The Australian Curriculum

Subjects	Essential Mathematics
Units	Unit 1, Unit 2, Unit 3 and Unit 4
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Essential Mathematics

Rationale and Aims

Rationale

Mathematics is the study of order, relation and pattern. From its origins in counting and measuring, it has evolved in highly sophisticated and elegant ways to become the language used to describe much of the physical world. Statistics is the study of ways of collecting and extracting information from data and of methods of using that information to describe and make predictions about the behaviour of aspects of the real world, in the face of uncertainty. Together, mathematics and statistics provide a framework for thinking and a means of communication that is powerful, logical, concise and precise.

Essential Mathematics focuses on enabling students to use mathematics effectively, efficiently and critically to make informed decisions in their daily lives. Essential Mathematics provides students with the mathematical knowledge, skills and understanding to solve problems in real contexts, in a range of workplace, personal, further learning and community settings. This subject offers students the opportunity to prepare for post-school options of employment and further training.

For all content areas of Essential Mathematics, the proficiency strands of understanding, fluency, problem solving and reasoning from the F–10 curriculum are still applicable and should be inherent in students' learning of the subject. Each of these proficiencies is essential, and all are mutually reinforcing. For all content areas, practice allows students to develop fluency in their skills. Students will encounter opportunities for problem solving, such as finding the volume of a solid so that the amount of liquid held in a container can be compared with what is written on the label, or finding the interest on a sum of money to enable comparison between different types of loans. In Essential Mathematics, reasoning includes critically interpreting and analysing information represented through graphs, tables and other statistical representations to make informed decisions. The ability to transfer mathematical skills between contexts is a vital part of learning in this subject. For example, familiarity with the concept of a rate enables students to solve a wide range of practical problems, such as fuel consumption, travel times, interest payments, taxation, and population growth.

The content of the Essential Mathematics subject is designed to be taught within contexts that are relevant to the needs of the particular student cohort. The skills and understandings developed throughout the subject will be further enhanced and reinforced through presentation in an area of interest to the students.

Aims

Essential Mathematics aims to develop students':

- understanding of concepts and techniques drawn from mathematics and statistics
- ability to solve applied problems using concepts and techniques drawn from mathematics and statistics
- reasoning and interpretive skills in mathematical and statistical contexts
- capacity to communicate in a concise and systematic manner using appropriate mathematical and statistical language
- capacity to choose and use technology appropriately.

Organisation

Overview of senior secondary Australian Curriculum

ACARA has developed senior secondary Australian Curriculum for English, Mathematics, Science and History according to a set of design specifications. The ACARA Board approved these specifications following consultation with state and territory curriculum, assessment and certification authorities.

The senior secondary Australian Curriculum specifies content and achievement standards for each senior secondary subject. Content refers to the knowledge, understanding and skills to be taught and learned within a given subject. Achievement standards refer to descriptions of the quality of learning (the depth of understanding, extent of knowledge and sophistication of skill) expected of students who have studied the content for the subject.

The senior secondary Australian Curriculum for each subject has been organised into four units. The last two units are cognitively more challenging than the first two units. Each unit is designed to be taught in about half a 'school year' of senior secondary studies (approximately 50–60 hours duration including assessment and examinations). However, the senior secondary units have also been designed so that they may be studied singly, in pairs (that is, year-long), or as four units over two years.

State and territory curriculum, assessment and certification authorities are responsible for the structure and organisation of their senior secondary courses and will determine how they will integrate the Australian Curriculum content and achievement standards into their courses. They will continue to be responsible for implementation of the senior secondary curriculum, including assessment, certification and the attendant quality assurance mechanisms. Each of these authorities acts in accordance with its respective legislation and the policy framework of its state government and Board. They will determine the assessment and certification specifications for their local courses that integrate the Australian Curriculum content and achievement standards and any additional information, guidelines and rules to satisfy local requirements including advice on entry and exit points and credit for completed study.

The senior secondary Australian Curriculum for each subject should not, therefore, be read as a course of study. Rather, it is presented as content and achievement standards for integration into state and territory courses.

Senior secondary Mathematics subjects

The Senior Secondary Australian Curriculum: Mathematics consists of four subjects in mathematics, with each subject organised into four units. The subjects are differentiated, each focusing on a pathway that will meet the learning needs of a particular group of senior secondary students.

Essential Mathematics focuses on using mathematics effectively, efficiently and critically to make informed decisions. It provides students with the mathematical knowledge, skills and understanding to solve problems in real contexts for a range of workplace, personal, further learning and community settings. This subject provides the opportunity for students to prepare for post-school options of employment and further training.

General Mathematics focuses on using the techniques of discrete mathematics to solve problems in contexts that include financial modelling, network analysis, route and project planning, decision making, and discrete growth and decay. It provides an opportunity to analyse and solve a wide range of geometrical problems in areas such as measurement, scaling, triangulation and navigation. It also provides opportunities to develop systematic strategies based on the statistical investigation process for answering statistical questions that involve comparing groups, investigating associations and analysing time series.

Mathematical Methods focuses on the development of the use of calculus and statistical analysis. The study of calculus in Mathematical Methods provides a basis for an understanding of the physical world involving rates of change, and includes the use of functions, their derivatives and integrals, in modelling physical processes. The study of statistics in Mathematical Methods develops the ability to describe and analyse phenomena involving uncertainty and variation.

Specialist Mathematics provides opportunities, beyond those presented in Mathematical Methods, to develop rigorous mathematical arguments and proofs, and to use mathematical models more extensively. Specialist Mathematics contains topics in functions and calculus that build on and deepen the ideas presented in Mathematical Methods as well as demonstrate their application in many areas. Specialist Mathematics also extends understanding and knowledge of probability and statistics and introduces the topics of vectors, complex numbers and matrices. Specialist Mathematics is the only mathematics subject that has been designed to not be taken as a stand-alone subject.

Structure of Essential Mathematics

Essential Mathematics has four units each of which contains a number of topics. It is intended that the topics be taught in a context relevant to students' needs and interests. In Essential Mathematics, students use their knowledge and skills to investigate realistic problems of interest which involve the application of mathematical relationships and concepts.

Unit 1	Unit 2	Unit 3	Unit 4
Calculations, percentages and rates Measurement Algebra Graphs	Representing and comparing data Percentages Rates and ratios Time and motion	Measurement Scales, plans and models Graphs Data collection	Probability and relative frequencies Earth geometry and time zones Loans and compound interest

Units

Unit 1 provides students with the mathematical skills and understanding to solve problems relating to calculations, applications of measurement, the use of formulas to find an unknown quantity, and the interpretation of graphs. Teachers are encouraged to apply the content of all topics in contexts which are meaningful and of interest to their students. A variety of approaches could be used to achieve this. Two contexts which could be used in this unit are *Mathematics and foods* and *Earning and managing money*. However, these contexts may not be relevant for all students, and teachers are encouraged to find a suitable context that will make the mathematical topics of this unit relevant for their particular student cohort.

Unit 2 provides students with the mathematical skills and understanding to solve problems related to representing and comparing data, percentages, rates and ratios, and time and motion. Teachers are encouraged to apply the content of all topics in contexts which are meaningful and of interest to the students. A variety of approaches could be used to achieve this purpose. Two possible contexts which could be used in this unit to achieve this goal are *Mathematics and cars* and *Mathematics and independent living*. However these contexts may not be relevant for all students, and teachers are encouraged to find a suitable context that will make the mathematical topics of this unit relevant for their particular student cohort.

Unit 3 provides students with the mathematical skills and understanding to solve problems related to measurement, scales, plans and models, drawing and interpreting graphs, and data collection. Teachers are encouraged to apply the content of all topics in contexts which are meaningful and of interest to the students. A variety of approaches could be used to achieve this purpose. Two possible contexts which could be used in this unit to achieve this goal are *Mathematics and design* and *Mathematics and medicine*. However these contexts may not be relevant for all students and teachers are encouraged to find a suitable context that will make the mathematical topics of this unit relevant for their particular student cohort.

Unit 4 provides students with the mathematical skills and understanding to solve problems related to probability, earth geometry and time zones, and loans and compound interest. Teachers are encouraged to apply the content of all topics in contexts which are meaningful and of interest to the students. A variety of approaches could be used to achieve this purpose. Two possible contexts which could be used in this unit are Mathematics of Finance and Mathematics of travelling. However these contexts may not be relevant for all students and teachers are encouraged to find a suitable context that will make the mathematical topics of this unit relevant for their particular student cohort.

Organisation of achievement standards

The achievement standards in Mathematics have been organised into two dimensions: 'Concepts and Techniques' and 'Reasoning and Communication'. These two dimensions reflect students' understanding and skills in the study of mathematics.

Senior secondary achievement standards have been written for each Australian Curriculum senior secondary subject. The achievement standards provide an indication of typical performance at five different levels (corresponding to grades A to E) following the completion of study of senior secondary Australian Curriculum content for a pair of units. They are broad statements of understanding and skills that are best read and understood in conjunction with the relevant unit content. They are structured to reflect key dimensions of the content of the relevant learning area. They will be eventually accompanied by illustrative and annotated samples of student work/ performance/ responses.

The achievement standards will be refined empirically through an analysis of samples of student work and responses to assessment tasks: they cannot be maintained *a priori* without reference to actual student performance. Inferences can be drawn about the quality of student learning on the basis of observable differences in the extent, complexity, sophistication and generality of the understanding and skills typically demonstrated by students in response to well-designed assessment activities and tasks.

In the short term, achievement standards will inform assessment processes used by curriculum, assessment and certifying authorities for course offerings based on senior secondary Australian Curriculum content.

ACARA has made reference to a common syntax (as a guide, not a rule) in constructing the achievement standards across the learning areas. The common syntax that has guided development is as follows:

- Given a specified context (as described in the curriculum content)
- With a defined level of consistency/accuracy (the assumption that each level describes what the student does well, competently, independently, consistently)
- Students perform a specified action (described through a verb)
- In relation to what is valued in the curriculum (specified as the object or subject)
- With a defined degree of sophistication, difficulty, complexity (described as an indication of quality)

Terms such as 'analyse' and 'describe' have been used to specify particular action but these can have everyday meanings that are quite general. ACARA has therefore associated these terms with specific meanings that are defined in the senior secondary achievement standards glossary and used precisely and consistently across subject areas.

Role of technology

It is assumed that students will be taught the Senior Secondary Australian Curriculum: Mathematics subjects with an extensive range of technological applications and techniques. If appropriately used, these have the potential to enhance the teaching and learning of mathematics. However, students also need to continue to develop skills that do not depend on technology. The ability to be able to choose when or when not to use some form of technology and to be able to work flexibly with technology are important skills in these subjects.

Links to Foundation to Year 10

For all content areas of Essential Mathematics, the proficiency strands of Understanding, Fluency, Problem solving and Reasoning from the F–10 curriculum are still very much applicable and should be inherent in students' learning of the subject. Each strand is essential, and all are mutually reinforcing. For all content areas, practice allows students to develop fluency in their skills. They will encounter opportunities for problem solving, such as finding the volume of a solid to enable the amount of liquid that is held in the container to be compared with what is written on the label, or finding the interest on an amount in order to be able to compare different types of loans. In Essential Mathematics, reasoning includes critically interpreting and analysing information represented through graphs, tables and other statistical representations to make informed decisions. The ability to transfer mathematical skills between contexts is a vital part of learning in this subject. For example, familiarity with the concept of a rate enables students to solve a wide range of practical problems, such as fuel consumption, travel times, interest payments, taxation, and population growth.

Representation of General capabilities

The seven general capabilities of *Literacy, Numeracy, Information and Communication Technology (ICT) capability, Critical and creative thinking, Personal and social capability, Ethical understanding*, and *Intercultural understanding* are identified where they offer opportunities to add depth and richness to student learning. Teachers will find opportunities to incorporate explicit teaching of the capabilities depending on their choice of learning activities.

Literacy in Mathematics

In the senior years these literacy skills and strategies enable students to express, interpret, and communicate complex mathematical information, ideas and processes. Mathematics provides a specific and rich context for students to develop their ability to read, write, visualise and talk about complex situations involving a range of mathematical ideas. Students can apply and further develop their literacy skills and strategies by shifting between verbal, graphic, numerical and symbolic forms of representing problems in order to formulate, understand and solve problems and communicate results. Students learn to communicate their findings in different ways, using multiple systems of representation and data displays to illustrate the relationships they have observed or constructed.

Numeracy in Mathematics

The students who undertake this subject will continue to develop their numeracy skills at a more sophisticated level than in Years F to 10. This subject contains financial applications of Mathematics that will assist students to become literate consumers of investments, loans and superannuation products. It also contains statistics topics that will equip students for the ever-increasing demands of the information age. Students will also learn about the probability of certain events occurring and will therefore be well equipped to make informed decisions about gambling.

ICT in Mathematics

In the senior years students use ICT both to develop theoretical mathematical understanding and apply mathematical knowledge to a range of problems. They use software aligned with areas of work and society with which they may be involved such as for statistical analysis, algorithm generation, data representation and manipulation, and complex calculation. They use digital tools to make connections between mathematical theory, practice and application; for example, to use data, to address problems, and to operate systems in authentic situations.

Critical and creative thinking in Mathematics

Students compare predictions with observations when evaluating a theory. They check the extent to which their theory-based predictions match observations. They assess whether, if observations and predictions don't match, it is due to a flaw in theory or method of applying the theory to make predictions – or both. They revise, or reapply their theory more skilfully, recognising the importance of self-correction in the building of useful and accurate theories and making accurate predictions.

Personal and social capability in Mathematics

In the senior years students develop personal and social competence in Mathematics through setting and monitoring personal and academic goals, taking initiative, building adaptability, communication, teamwork and decision-making.

The elements of personal and social competence relevant to Mathematics mainly include the application of mathematical skills for their decision-making, life-long learning, citizenship and self-management. In addition, students will work collaboratively in teams and independently as part of their mathematical explorations and investigations.

Ethical understanding in Mathematics

In the senior years students develop ethical behaviour in Mathematics through decision-making connected with ethical dilemmas that arise when engaged in mathematical calculation and the dissemination of results and the social responsibility associated with teamwork and attribution of input.

The areas relevant to Mathematics include issues associated with ethical decision-making as students work collaboratively in teams and independently as part of their mathematical explorations and investigations. Acknowledging errors rather than denying findings and/or evidence involves resilience and examined ethical behaviour. Students develop increasingly advanced communication, research and presentation skills to express viewpoints.

Intercultural understanding in Mathematics

Students understand Mathematics as a socially constructed body of knowledge that uses universal symbols but has its origin in many cultures. Students understand that some languages make it easier to acquire mathematical knowledge than others. Students also understand that there are many culturally diverse forms of mathematical knowledge, including diverse relationships to number and that diverse cultural spatial abilities and understandings are shaped by a person's environment and language.

Representation of Cross-curriculum priorities

The Senior Secondary Mathematics curriculum values the histories, cultures, traditions and languages of Aboriginal and Torres Strait Islander Peoples past and ongoing contributions to contemporary Australian society and culture. Through the study of mathematics within relevant contexts, opportunities will allow for the development of students' understanding and appreciation of the diversity of Aboriginal and Torres Strait Islander Peoples histories and cultures.

There are strong social, cultural and economic reasons for Australian students to engage with the countries of Asia and with the past and ongoing contributions made by the peoples of Asia in Australia. It is through the study of mathematics in an Asian context that students engage with Australia's place in the region. Through analysis of relevant data, students are provided with opportunities to further develop an understanding of the diverse nature of Asia's environments and traditional and contemporary cultures.

Each of the senior Mathematics subjects provides the opportunity for the development of informed and reasoned points of view, discussion of issues, research and problem solving. Therefore, teachers are encouraged to select contexts for discussion connected with sustainability. Through analysis of data, students have the opportunity to research and discuss this global issue and learn the importance of respecting and valuing a wide range of world perspectives.

Unit 1

Unit Description

This unit provides students with the mathematical skills and understanding to solve problems relating to calculations, applications of measurement, the use of formulas to find an unknown quantity, and the interpretation of graphs. Teachers are encouraged to apply the content of the four topics in this unit – 'Calculations, percentages and rates', 'Measurement', 'Algebra' and 'Graphs' – in contexts which are meaningful and of interest to their students. A variety of approaches can be used to achieve this purpose. Two possible contexts which may be used are *Mathematics and foods* and *Earning and managing money*. However, as these contexts may not be relevant to all students, teachers are encouraged to find suitable contexts relevant to their particular student cohort.

It is assumed that an extensive range of technological applications and techniques will be used in teaching this unit. The ability to choose when and when not to use some form of technology, and the ability to work flexibly with technology, are important skills.

Learning Outcomes

By the end of this unit students:

- understand the concepts and techniques in calculations, measurement, algebra and graphs
- apply reasoning skills and solve practical problems in calculations, measurement, algebra and graphs
- communicate their arguments and strategies when solving problems using appropriate mathematical language
- interpret mathematical information and ascertain the reasonableness of their solutions to problems.

Content Descriptions

Topic 1: Calculations, percentages and rates

Calculations:

- solve practical problems requiring basic number operations (ACMEM001)
- apply arithmetic operations according to their correct order (ACMEM002)
- ascertain the reasonableness of answers to arithmetic calculations (ACMEM003)
- use leading-digit approximation to obtain estimates of calculations (ACMEM004)
- use a calculator for multi-step calculations (ACMEM005)
- check results of calculations for accuracy (ACMEM006)
- recognise the significance of place value after the decimal point (ACMEM007)
- evaluate decimal fractions to the required number of decimal places (ACMEM008)
- round up or round down numbers to the required number of decimal places (ACMEM009)
- apply approximation strategies for calculations. (ACMEM010)

Percentages:

- calculate a percentage of a given amount (ACMEM011)
- determine one amount expressed as a percentage of another (ACMEM012)
- apply percentage increases and decreases in situations; for example, mark-ups, discounts and GST. (ACMEM013)

Rates:

- identify common usage of rates; for example, km/h as a rate to describe speed, beats/minute as a rate to describe pulse (ACMEM014)
- convert units of rates occurring in practical situations to solve problems (ACMEM015)
- use rates to make comparisons; for example, using unit prices to compare best buys, comparing heart rates after exercise. (ACMEM016)

Topic 2: Measurement

Linear measure:

- use metric units of length, their abbreviations, conversions between them, and appropriate levels of accuracy and choice of units (ACMEM017)
- estimate lengths (ACMEM018)
- convert between metric units of length and other length units (ACMEM019)
- calculate perimeters of familiar shapes, including triangles, squares, rectangles, and composites of these. (ACMEM020)

Area measure:

- use metric units of area, their abbreviations, conversions between them, and appropriate choices of units (ACMEM021)
- estimate the areas of different shapes (ACMEM022)
- convert between metric units of area and other area units (ACMEM023)

- calculate areas of rectangles and triangles. (ACMEM024)

Mass:

- use metric units of mass, their abbreviations, conversions between them, and appropriate choices of units (ACMEM025)
- estimate the mass of different objects. (ACMEM026)

Volume and capacity:

- use metric units of volume, their abbreviations, conversions between them, and appropriate choices of units (ACMEM027)
- understand the relationship between volume and capacity (ACMEM028)
- estimate volume and capacity of various objects (ACMEM029)
- calculate the volume of objects, such as cubes and rectangular and triangular prisms. (ACMEM030)

Units of energy:

- use units of energy to describe consumption of electricity, such as kilowatt hours (ACMEM031)
- use units of energy used for foods, including calories (ACMEM032)
- use units of energy to describe the amount of energy in activity, such as kilojoules (ACMEM033)
- convert from one unit of energy to another. (ACMEM034)

Topic 3: Algebra

Single substitution:

- substitute numerical values into algebraic expressions; for example, substitute different values of *x* to evaluate the expressions $\frac{3x}{5}$, $5\left(2x-4\right)$. (ACMEM035)

General substitution:

- substitute given values for the other pronumerals in a mathematical formula to find the value of the subject of the formula. (ACMEM036)

Topic 4: Graphs

Reading and interpreting graphs:

- interpret information presented in graphs, such as conversion graphs, line graphs, step graphs, column graphs and picture graphs (ACMEM037)
- interpret information presented in two-way tables (ACMEM038)
- discuss and interpret graphs found in the media and in factual texts. (ACMEM039)

Drawing graphs:

- determine which type of graph is best used to display a dataset (ACMEM040)
- use spreadsheets to tabulate and graph data (ACMEM041)
- draw a line graph to represent any data that demonstrate a continuous change, such as hourly temperature. (ACMEM042)

Unit 2

Unit Description

This unit provides students with the mathematical skills and understanding to solve problems related to representing and comparing data, percentages, rates and ratios, the mathematics of finance, and time and motion. Teachers are encouraged to apply the content of the four topics in this unit – 'Representing and comparing data', 'Percentages', 'Rates and ratios' and 'Time and motion' – in a context which is meaningful and of interest to their students. A variety of approaches can be used to achieve this purpose. Two possible contexts which may be used are *Mathematics and cars* and *Mathematics and independent living*. However, as these contexts may not be relevant to all students, teachers are encouraged to find suitable contexts relevant to their particular student cohort.

It is assumed that an extensive range of technological applications and techniques will be used in teaching this unit. The ability to choose when and when not to use some form of technology, and the ability to work flexibly with technology, are important skills.

Learning Outcomes

By the end of this unit, students:

- understand the concepts and techniques used in representing and comparing data, percentages, rates and ratios, and time and motion
- apply reasoning skills and solve practical problems in representing and comparing data, percentages, rates and ratios, and time and motion
- communicate their arguments and strategies when solving mathematical and statistical problems using appropriate mathematical or statistical language
- interpret mathematical and statistical information and ascertain the reasonableness of their solutions to problems.

Content Descriptions

Topic 1: Representing and comparing data

Classifying data:

- identify examples of categorical data (ACMEM043)
- identify examples of numerical data. (ACMEM044)

Data presentation and interpretation:

- display categorical data in tables and column graphs (ACMEM045)
- display numerical data as frequency distributions, dot plots, stem and leaf plots, and histograms (ACMEM046)
- recognise and identify outliers (ACMEM047)
- compare the suitability of different methods of data presentation in real-world contexts. (ACMEM048)

Summarising and interpreting data:

- identify the mode (ACMEM049)
- calculate measures of central tendency, the arithmetic mean and the median (ACMEM050)
- investigate the suitability of measures of central tendency in various real-world contexts (ACMEM051)
- investigate the effect of outliers on the mean and the median (ACMEM052)
- calculate and interpret quartiles, deciles and percentiles (ACMEM053)
- use informal ways of describing spread, such as spread out/dispersed, tightly packed, clusters, gaps, more/less dense regions, outliers (ACMEM054)
- calculate and interpret statistical measures of spread, such as the range, interquartile range and standard deviation (ACMEM055)
- investigate real-world examples from the media illustrating inappropriate uses, or misuses, of measures of central tendency and spread. (ACMEM056)

Comparing data sets:

- compare back-to-back stem plots for different data-sets (ACMEM057)
- complete a five number summary for different datasets (ACMEM058)
- construct box plots using a five number summary (ACMEM059)
- compare the characteristics of the shape of histograms using symmetry, skewness and bimodality. (ACMEM060)

Topic 2: Percentages

Percentage calculations:

- review calculating a percentage of a given amount (ACMEM061)
- review one amount expressed as a percentage of another. (ACMEM062)

Applications of percentages:

- determine the overall change in a quantity following repeated percentage changes; for example, an increase of 10% followed by a decrease of 10% (ACMEM063)

- calculate simple interest for different rates and periods. (ACMEM064)

Topic 3: Rates and ratios

Ratios:

- demonstrate an understanding of the elementary ideas and notation of ratio (ACMEM065)
- understand the relationship between fractions and ratio (ACMEM066)
- express a ratio in simplest form (ACMEM067)
- find the ratio of two quantities (ACMEM068)
- divide a quantity in a given ratio (ACMEM069)
- use ratio to describe simple scales. (ACMEM070)

Rates:

- review identifying common usage of rates such as km/h (ACMEM071)
- convert between units for rates; for example, km/h to m/s, mL/min to L/h (ACMEM072)
- complete calculations with rates, including solving problems involving direct proportion in terms of rate. (ACMEM073)
- use rates to make comparisons (ACMEM074)
- use rates to determine costs; for example, calculating the cost of a tradesman using rates per hour, call-out fees. (ACMEM075)

Topic 4: Time and motion

Time:

- use units of time, conversions between units, fractional, digital and decimal representations (ACMEM076)
- represent time using 12-hour and 24-hour clocks (ACMEM077)
- calculate time intervals, such as time between, time ahead, time behind (ACMEM078)
- interpret timetables, such as bus, train and ferry timetables (ACMEM079)
- use several timetables and electronic technologies to plan the most time-efficient routes (ACMEM080)
- interpret complex timetables, such as tide charts, sunrise charts and moon phases (ACMEM081)
- compare the time taken to travel a specific distance with various modes of transport (ACMEM082)

Distance:

- use scales to find distances, such as on maps; for example, road maps, street maps, bushwalking maps, online maps and cadastral maps (ACMEM083)
- optimise distances through trial-and-error and systematic methods; for example, shortest path, routes to visit all towns, and routes to use all roads. (ACMEM084)

Speed:

- identify the appropriate units for different activities, such as walking, running, swimming and flying (ACMEM085)
- calculate speed, distance or time using the formula *speed = distance/time* (ACMEM086)
- calculate the time or costs for a journey from distances estimated from maps (ACMEM087)

- interpret distance-versus-time graphs (ACMEM088)
- calculate and interpret average speed; for example, a 4-hour trip covering 250 km. (ACMEM089)

Units 1 and 2 Achievement Standards

Concepts and Techniques

A	B	C	D	E
• demonstrates knowledge of concepts of measurement, financial mathematics and statistics in routine and non-routine problems in a variety of contexts • selects and applies techniques in measurement, financial mathematics and statistics to solve routine and non-routine problems in a variety of contexts • uses digital technologies effectively to display and organise mathematical and statistical information to solve routine and non-routine problems in a variety of contexts	• demonstrates knowledge of concepts of measurement, financial mathematics and statistics in routine and non-routine problems • selects and applies techniques in measurement, financial mathematics and statistics to solve routine and non-routine problems • uses digital technologies appropriately to display and organise mathematical and statistical information to solve routine and non-routine problems	• demonstrates knowledge of concepts of measurement, financial mathematics and statistics in routine problems • selects and applies techniques in measurement, financial mathematics and statistics to solve routine problems • uses digital technologies to display and organise mathematical and statistical information to solve routine problems	• demonstrates familiarity with concepts of measurement, financial mathematics and statistics • uses simple techniques in measurement, financial mathematics and statistics • uses digital technologies to display and organise simple mathematical and statistical information	• demonstrates limited familiarity with concepts of measurement, financial mathematics or statistics • uses simple techniques in a structures context • uses digital technologies for arithmetic calculations

Reasoning and Communication

A	B	C	D	E
• represents mathematical and statistical information in numerical, graphical and symbolic form in routine and non-routine problems in a variety of contexts • communicates clear and reasoned observations and judgments using appropriate mathematical and statistical language • interprets solutions to routine and non-routine problems in a variety of contexts • explains the reasonableness of results and solutions to routine and non-routine problems in a variety of contexts	• represents mathematical and statistical information in numerical, graphical and symbolic form in routine and non-routine problems • communicates clear observations and judgments using appropriate mathematical and statistical language • interprets solutions to routine and non-routine problems • explains the reasonableness of results and solutions to routine and non-routine problems	• represents mathematical and statistical information in numerical, graphical and symbolic form in routine problems • communicates observations and judgments using appropriate mathematical and statistical language • interprets solutions to routine problems • describes the reasonableness of results and solutions to routine problems	• represents simple mathematical and statistical information in numerical, graphical and symbolic form • describes observations using mathematical and statistical language • describes solutions to routine problems • describes the appropriateness of the results of calculations	• represents simple mathematical and statistical information in a structured context • describes simple observations • identifies solutions to routine problems • demonstrates limited familiarity with the appropriateness of the results of calculations

Unit 3

Unit Description

This unit provides students with the mathematical skills and understanding to solve problems related to measurement, scales, plans and models, drawing and interpreting graphs, and data collection. Teachers are encouraged to apply the content of the four topics in this unit – 'Measurement', 'Scales, plans and models', 'Graphs' and 'Data collection' – in a context which is meaningful and of interest to the students. A variety of approaches can be used to achieve this purpose. Two possible contexts which may be used in this unit are *Mathematics and design* and *Mathematics and medicine*. However, as these contexts may not be relevant to all students, teachers are encouraged to find suitable contexts relevant to their particular student cohort.

It is assumed that an extensive range of technological applications and techniques will be used in teaching this unit. The ability to choose when and when not to use some form of technology, and the ability to work flexibly with technology, are important skills.

Learning Outcomes

By the end of this unit, students:

- understand the concepts and techniques used in measurement, scales, plans and models, graphs, and data collection
- apply reasoning skills and solve practical problems in measurement, scales, plans and models, graphs, and data collection
- communicate their arguments and strategies when solving mathematical and statistical problems using appropriate mathematical or statistical language
- interpret mathematical and statistical information and ascertain the reasonableness of their solutions to problems.

Content Descriptions

Topic 1: Measurement

Linear measure:

- review metric units of length, their abbreviations, conversions between them, estimation of lengths, and appropriate choices of units (ACMEM090)
- calculate perimeters of familiar shapes, including triangles, squares, rectangles, polygons, circles, arc lengths, and composites of these. (ACMEM091)

Area measure:

- review metric units of area, their abbreviations, and conversions between them (ACMEM092)
- use formulas to calculate areas of regular shapes, including triangles, squares, rectangles, parallelograms, trapeziums, circles and sectors (ACMEM093)
- find the area of irregular figures by decomposition into regular shapes (ACMEM094)
- find the surface area of familiar solids, including cubes, rectangular and triangular prisms, spheres and cylinders (ACMEM095)
- find the surface area of pyramids, such as rectangular- and triangular-based pyramids (ACMEM096)
- use addition of the area of the faces of solids to find the surface area of irregular solids. (ACMEM097)

Mass:

- review metric units of mass (and weight), their abbreviations, conversions between them, and appropriate choices of units (ACMEM098)
- recognise the need for milligrams (ACMEM099)
- convert between grams and milligrams. (ACMEM100)

Volume and capacity:

- review metric units of volume, their abbreviations, conversions between them, and appropriate choices of units (ACMEM101)
- recognise relations between volume and capacity, recognising that $\mathbf{1cm^3 = 1mL}$ and $\mathbf{1m^3 = 1kL}$ (ACMEM102)
- use formulas to find the volume and capacity of regular objects such as cubes, rectangular and triangular prisms and cylinders (ACMEM103)
- use formulas to find the volume of pyramids and spheres. (ACMEM104)

Topic 2: Scales, plans and models

Geometry:

- recognise the properties of common two-dimensional geometric shapes and three-dimensional solids (ACMEM105)
- interpret different forms of two-dimensional representations of three-dimensional objects, including nets and perspective diagrams (ACMEM106)
- use symbols and conventions for the representation of geometric information; for example, point, line, ray, angle, diagonal,

edge, curve, face and vertex. (ACMEM107)

Interpret scale drawings:

- interpret commonly used symbols and abbreviations in scale drawings (ACMEM108)
- find actual measurements from scale drawings, such as lengths, perimeters and areas (ACMEM109)
- estimate and compare quantities, materials and costs using actual measurements from scale drawings; for example, using measurements for packaging, clothes, painting, bricklaying and landscaping. (ACMEM110)

Creating scale drawings:

- understand and apply drawing conventions of scale drawings, such as scales in ratio, clear indications of dimensions, and clear labelling (ACMEM111)
- construct scale drawings by hand and by using software packages. (ACMEM112)

Three dimensional objects:

- interpret plans and elevation views of models (ACMEM113)
- sketch elevation views of different models (ACMEM114)
- interpret diagrams of three-dimensional objects. (ACMEM115)

Right-angled triangles:

- apply Pythagoras' theorem to solve problems (ACMEM116)
- apply the tangent ratio to find unknown angles and sides in right-angled triangles (ACMEM117)
- work with the concepts of angle of elevation and angle of depression (ACMEM118)
- apply the cosine and sine ratios to find unknown angles and sides in right-angled triangles (ACMEM119)
- solve problems involving bearings. (ACMEM120)

Topic 3: Graphs

Cartesian plane:

- demonstrate familiarity with Cartesian coordinates in two dimensions by plotting points on the Cartesian plane (ACMEM121)
- generate tables of values for linear functions, including for negative values of x (ACMEM122)
- graph linear functions for all values of x with pencil and paper and with graphing software. (ACMEM123)

Using graphs:

- interpret and use graphs in practical situations, including travel graphs and conversion graphs (ACMEM124)
- draw graphs from given data to represent practical situations (ACMEM125)
- interpret the point of intersection and other important features of given graphs of two linear functions drawn from practical contexts; for example, the 'break-even' point. (ACMEM126)

Topic 4: Data collection

Census:

- investigate the procedure for conducting a census (ACMEM127)

- investigate the advantages and disadvantages of conducting a census. (ACMEM128)

Surveys:

- understand the purpose of sampling to provide an estimate of population values when a census is not used (ACMEM129)
- investigate the different kinds of samples; for example, systematic samples, self-selected samples, simple random samples (ACMEM130)
- investigate the advantages and disadvantages of these kinds of samples; for example, comparing simple random samples with self-selected samples. (ACMEM131)

Simple survey procedure:

- identify the target population to be surveyed (ACMEM132)
- investigate questionnaire design principles; for example, simple language, unambiguous questions, consideration of number of choices, issues of privacy and ethics, and freedom from bias. (ACMEM133)

Sources of bias:

- describe the faults in the collection of data process (ACMEM134)
- describe sources of error in surveys; for example, sampling error and measurement error (ACMEM135)
- investigate the possible misrepresentation of the results of a survey due to misunderstanding the procedure, or misunderstanding the reliability of generalising the survey findings to the entire population (ACMEM136)
- investigate errors and misrepresentation in surveys, including examples of media misrepresentations of surveys. (ACMEM137)

Bivariate scatterplots:

- describe the patterns and features of bivariate data (ACMEM138)
- describe the association between two numerical variables in terms of direction (positive/negative), form (linear/non-linear) and strength (strong/moderate/weak). (ACMEM139)

Line of best fit:

- identify the dependent and independent variable (ACMEM140)
- find the line of best fit by eye (ACMEM141)
- use technology to find the line of best fit (ACMEM142)
- interpret relationships in terms of the variables (ACMEM143)
- use technology to find the correlation coefficient (an indicator of the strength of linear association) (ACMEM144)
- use the line of best fit to make predictions, both by interpolation and extrapolation (ACMEM145)
- recognise the dangers of extrapolation (ACMEM146)
- distinguish between causality and correlation through examples. (ACMEM147)

Unit 4

Unit Description

This unit provides students with the mathematical skills and understanding to solve problems related to probability, Earth geometry and time zones, and loans and compound interest. Teachers are encouraged to apply the content of the three topics in this unit – 'Probability and relative frequencies', 'Earth geometry and time zones' and 'Loans and compound interest' – in a context which is meaningful and of interest to the students. A variety of approaches can be used to achieve this purpose. Two possible contexts which may be used in this unit are Mathematics of finance and Mathematics of travelling. However, as these contexts may not be relevant to all students, teachers are encouraged to find suitable contexts relevant to their particular student cohort.

It is assumed that an extensive range of technological applications and techniques will be used in teaching this unit. The ability to choose when and when not to use some form of technology, and the ability to work flexibly with technology, are important skills.

Learning Outcomes

By the end of this unit, students:

- understand the concepts and techniques used in probability and relative frequencies, earth geometry and time zones, loans and compound interest
- apply reasoning skills and solve practical problems in probability and relative frequencies, earth geometry and time zones, loans and compound interest
- communicate their arguments and strategies when solving mathematical problems using appropriate mathematical or statistical language
- interpret mathematical information and ascertain the reasonableness of their solutions to problems.

Content Descriptions

Topic 1: Probability and relative frequencies

Probability expressions:

- interpret commonly used probability statements, including ‘possible’, ‘probable’, ‘likely’, ‘certain’ (ACMEM148)
- describe ways of expressing probabilities formally using fractions, decimals, ratios, and percentages. (ACMEM149)

Simulations:

- perform simulations of experiments using technology (ACMEM150)
- recognise that the repetition of chance events is likely to produce different results (ACMEM151)
- identify relative frequency as probability (ACMEM152)
- identify factors that could complicate the simulation of real-world events. (ACMEM153)

Simple probabilities:

- construct a sample space for an experiment (ACMEM154)
- use a sample space to determine the probability of outcomes for an experiment (ACMEM155)
- use arrays or tree diagrams to determine the outcomes and the probabilities for experiments. (ACMEM156)

Probability applications

- determine the probabilities associated with simple games (ACMEM157)
- determine the probabilities of occurrence of simple traffic-light problems. (ACMEM158)

Topic 2: Earth geometry and time zones

Location:

- locate positions on Earth’s surface given latitude and longitude using GPS, a globe, an atlas, and digital technologies (ACMEM159)
- find distances between two places on Earth on the same longitude (ACMEM160)
- find distances between two places on Earth using appropriate technology. (ACMEM161)

Time:

- understand the link between longitude and time (ACMEM162)
- solve problems involving time zones in Australia and in neighbouring nations, making any necessary allowances for daylight saving (ACMEM163)
- solve problems involving Greenwich Mean Time and the International Date Line (ACMEM164)
- find time differences between two places on Earth (ACMEM165)
- solve problems associated with time zones; for example, internet and phone usage (ACMEM166)
- solve problems relating to travelling east and west, incorporating time zone changes. (ACMEM167)

Topic 3: Loans and compound interest

Compound interest:

- review the principles of simple interest (ACMEM168)
- understand the concept of compound interest as a recurrence relation (ACMEM169)
- consider similar problems involving compounding; for example, population growth (ACMEM170)
- use technology to calculate the future value of a compound interest loan or investment and the total interest paid or earned (ACMEM171)
- use technology to compare, numerically and graphically, the growth of simple interest and compound interest loans and investments (ACMEM172)
- use technology to investigate the effect of the interest rate and the number of compounding periods on the future value of a loan or investment. (ACMEM173)

Reducing balance loans (compound interest loans with periodic repayments):

- use technology and a recurrence relation to model a reducing balance loan (ACMEM174)
- investigate the effect of the interest rate and repayment amount on the time taken to repay a loan. (ACMEM175)

Units 3 and 4 Achievement Standards

Concepts and Techniques

A	B	C	D	E
• demonstrates knowledge of concepts of measurement, scales, graphs and statistics in routine and non-routine problems in a variety of contexts • selects and applies techniques in measurement, scales, graphs and statistics to solve routine and non-routine problems in a variety of contexts • uses digital technologies effectively to display and organise mathematical and statistical information to solve routine and non-routine problems in a variety of contexts	• demonstrates knowledge of concepts of measurement, scales, graphs and statistics in routine and non-routine problems • selects and applies techniques in measurement, scales, graphs and statistics to solve routine and non-routine problems • uses digital technologies appropriately to display and organise mathematical and statistical information to solve routine and non-routine problems	• demonstrates knowledge of concepts of measurement, scales, graphs and statistics in routine problems • selects and applies techniques in measurement, scales, graphs and statistics to solve routine problems • uses digital technologies to display and organise mathematical and statistical information to solve routine problems	• demonstrates familiarity with concepts of measurement, scales, graphs and statistics • uses simple techniques in measurement, scales, graphs and statistics • uses digital technologies to display and organise simple mathematical and statistical information	• demonstrates limited familiarity with concepts of measurement, scales, graphs and statistics • uses simple techniques in a structured context • uses digital technologies for arithmetic calculations

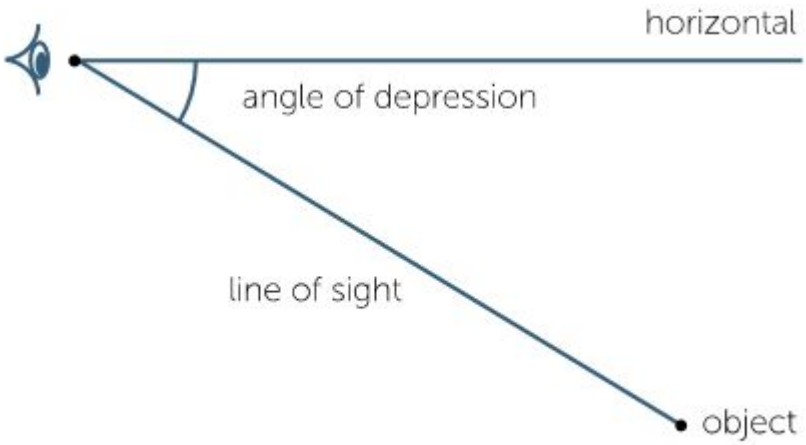
Reasoning and Communication

A	B	C	D	E
• represents mathematical and statistical information in numerical, graphical and symbolic form in routine and non-routine problems in a variety of contexts • communicates clear and reasoned observations and judgments using appropriate mathematical and statistical language • interprets the solutions to routine and non-routine problems in a variety of contexts • explains the reasonableness of results and solutions to routine and non-routine problems in a variety of contexts	• represents mathematical and statistical information in numerical, graphical and symbolic form in routine and non-routine problems • communicates clear observations and judgments using appropriate mathematical and statistical language • interprets the solutions to routine and non-routine problems • explains the reasonableness of results and solutions to routine and non-routine problems	• represents mathematical and statistical information in numerical, graphical and symbolic form in routine problems • communicates observations and judgments using appropriate mathematical and statistical language • interprets the solutions to routine problems • describes the reasonableness of results and solutions to routine problems	• represents simple mathematical and statistical information in numerical, graphical and symbolic form • describes observations using mathematical and statistical language • describes the solutions to routine problems • describes the appropriateness of the results of calculations	• represents simple mathematical and statistical information in a structured context • describes simple observations • identifies the solutions to routine problems • demonstrates limited familiarity with the appropriateness of the results of calculations

Essential Mathematics Glossary

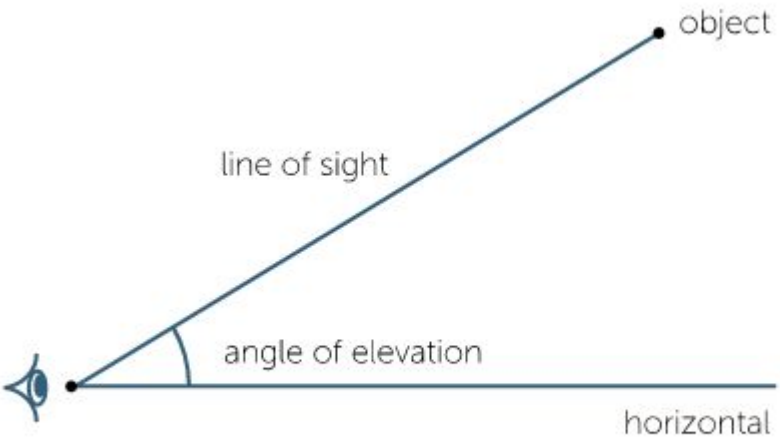
Angle of depression

When an observer looks at an object that is lower than 'the eye of' the observer', the angle between the line of sight and the horizontal is called the angle of depression.



Angle of elevation

When an observer looks at an object that is higher than 'the eye of' the observer', the angle between the line of sight and the horizontal is called the angle of elevation.



Average speed

Average speed is the total distance travelled divided by the total time taken.

Back-to back stem plots

A back-to-back stem-and-leaf plot is a method for comparing two data distributions by attaching two sets of ‘leaves’ to the same ‘stem’ in a stem-and-leaf plot.

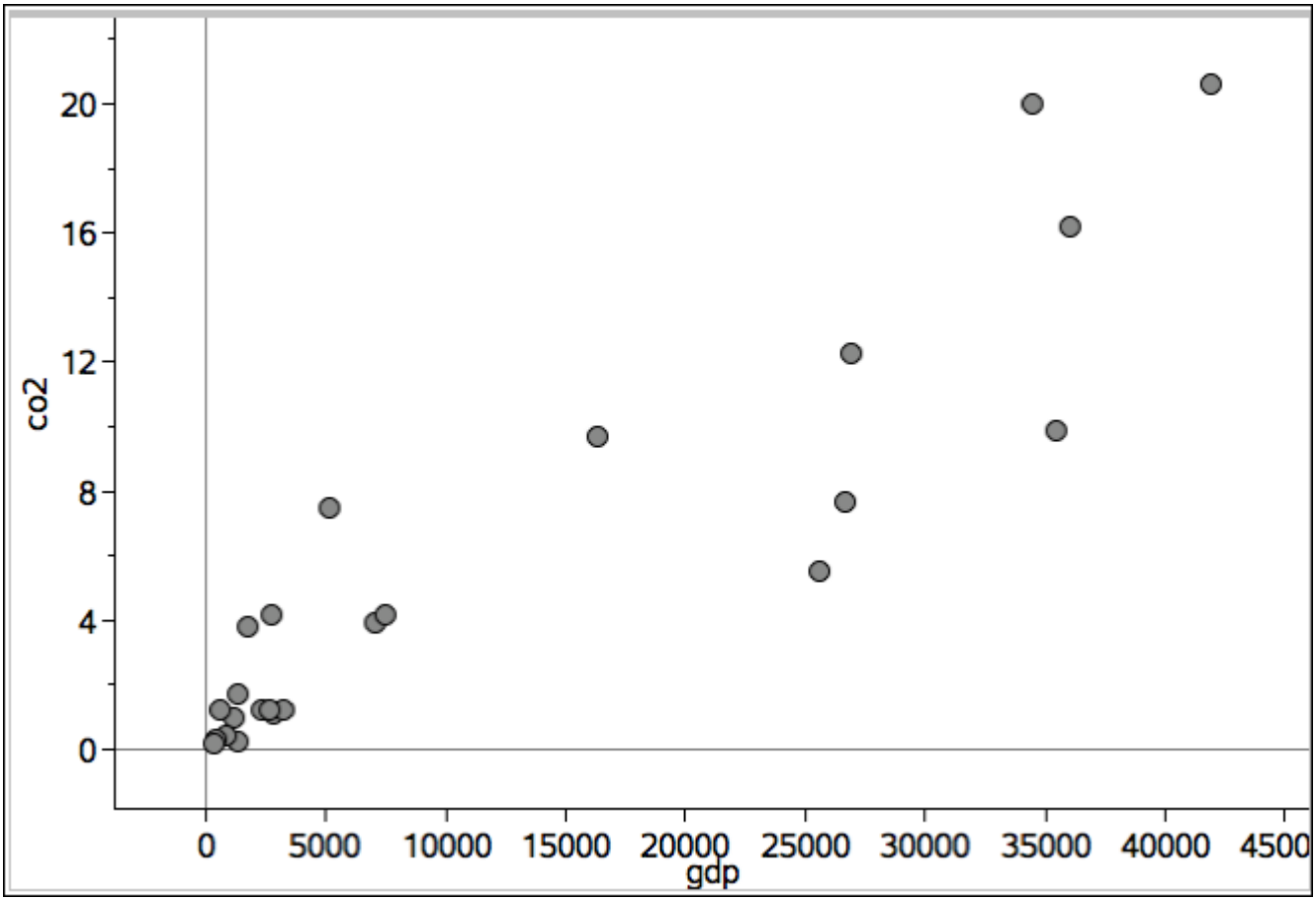
For example, the stem-and-leaf plot below displays the distribution of pulse rates of 19 students before and after gentle exercise.

before	after	pulse rate
9 8 8 8	6	
8 6 6 4 1 1	7	
8 8 6 2	8	6 7 8 8
6 0	9	0 2 2 4 5 8 9 9
4	10	0 4 4
0	11	8
	12	4 4
	13	

Bivariate data scatter plot

A two-dimensional data plot using Cartesian co-ordinates to display the values of two variables in a bivariate data set.

For example the scatterplot below displays the CO2 emissions in tonnes per person (*co2*) plotted against Gross Domestic Product per person in $US (*gdp*) for a sample of 24 countries in 2004. In constructing this scatterplot, gdp has been used as the explanatory variable.



Categorical data

Data associated with a categorical variable is called categorical data.

Categorical variable

A categorical variable is a variable whose values are categories.

Examples include blood group (A, B, AB or O) or house construction type (brick, concrete, timber, steel, other).

Categories may have numerical labels, eg. the numbers worn by player in a sporting team, but these labels have no numerical significance, they merely serve as labels.

Census

A population is the complete set of individuals, objects, places, etc, that we want information about.

A census is an attempt to collect information about the whole population.

Clarks' formula

Dosage for children (general formula) = (weight in kg x adult dosage) /70

Compound interest

The interest earned by investing a sum of money (the principal) is compound interest if each successive interest payment is added to the principal for the purpose of calculating the next interest payment.

For example, if the principal P earns compound interest at the rate of i % per period, then after n periods the total amount accrued is $P\left(1+\frac{i}{100}\right)^n$

Correlation

Correlation is a measure of the strength of the linear relationship between two variables.

Correlation coefficient

The correlation coefficient (r) is a measure of the strength of the liner relationship between a pair of variables. The formula for calculating r is given below.

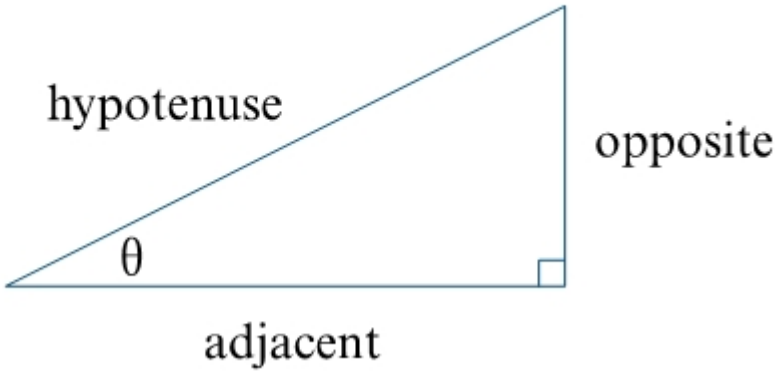
For variables x and y, and computed for n cases, the formula for r is:

$$r = \frac{1}{n-1}\sum\left(\frac{x_i-\bar{x}}{s_x}\right)\left(\frac{y_i-\bar{y}}{s_y}\right)$$

Cosine ratio

In any right-angled triangle,

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} \quad \text{where} \quad 0° < \theta < 90°$$



Extrapolation

In the context of fitting a linear relationship between two variables, extrapolation occurs when the fitted model is used to make predictions using values of the explanatory variable that are outside the range of the original data. Extrapolation is a dangerous process as it can sometimes lead to quite erroneous predictions.

Five-number summary

A five-number summary is a method of summarising a set of data using the minimum value, the lower or first-quartile (Q_1), the median, the upper or third-quartile (Q_3) and the maximum value. Forms the basis for a boxplot.

Frieds' formula

Dosage for children 1-2 years = (age (in months) x adult dosage) /150

GST

The GST (Goods and Services Tax) is a broad sales tax of 10% on most goods and services transactions in Australia.

Interquartile range

The interquartile range (IQR) is a measure of the spread within a numerical data set. It is equal to the upper quartile (Q_3) minus the lower quartiles (Q_1); that is, $IQR = Q_3 - Q_1$

The IQR is the width of an interval that contains the middle 50% (approximately) of the data values. To be exactly 50%, the sample size must be a multiple of four.

kWh (kilowatt hour)

The kilowatt hour, or kilowatt-hour, is a unit of energy equal to 1000 watt hours or 3.6 megajoules The kilowatt hour is most commonly known as a billing unit for energy delivered to consumers by electric utilities.

Mean

The arithmetic mean of a list of numbers is the sum of the data values divided by the number of values in the list.

In everyday language, the arithmetic mean is commonly called the average.

For example, for the following list of five numbers 2, 3, 3, 6, 8 the mean equals

$$\frac{2+3+3+6+8}{5} = \frac{22}{5} = 4.4$$

In more general language, the mean of n observations $x_1, x_2, \ldots, x_n$ is

$$\overline{x} = \frac{\sum x_i}{n}$$

Median

The median is the value in a set of ordered set of data values that divides the data into two parts of equal size. When there are an odd number of data values, the median is the middle value. When there is an even number of data values, the median is the average of the two central values.

MJ (Megajoule)

A joule is the SI unit of work. The megajoule (MJ) is equal to one million joules

Mode

The mode is the most frequently occurring value is a data set.

Outlier

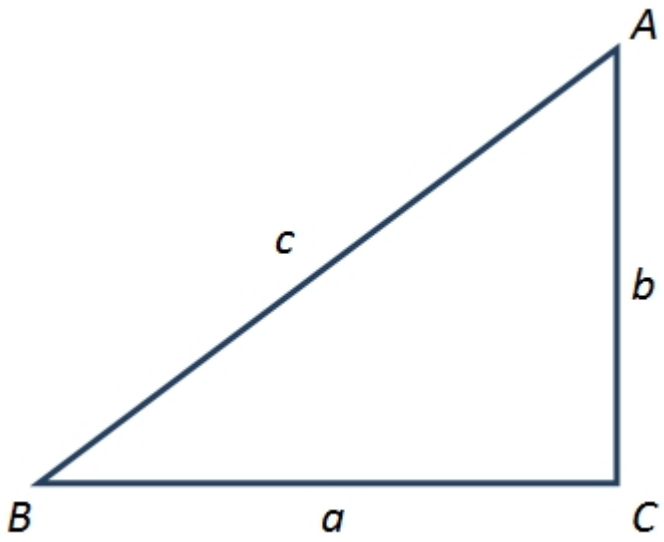
An outlier in a set of data is an observation that appears to be inconsistent with the remainder of that set of data. An outlier is a surprising observation.

Pythagoras' theorem

For a right-angled triangle

The square of the hypotenuse of a right-angled triangle equals the sum of the squares of the lengths of the other two sides.

In symbols, $c^2 = a^2 + b^2$.



Range

The range is the difference between the largest and smallest observations in a data set.

The range can be used as a measure of spread in a data set, but it is extremely sensitive to the presence of outliers and should only be used with care.

Reaction time

The time a person takes to react to a situation (pressing the brake) requiring them to stop

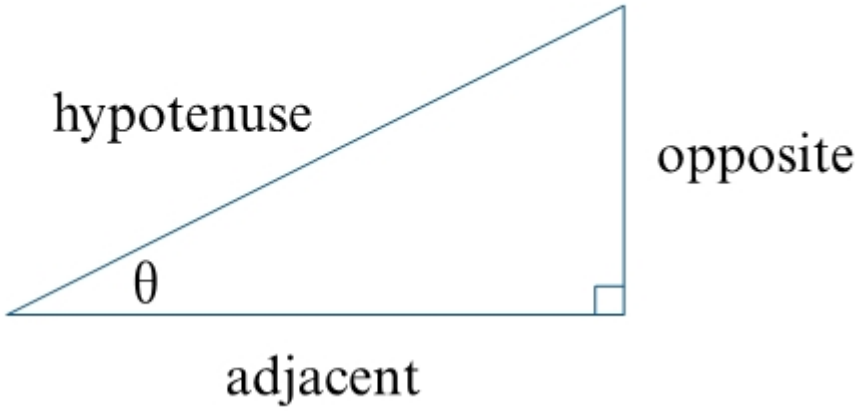
Simple interest

Simple interest is the interest accumulated when the interest payment in each period is a fixed fraction of the principal. For example, if the principle P earns simple interest at the rate of i % per period, then after n periods the accumulated simple interest is $\frac{Pni}{100}$

Sine ratio

In any right-angled triangle,

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} \text{, where } 0° < \theta < 90°$$



Stopping distances

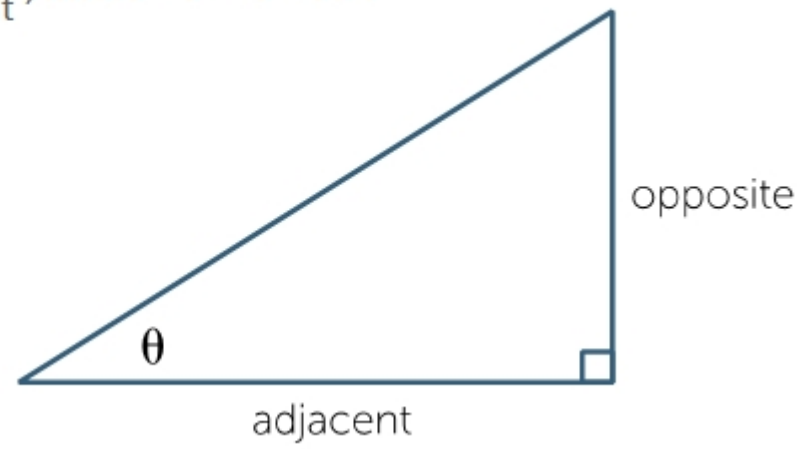
The distance a car travels after the driver has applied the brake given speed of the vehicle and/or conditions of the road which can be found using formula or tables.

Stopping distance = braking distance + reaction time(secs) Xspeed

Tangent ratio

In any right-angled triangle,

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}} \text{, where } 0° < \theta < 90°.$$



The converse

If $c^2 = a^2 + b^2$ in a triangle ABC, then $\angle C$ is a right angle.

Young's formula

Dosage for Children 1-12 years = (weight in kg x adult dosage)/ (age of child (in years) + 12)

Glossary

Abstract

Abstract scenario: a scenario for which there is no concrete referent provided.

Account

Account for: provide reasons for (something).

Give an account of: report or describe an event or experience.

Taking into account: considering other information or aspects.

Analyse

Consider in detail for the purpose of finding meaning or relationships, and identifying patterns, similarities and differences.

Apply

Use, utilise or employ in a particular situation.

Assess

Determine the value, significance or extent of (something).

Coherent

Orderly, logical, and internally consistent relation of parts.

Communicates

Conveys knowledge and/or understandings to others.

Compare

Estimate, measure or note how things are similar or dissimilar.

Complex

Consisting of multiple interconnected parts or factors.

Considered

Formed after careful thought.

Critically analyse

Examine the component parts of an issue or information, for example the premise of an argument and its plausibility, illogical reasoning or faulty conclusions

Critically evaluate

Evaluation of an issue or information that includes considering important factors and available evidence in making critical judgement that can be justified.

Deduce

Arrive at a conclusion by reasoning.

Demonstrate
Give a practical exhibition as an explanation.

Describe
Give an account of characteristics or features.

Design
Plan and evaluate the construction of a product or process.

Develop
In history: to construct, elaborate or expand.

In English: begin to build an opinion or idea.

Discuss
Talk or write about a topic, taking into account different issues and ideas.

Distinguish
Recognise point/s of difference.

Evaluate
Provide a detailed examination and substantiated judgement concerning the merit, significance or value of something.

In mathematics: calculate the value of a function at a particular value of its independent variables.

Explain
Provide additional information that demonstrates understanding of reasoning and/or application.

Familiar
Previously encountered in prior learning activities.

Identify
Establish or indicate who or what someone or something is.

Integrate
Combine elements.

Investigate
Plan, collect and interpret data/information and draw conclusions about.

Justify
Show how an argument or conclusion is right or reasonable.

Locate
Identify where something is found.

Manipulate
Adapt or change.

Non-routine

Non-routine problems: Problems solved using procedures not previously encountered in prior learning activities.

Reasonableness

Reasonableness of conclusions or judgements: the extent to which a conclusion or judgement is sound and makes sense

Reasoned

Reasoned argument/conclusion: one that is sound, well-grounded, considered and thought out.

Recognise

Be aware of or acknowledge.

Relate

Tell or report about happenings, events or circumstances.

Represent

Use words, images, symbols or signs to convey meaning.

Reproduce

Copy or make close imitation.

Responding

In English: When students listen to, read or view texts they interact with those texts to make meaning. Responding involves students identifying, selecting, describing, comprehending, imagining, interpreting, analysing and evaluating.

Routine problems

Routine problems: Problems solved using procedures encountered in prior learning activities.

Select

Choose in preference to another or others.

Sequence

Arrange in order.

Solve

Work out a correct solution to a problem.

Structured

Arranged in a given organised sequence.

In Mathematics: When students provide a structured solution, the solution follows an organised sequence provided by a third party.

Substantiate

Establish proof using evidence.

Succinct

Written briefly and clearly expressed.

Sustained

Consistency maintained throughout.

Synthesise

Combine elements (information/ideas/components) into a coherent whole.

Understand

Perceive what is meant, grasp an idea, and to be thoroughly familiar with.

Unfamiliar

Not previously encountered in prior learning activities.