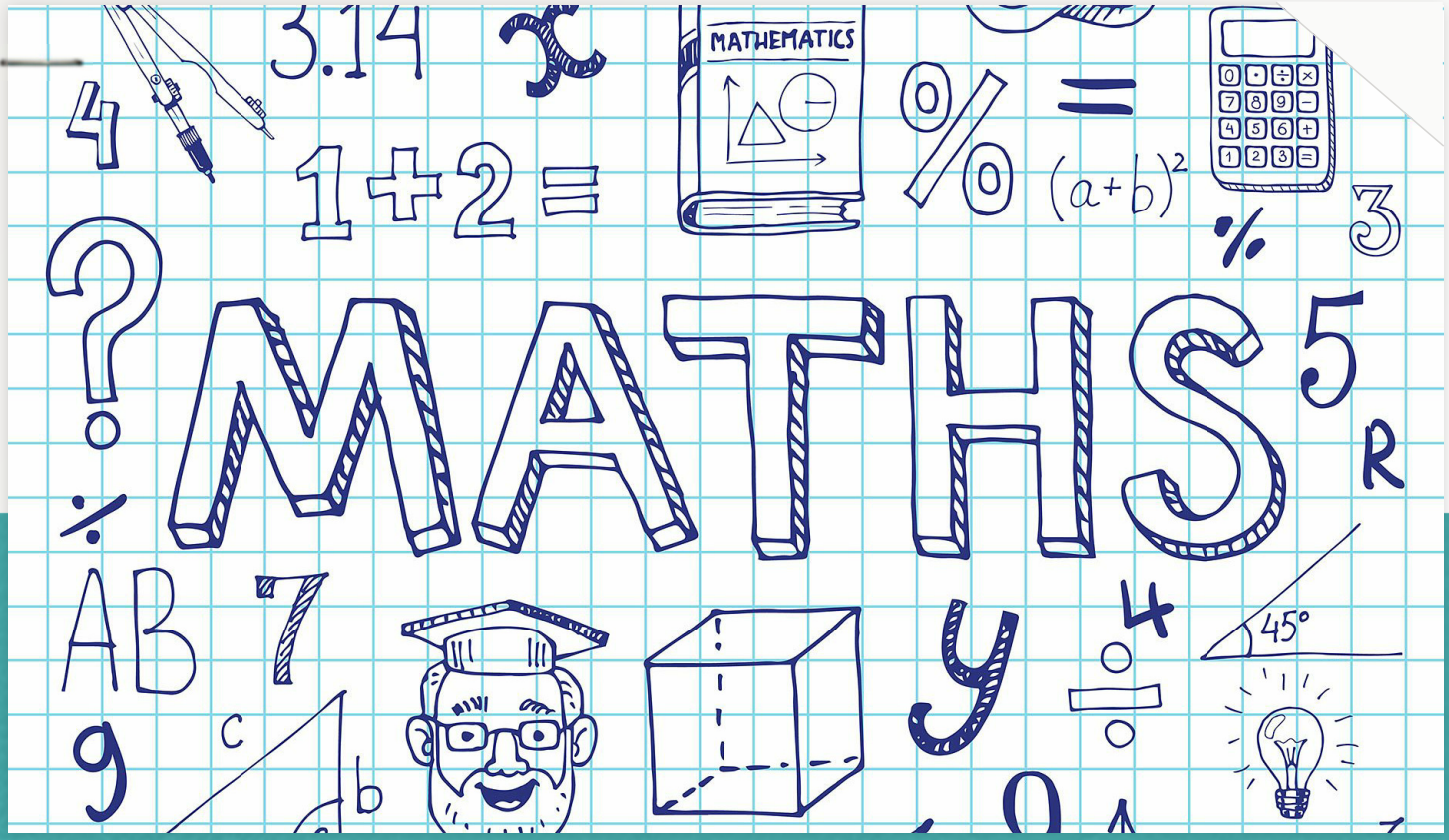
Standard Mathematics

“Not everything that counts can be counted. Not everything that can be counted counts.” Albert Einstein



Year 11 Dot Point Booklet

"Arithmetic is being able to count up to twenty without taking off your shoes." Mickey Mouse

"No employment can be managed without arithmetic, no mechanical invention without geometry." Benjamin Franklin

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Topic: Algebra

Outcomes

A student:

- uses algebraic and graphical techniques to compare alternative solutions to contextual problems MS11-1
- represents information in symbolic, graphical and tabular form MS11-2
- makes predictions about everyday situations based on simple mathematical models MS11-6
- 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

Related Life Skills outcomes: MALS6-1, MALS6-7, MALS6-8, MALS6-13, MALS6-14

Topic Focus

Algebra involves the use of symbols to represent numbers or quantities and to express relationships, using mathematical models and applications.

Knowledge of algebra enables the modelling of a problem conceptually so that it is simpler to solve.

Study of algebra is important in developing students' reasoning skills and logical thought processes, as well as their ability to represent and solve problems.

Subtopics

MS-A1: Formulae and Equations
MS-A2: Linear Relationships

Algebra

MS-A1 Formulae and Equations

Outcomes

A student:

- uses algebraic and graphical techniques to compare alternative solutions to contextual problems MS11-1
- makes predictions about everyday situations based on simple mathematical models MS11-6
- 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

Related Life Skills outcomes: MALS6-1, MALS6-7, MALS6-8, MALS6-13, MALS6-14

Subtopic Focus

The principal focus of this subtopic is to provide a solid foundation in algebraic skills, including finding solutions to a variety of equations in work-related and everyday contexts.

Students develop awareness of the applicability of algebra in their approach to everyday life.

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.

Content

Students:

- review substitution of numerical values into linear and non-linear algebraic expressions and equations ◊
  - review evaluating the subject of a formula, given the value of other pronumerals in the formula
  - change the subject of a linear formula
  - solve problems involving formulae, including but not limited to calculating distance, speed and time (with change of units of measurement as required) or calculating stopping distances of vehicles using a suitable formula **AAM**

Students:

- develop and solve linear equations, including but not limited to those derived from substituting values into a formula, or those developed from a word description **AAM** ◊

Students:

- calculate and interpret blood alcohol content (BAC) based on drink consumption and body weight **AAM**
  - use formulae, both in word form and algebraic form, to calculate an estimate for blood alcohol content (BAC), including $BAC_{\text{Male}} = \frac{10N - 7.5H}{6.8M}$ and $BAC_{\text{Female}} = \frac{10N - 7.5H}{5.5M}$ where N is the number of standard drinks consumed, H is the number of hours of drinking, and M is the person's weight in kilograms
  - determine the number of hours required for a person to stop consuming alcohol in order to reach zero BAC, eg using the formula $\text{time} = \frac{BAC}{0.015}$
  - describe limitations of methods estimating BAC

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Students:

- calculate required medication dosages for children and adults from packets, given age or weight, using Fried's, Young's or Clark's formula as appropriate **AAM**
  - Fried's formula: $\text{Dosage for children } 1-2 \text{ years} = \frac{\text{age (in months)} \times \text{adult dosage}}{150}$
  - Young's formula: $\text{Dosage for children } 1-12 \text{ years} = \frac{\text{age of child (in years)} \times \text{adult dosage}}{\text{age of child (in years)} + 12}$
  - Clark's formula: $\text{Dosage} = \frac{\text{weight in kg} \times \text{adult dosage}}{70}$

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Algebra

MS-A2 Linear Relationships

Outcomes

A student:

- uses algebraic and graphical techniques to compare alternative solutions to contextual problems MS11-1
- represents information in symbolic, graphical and tabular form MS11-2
- makes predictions about everyday situations based on simple mathematical models MS11-6
- 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

Related Life Skills outcomes: MALS6-1, MALS6-7, MALS6-8, MALS6-13, MALS6-14

Subtopic Focus

The principal focus of this subtopic is the graphing and interpretation of practical linear and direct variation relationships.

Students develop fluency in the graphical approach to linear modelling and its representativeness in common facets of their life.

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.

Content

Students:

- model, analyse and solve problems involving linear relationships, including constructing a straight-line graph and interpreting features of a straight-line graph, including the gradient and intercepts **AAM** ◊
  - recognise that a direct variation relationship produces a straight-line graph
  - determine a direct variation relationship from a written description, a straight-line graph passing through the origin, or a linear function in the form $y = mx$
  - review the linear function $y = mx + c$ and understand the geometrical significance of m and c
  - recognise the gradient of a direct variation graph as the constant of variation **AAM**
  - construct straight-line graphs both with and without the aid of technology (ACMGM040)

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Students:

- construct and analyse a linear model, graphically or algebraically, to solve practical direct variation problems, including but not limited to the cost of filling a car with fuel or a currency conversion graph **AAM** ◊
  - identify and evaluate the limitations of a linear model in a practical context

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Topic: Measurement

Outcomes

A student:

- solves problems involving quantity measurement, including accuracy and the choice of relevant units MS11-3
- performs calculations in relation to two-dimensional and three-dimensional figures MS11-4
- 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

Related Life Skills outcomes: MALS6-3, MALS6-4, MALS6-13, MALS6-14

Topic Focus

Measurement involves the application of knowledge, skills and understanding of numbers and geometry to quantify and solve problems in practical situations.

Knowledge of measurement enables completion of daily tasks such as making time estimations, measuring medicine, finding weights and understanding areas of materials or substances.

Study of measurement is important in developing students' ability to make reasonable estimates for quantities, apply appropriate levels of accuracy to particular situations, and apply understanding of aspects of measurement such as length, area, volume and similarity to a variety of problems.

Subtopics

MS-M1: Applications of Measurement
MS-M2: Working with Time

Measurement

MS-M1 Applications of Measurement

Outcomes

A student:

- solves problems involving quantity measurement, including accuracy and the choice of relevant units MS11-3
- performs calculations in relation to two-dimensional and three-dimensional figures MS11-4
- 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

Related Life Skills outcomes: MALS6-3, MALS6-4, MALS6-13, MALS6-14

Subtopic Focus

The principal focus of this subtopic is to develop an awareness of the inherent error in measurements and to become competent in solving practical problems involving energy, mass, perimeter, area, volume and capacity.

Students develop knowledge of the concepts of measurement and demonstrate fluency with its application.

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.

Content

M1.1: Practicalities of measurement

Students:

- review the use of different metric units of measurement including units of area, take measurements, and calculate conversions between common units of measurement, for example kilometres to metres or litres to millilitres ◊

Students:

- calculate the absolute error of a reported measurement using $\text{Absolute error} = \frac{1}{2} \times \text{Precision}$ and state the corresponding limits of accuracy ◊
  - find the limits of accuracy as given by:
    $\text{Upper bound} = \text{Measurement} + \text{Absolute error}$
    $\text{Lower bound} = \text{Measurement} - \text{Absolute error}$
  - investigate types of errors, eg human error or device limitations
  - calculate the percentage error of a reported measurement using
    $\text{Percentage error} = \frac{\text{Absolute error}}{\text{Measurement}} \times 100\%$

Students:

- use standard form and standard metric prefixes in the context of measurement, with and without a required number of significant figures ◊

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M1.2: Perimeter, area and volume

Students:

- review and extend how to solve practical problems requiring the calculation of perimeters and areas of triangles, rectangles, parallelograms, trapezia, circles, sectors of circles and composite shapes ◊
  - review the use of Pythagoras' theorem to solve problems involving right-angled triangles
  - review the use of a scale factor to find unknown lengths in similar figures

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Students:

- solve problems involving surface area of solids including but not limited to prisms, cylinders, spheres and composite solids

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Students:

- solve problems involving volume and capacity of solids including but not limited to prisms, cylinders, spheres, pyramids and composite solids
  - convert between units of volume and capacity

Students:

- calculate perimeters and areas of irregularly shaped blocks of land by dissection into regular shapes including triangles and trapezia **AAM**
  - derive the Trapezoidal rule for a single application, $A \approx \frac{h}{2}(d_f + d_l)$
  - use the Trapezoidal rule to solve a variety of practical problems
  - use the Trapezoidal rule to estimate the base area of a solid in a practical context, using technology, and then calculate its approximate volume, eg the volume of water in a swimming pool

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Students:

- solve problems involving perimeters, area, surface area, volumes and capacity in a variety of contexts **AAM**

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M1.3: Units of energy and mass

Students:

- review the use of metric units of mass in solving problems, including grams, kilograms and tonnes, their abbreviations and how to convert between them

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Students:

- use metric units of energy to solve problems, including calories, kilocalories, joules and kilojoules, their abbreviations and how to convert between them

Students:

- use units of energy and mass to solve problems related to food and nutrition, including calories

Students:

- use units of energy to solve problems involving the amount of energy expended in activities, for example kilojoules

Students:

- use units of energy to solve problems involving the consumption of electricity, for example kilowatt hours, and investigate common appliances in terms of their energy consumption **AAM**

Measurement

MS-M2 Working with Time

Outcomes

A student:

- solves problems involving quantity measurement, including accuracy and the choice of relevant units MS11-3
- performs calculations in relation to two-dimensional and three-dimensional figures MS11-4
- 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

Related Life Skills outcomes: MALS6-3, MALS6-4, MALS6-13, MALS6-14

Subtopic Focus

The principal focus of this subtopic is to understand concepts related to locations on Earth's surface and calculation of time differences using time zones.

Students develop awareness of being a global citizen and the relationships between different countries in terms of location, distance and time.

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.

Content

Students:

- indicate positions on the Earth's surface
  - locate points on Earth's surface using latitude, longitude or position coordinates with a globe, an atlas and digital technologies, eg a smartphone or GPS device

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Students:

- calculate times and time differences around the world **AAM** ◊
  - review using units of time, converting between 12-hour and 24-hour clocks and calculating time intervals
  - solve problems involving time zones in Australia and in neighbouring nations, making any necessary allowances for daylight saving (ACMEM163)
  - solve problems involving Coordinated Universal Time (UTC), and the International Date Line (IDL)
  - find time differences between two places on Earth using recognised international time zones (ACMEM165)
  - review how to interpret timetables, eg bus, train and ferry timetables, and use them to solve problems
  - solve practical problems, eg travelling east and west, incorporating time zones, or internet and phone usage across time zones, or the timing of events broadcast live from states of countries between different time zones

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Students:

- calculate times and time differences around the world **AAM** ◊
  - review using units of time, converting between 12-hour and 24-hour clocks and calculating time intervals
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Financial Mathematics

Outcomes

A student:

- represents information in symbolic, graphical and tabular form MS11-2
- models relevant financial situations using appropriate tools MS11-5
- makes predictions about everyday situations based on simple mathematical models MS11-6
- 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

Related Life Skills outcomes: MALS6-2, MALS6-5, MALS6-6, MALS6-7, MALS6-8, MALS6-13, MALS6-14

Topic Focus

Financial Mathematics involves the application of knowledge, skills and understanding of numbers to earning, spending, investing, saving and borrowing money.

Knowledge of financial mathematics enables students to analyse different financial situations, to calculate the best options for given circumstances, and to solve financial problems.

Study of financial mathematics is important in developing students' ability to make informed financial decisions, to be aware of the consequences of such decisions, and to manage personal financial resources effectively.

Subtopics

MS-F1: Money Matters

Financial Mathematics

MS-F1 Money Matters

Outcomes

A student:

- represents information in symbolic, graphical and tabular form MS11-2
- models relevant financial situations using appropriate tools MS11-5
- makes predictions about everyday situations based on simple mathematical models MS11-6
- 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

Related Life Skills outcomes: MALS6-2, MALS6-5, MALS6-6, MALS6-7, MALS6-8, MALS6-13, MALS6-14

Subtopic Focus

The principal focus of this subtopic is to calculate and graph simple interest, manage earnings, wages and taxation, and develop an appropriate budget for a given situation.

Students develop an ability to justify various types of financial decisions which will affect their life now and into the future.

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.

Content

F1.1: Interest and depreciation

Students:

- calculate simple interest for different rates and periods (ACMEM064) ◊
  - apply percentage increase or decrease in various contexts, eg calculating the goods and services tax (GST) payable on a range of goods and services, and calculating profit or loss in absolute and percentage terms
  - use technology or otherwise to compare simple interest graphs for different rates and periods

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Students:

- calculate the depreciation of an asset using the straight-line method as an application of the simple interest formula **AAM** ◊
  - use $S = V_0 - Dn$, where S is the salvage value of the asset after n periods, V_0 is the initial value of the asset, D is the amount of depreciation per period, and n is the number of periods

Students:

- use a spreadsheet to calculate and graph compound interest as a recurrence relation involving repeated applications of simple interest **AAM** ◊

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F1.2: Earning and managing money

Students:

- calculate monthly, fortnightly, weekly, daily or hourly pay rates from a given salary, wages involving hourly rates and penalty rates, including situations involving overtime and other special allowances, and earnings based on commission (including commission based on a sliding scale), piecework or royalties ◊
  - calculate annual leave loading
  - calculate payments based on government allowances and pensions (ACMGM003)

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Students:

- calculate income tax ◊
  - identify allowable tax deductions
  - calculate taxable income after allowable tax deductions are taken from gross pay
  - calculate the Medicare levy (basic levy only)
  - calculate net pay following deductions from income
  - calculate the amount of Pay As You Go (PAYG) tax payable per fortnight or week using current tax scales, and use this to determine if more tax is payable or if a refund is owing after completing a tax return

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Students:

- use technology to perform financial computations, for example calculating percentage change, calculating tax payable and preparing a wage-sheet ◊

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F1.3: Budgeting and household expenses

Students:

- interpret and use information about a household's electricity, water or gas usage and related charges and costs from household bills **AAM** ◊

Students:

- plan for the purchase of a car **AAM** ◊
  - investigate on-road costs for new and used vehicles, including sale price (or loan repayments), registration, insurance and stamp duty at current rates
  - consider sustainability when choosing a vehicle to purchase, eg fuel consumption rates
  - calculate and compare the cost of purchasing different vehicles using a spreadsheet

Students:

- plan for the running and maintenance of a car **AAM** ◊
  - describe the different types of insurance available, including compulsory and non-compulsory third-party insurance, and comprehensive insurance
  - investigate other running costs associated with ownership of a vehicle, eg cost of servicing, repairs and tyres
  - calculate and compare the cost of running different vehicles using a spreadsheet

Students:

- prepare a personal budget for a given income, taking into account fixed and discretionary spending (ACMGM004) **AAM** ◊

Topic: Statistical Analysis

Outcomes

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
- solves probability problems involving multistage events MS11-8
- 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

Related Life Skills outcomes: MALS6-2, MALS6-9, MALS6-10, MALS6-13, MALS6-14

Topic Focus

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' understanding of the contribution that statistical thinking makes to decision-making in society and in the professional and personal lives of individuals.

Subtopics

MS-S1: Data Analysis
MS-S2: Relative Frequency and Probability

Statistical Analysis

MS-S1 Data Analysis

Outcomes

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

Related Life Skills outcomes: MALS6-2, MALS6-9, MALS6-13, MALS6-14

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.

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.

Content

S1.1: Classifying and representing data (grouped and ungrouped)

Students:

- 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, eg surveys, experiments and observational studies, misunderstandings and misrepresentations, including examples from the media

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Students:

- classify data relating to a single random variable ◊
  - classify a categorical variable as either ordinal, eg income level (low, medium, high) or nominal, eg place of birth (Australia, overseas)
  - classify a numerical variable as either discrete, eg the number of rooms in a house, or continuous, eg the temperature in degrees Celsius

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Students:

- 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

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Students:

- 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, eg a heat map to illustrate climate change data or the median house prices across suburbs

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S1.2: Summary statistics

Students:

- 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 $\bar{x}$ and sample standard deviation s

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Students:

- 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)

Students:

- 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 $Q_1 - 1.5 \times IQR$ and $Q_3 + 1.5 \times IQR$ as criteria, recognising and justifying when each approach is appropriate
  - investigate and recognise the effect of outliers on the mean and median

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Students:

- investigate real-world examples from the media illustrating appropriate and inappropriate uses or misuses of measures of central tendency and spread (ACMEM056) **AAM**

Students:

- 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

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Students:

- construct and compare parallel box-plots **AAM**
  - 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)
  - interpret and communicate the differences observed between parallel box-plots in the context of the data

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Statistical Analysis

MS-S2 Relative Frequency and Probability

Outcomes

A student:

- solves probability problems involving multistage events MS11-8
- 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

Related Life Skills outcomes: MALS6-10, MALS6-13, MALS6-14

Subtopic Focus

The principal focus of this subtopic is to draw conclusions related to the chance that an event will occur.

Students develop awareness of the broad range of applications of probability concepts in everyday life and their use in decision-making.

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.

Content

Students:

- review, understand and use the language associated with theoretical probability and relative frequency ◊
  - construct a sample space for an experiment and use it to determine the number of outcomes (ACMEM154)
  - review probability as a measure of the 'likely chance of occurrence' of an event (ACMMM052)
  - review the probability scale: $0 \leq P(A) \leq 1$ for each event A, with $P(A) = 0$ if A is an impossibility and $P(A) = 1$ if A is a certainty (ACMMM053)

Students:

- determine the probabilities associated with simple games and experiments ◊
  - use the following definition of probability of an event where outcomes are equally likely: $P(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{total number of outcomes}}$
  - calculate the probability of the complement of an event using the relationship $P(\text{an event does not occur}) = 1 - P(\text{the event does occur}) = P(\overline{\text{the event does occur}}) = P(\text{event}^c)$

Students:

- use arrays and tree diagrams to determine the outcomes and probabilities for multistage experiments (ACMEM156) **AAM**
  - construct and use tree diagrams to establish the outcomes for a simple multistage event
  - use probability tree diagrams to solve problems involving two-stage events

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Students:

- solve problems involving simulations or trials of experiments in a variety of contexts **AAM** ◊
  - perform simulations of experiments using technology (ACMEM150)
  - use relative frequency as an estimate of probability (ACMEM152)
  - recognise that an increasing number of trials produces relative frequencies that gradually become closer in value to the theoretical probability
  - identify factors that could complicate the simulation of real-world events (ACMEM153)

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Students:

- solve problems involving probability and/or relative frequency in a variety of contexts **AAM**
  - use existing known probabilities, or estimates based on relative frequencies to calculate expected frequency for a given sample or population, eg predicting, by calculation, the number of people of each blood type in a population given the percentage breakdowns
  - calculate the expected frequency of an event occurring using np where n represents the number of times an experiment is repeated, and on each of those times the probability that the event occurs is p