



Government of **Western Australia**
School Curriculum and Standards Authority

MATHEMATICS ESSENTIAL

General course

Year 12 syllabus

Acknowledgement of Country

Kaya. The School Curriculum and Standards Authority (the Authority) acknowledges that our offices are on Whadjuk Noongar boodjar and that we deliver our services on the country of many traditional custodians and language groups throughout Western Australia. The Authority acknowledges the traditional custodians throughout Western Australia and their continuing connection to land, waters and community. We offer our respect to Elders past and present.

Important information

This syllabus is effective from 1 January 2025.

Users of this syllabus are responsible for checking its currency.

Syllabuses are formally reviewed by the School Curriculum and Standards Authority (the Authority) on a cyclical basis, typically every five years.

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Overview of Mathematics courses

There are six mathematics courses. Each course is organised into four units, with Unit 1 and Unit 2 being taken in Year 11 and Unit 3 and Unit 4 in Year 12. The ATAR course examination for each of the three ATAR courses is based on Unit 3 and Unit 4 only.

The courses are differentiated, each focusing on a pathway that will meet the learning needs of a particular group of senior secondary students.

Mathematics Preliminary is a course which focuses on the practical application of knowledge, skills and understandings to a range of environments that will be accessed by students with special education needs. Grades are not assigned for these units. Student achievement is recorded as 'completed' or 'not completed'. This course provides the opportunity for students to prepare for post-school options of employment and further training.

Mathematics Foundation is a course which focuses on building the capacity, confidence and disposition to use mathematics to meet the numeracy standard for the WACE. It provides students with the knowledge, skills and understanding to solve problems across a range of contexts, including personal, community and workplace/employment. This course provides the opportunity for students to prepare for post-school options of employment and further training.

Mathematics Essential is a General course which 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 course provides the opportunity for students to prepare for post-school options of employment and further training.

Mathematics Applications is an ATAR course which focuses on the use of mathematics to solve problems in contexts that involve financial modelling, geometric and trigonometric analysis, graphical and network analysis, and growth and decay in sequences. It also provides opportunities for students to develop systematic strategies based on the statistical investigation process for answering statistical questions that involve analysing univariate and bivariate data, including time series data.

Mathematics Methods is an ATAR course which focuses on the use of calculus and statistical analysis. The study of calculus provides a basis for understanding rates of change in the physical world, and includes the use of functions, their derivatives and integrals, in modelling physical processes. The study of statistics develops students' ability to describe and analyse phenomena that involve uncertainty and variation.

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

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 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.

The Mathematics Essential General course focuses on enabling students to use mathematics effectively, efficiently and critically to make informed decisions in their daily lives. 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 course offers students the opportunity to prepare for post-school options of employment and further training.

For all content areas of the Mathematics Essential General course, the proficiency strands of understanding, fluency, problem solving and reasoning from the Year 7–10 curriculum continue to be very much applicable and should be inherent in students' learning of the course. Each of these is essential and mutually reinforcing. For all content areas, practice, together with a focus on understanding allows students to develop fluency in their skills. Students will encounter opportunities for problem solving, such as finding the interest on a sum of money to enable comparison between different types of loans. In the Mathematics Essential General course, 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 course. 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 Mathematics Essential General course 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 course will be further enhanced and reinforced through presentation related to areas encountered in vocational education and training (VET), apprenticeships, traineeships or employment.

Aims

The Mathematics Essential General course aims to develop students' capacity, disposition and confidence to:

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

Organisation

This course is organised into a Year 11 syllabus and a Year 12 syllabus. The cognitive complexity of the syllabus content increases from Year 11 to Year 12.

Structure of the syllabus

The Year 12 syllabus is divided into two units which are delivered as a pair. The notional time for the pair of units is 110 class contact hours.

Unit 3

This unit includes the following four topics:

- Measurement
- Scales, plans and models
- Graphs in practical situations
- Data collection

Unit 4

This unit includes the following three topics:

- Probability and relative frequencies
- Earth geometry and time zones
- Loans and compound interest

Each unit includes:

- a unit description – a short description of the focus of the unit and suggested contexts through which the content could be taught
- learning outcomes – a set of statements describing the learning expected as a result of studying the unit
- unit content – the content to be taught and learned, including examples in context which emphasise the intent of the course.

Throughout each unit, students apply the mathematical thinking process to real-world problems

- interpret the task and gather the key information
- identify the mathematics which could help to complete the task
- analyse information and data from a variety of sources
- apply existing mathematical knowledge and strategies to obtain a solution
- verify the reasonableness of the solution
- communicate findings in a systematic and concise manner.

Students apply the statistical investigation process to real-world tasks

- clarify the problem and pose one or more questions that can be answered with data
- design and implement a plan to collect or obtain appropriate data
- select and apply appropriate graphical or numerical techniques to analyse the data
- interpret the results of this analysis and relate the interpretation to the original question
- communicate findings in a systematic and concise manner.

Organisation of content

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 advised to apply the content of all topics in contexts which are meaningful and of interest to the students. Possible contexts for this unit are Construction and design, and Medicine.

Unit 4 provides students with the mathematical skills and understanding to solve problems related to probability, earth geometry and time zones, loans and compound interest. Teachers are advised to apply the content of all topics in contexts which are meaningful and of interest to the students.

Possible contexts for this unit are Finance, and Travel. 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.

Role of technology

It is assumed that students will be taught the Mathematics Essential General course with a 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 this course.

Representation of the general capabilities

The general capabilities encompass the knowledge, skills, behaviours and dispositions that will assist students to live and work successfully in the twenty-first century. Teachers may find opportunities to incorporate the capabilities into the teaching and learning program for the Mathematics Essential General course. The general capabilities are not assessed unless they are identified within the specified unit content.

Literacy

Literacy skills and strategies enable students to express, interpret, and communicate 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 situations involving a range of mathematical ideas. Students can apply and further develop their literacy skills and strategies by shifting between verbal, written and spoken, 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

The students who undertake this course will continue to develop their numeracy skills. This course contains financial applications of mathematics that will assist students to become literate consumers of investments and loans. It also contains statistics topics that will equip students for the ever-increasing demands of the information age. Students will be well equipped to make informed decisions about events and activities which involve an element of chance.

Information and communication technology capability

In the Mathematics Essential General course, students use information and communications technology (ICT) to apply mathematical knowledge to a range of problems. They use software which may be used for statistical analysis, data representation and manipulation, and calculation. They use digital tools to visualise and manipulate shapes in design.

Critical and creative thinking

The Mathematics Essential General course provides students with opportunities to use their mathematical knowledge, skills and understanding to solve problems in real contexts. Solutions to these problems involve drawing on knowledge of the context to decide what and how mathematics will help to reach a conclusion.

Personal and social capability

In the Mathematics Essential General course, students develop personal and social competence 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 the Mathematics Essential General course 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 the Mathematics Essential General course, students may develop ethical understanding 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 the Mathematics Essential General course 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. They develop communication, research and presentation skills to express viewpoints.

Intercultural understanding

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 ability and understandings are shaped by a person's environment and language.

Representation of the cross-curriculum priorities

The cross-curriculum priorities address the contemporary issues which students face in a globalised world. Teachers may find opportunities to incorporate the priorities into the teaching and learning program for the Mathematics Essential General course. The cross-curriculum priorities are not assessed unless they are identified within the specified unit content.

Aboriginal and Torres Strait Islander histories and cultures

Mathematics courses value 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 may allow for the development of students' understanding and appreciation of the diversity of Aboriginal and Torres Strait Islander Peoples' histories and cultures.

Asia and Australia's engagement with Asia

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.

Sustainability

The Mathematics Essential General course 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 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. Students use the mathematical thinking process and apply the statistical investigation process. Teachers are encouraged to apply the content of the four topics in this unit: Measurement; Scales, plans and models; Graphs in practical situations; and Data collection, in a context which is meaningful and of interest to the students. A variety of approaches could be used to achieve this purpose. Possible contexts for this unit are Construction and design, and Medicine.

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.

The number formats for the unit are positive and negative numbers, decimals, fractions, percentages, rates, ratios, square and cubic numbers written with powers and square roots.

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.

Unit content

An understanding of the Year 11 content is assumed knowledge for students in Year 12.

This unit includes the knowledge, understandings and skills described below.

For topics 3.1, 3.2 and 3.3 students apply the mathematical thinking process to real-world problems relating to the topic content.

Students:

- interpret the task and gather the key information
- identify the mathematics which could help to complete the task
- analyse information and data from a variety of sources
- apply existing mathematical knowledge and strategies to obtain a solution

- verify the reasonableness of the solution
- communicate findings in a systematic and concise manner.

Topic 3.1: Measurement (15 hours)

Linear measure

- 3.1.1 extend the calculation of perimeters to include polygons, circles and composites of familiar shapes

Area measure

- 3.1.2 calculate areas of parallelograms, trapeziums, circles and semi-circles
- 3.1.3 determine the area of composite figures by decomposition into familiar shapes
- 3.1.4 determine the surface area of familiar solids, including, cubes, rectangular and triangular prisms, spheres and cylinders
- 3.1.5 use addition of the area of the faces of solids to determine the surface area of composite solids

Examples in context – Area measure:

- calculating surface area of various buildings to compare costs of external painting

Volume and capacity

- 3.1.6 recognise relations between volume and capacity, recognising that $1 \text{ cm}^3 = 1 \text{ mL}$ and $1 \text{ m}^3 = 1 \text{ kL}$
- 3.1.7 calculate the volume and capacity of cylinders, pyramids and spheres

Examples in context – Volume and capacity:

- interpreting dosages for children and adults from dosage panels on medicines, given age or weight
- calculating and interpreting dosages for children from adults' medication using various formulas (Fried, Young, Clark) in millilitres
- comparing the capacity of rainwater tanks

Topic 3.2: Scales, plans and models (15 hours)

Geometry

- 3.2.1 recognise the properties of common two-dimensional geometric shapes and three-dimensional solids
- 3.2.2 interpret different forms of two-dimensional representations of three-dimensional objects, including nets and perspective diagrams
- 3.2.3 use terminology of geometric shapes; for example, point, line, angle, diagonal, edge, curve, face and vertex, parallel and perpendicular

Interpret scale drawings

- 3.2.4 interpret commonly used symbols and abbreviations in scale drawings
- 3.2.5 determine actual measurements of angle, perimeters and areas from scale drawings
- 3.2.6 estimate and compare quantities, materials and costs using actual measurements from scale drawings, for example using measurements for packaging, clothes, painting, bricklaying and landscaping

Creating scale drawings

- 3.2.7 understand and apply drawing conventions of scale drawings, such as scales in ratio, dimensions and labelling
- 3.2.8 construct scale drawings by hand and by using appropriate software/technology

Three dimensional objects

- 3.2.9 interpret plans and elevation views of models
- 3.2.10 sketch elevation views of different models
- 3.2.11 interpret diagrams of three-dimensional objects

Right-angled triangles (no bearings)

- 3.2.12 apply Pythagoras' theorem to solve problems in practical two-dimensional views
- 3.2.13 apply the tangent ratio to determine unknown angles and sides in right-angled triangles
- 3.2.14 work with the concepts of angle of elevation and angle of depression
- 3.2.15 apply the cosine and sine ratios to determine unknown angles and sides in right-angle triangles
- 3.2.16 solve problems involving trigonometric ratios in practical two-dimensional views

Examples in context – Scales, plans and models:

- drawing scale diagrams of everyday two-dimensional shapes
- interpreting common symbols and abbreviations used on house plans
- using the scale on a plan to calculate actual external or internal dimensions, the lengths of the house and the dimensions of particular rooms
- using technology to translate two-dimensional house plans into three-dimensional buildings
- creating landscape designs using technology

Topic 3.3: Graphs in practical situations (10 hours)**Cartesian plane**

- 3.3.1 demonstrate familiarity with Cartesian co-ordinates in two dimensions by plotting points on the Cartesian plane
- 3.3.2 generate tables of values for linear functions drawn from practical contexts

- 3.3.3 graph linear functions drawn from practical contexts with pencil and paper and with graphing software

Using graphs

- 3.3.4 interpret and use graphs in practical situations, including travel graphs, time series and conversion graphs
- 3.3.5 draw graphs from given data to represent practical situations
- 3.3.6 describe trend as increasing or decreasing for time series data
- 3.3.7 identify the rate of change of the dependent variable, relating it to the difference pattern in a table and the slope of an associated line drawn from practical contexts
- 3.3.8 determine and describe the significance of the vertical intercept in practical situations
- 3.3.9 use the rate of change and the initial value to determine the linear relationship in practical situations
- 3.3.10 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

Examples in context – Graphs in practical situations:

- interpreting graphs showing growth ranges for children (height or weight or head circumference versus age)
- interpreting hourly hospital charts showing temperature and pulse
- interpreting graphs showing life expectancy with different variables

For topic 3.4 students apply the statistical investigation process to real-world tasks relating to the topic content.

Students:

- clarify the problem and pose one or more questions that can be answered with data
- design and implement a plan to collect or obtain appropriate data
- select and apply appropriate graphical or numerical techniques to analyse the data
- interpret the results of this analysis and relate the interpretation to the original question
- communicate findings in a systematic and concise manner.

Topic 3.4: Data collection (15 hours)

Census

- 3.4.1 investigate the procedure for conducting a census
- 3.4.2 investigate the advantages and disadvantages of conducting a census

Surveys

- 3.4.3 understand the purpose of sampling to provide an estimate of population values when a census is not used

- 3.4.4 investigate the different kinds of samples, for example, systematic samples, self-selected samples, simple random samples
- 3.4.5 recognise the advantages and disadvantages of these kinds of samples; for example, comparing simple random samples with self-selected samples

Simple survey procedure

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

Sources of bias

- 3.4.8 describe the faults in the collection of data process
- 3.4.9 describe sources of error in surveys; for example, sampling error and measurement error
- 3.4.10 describe possible misrepresentation of the results of a survey due to the unreliability of generalising the survey findings to the entire population, for example, because of limited sample size or chance variation between samples
- 3.4.11 describe errors and misrepresentation of the results of a survey, including examples of media misrepresentations of surveys and the manipulation of data to serve different purposes

Bivariate scatterplots

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

Trend lines

- 3.4.14 identify the dependent and independent variable
- 3.4.15 fit a trend line by eye
- 3.4.16 interpret relationships in terms of the variables, for example, describe trend as increasing or decreasing
- 3.4.17 use the trend line to make predictions, both by interpolation and extrapolation
- 3.4.18 recognise the dangers of extrapolation
- 3.4.19 distinguish between causality and association through examples

Examples in context:

- analysing data obtained from medical sources, including bivariate data
- analysing and interpreting tables and graphs that compare body ratios, such as hip height versus stride length, foot length versus height

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, loans and compound interest. Students use the mathematical thinking process and apply the statistical investigation process to solve problems involving probability. Teachers are advised 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. Possible contexts for this unit are Finance, and Travel.

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.

The number formats for the unit are positive and negative numbers, decimals, fractions, percentages, rates, ratios and numbers expressed with integer powers.

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.

Unit content

This unit includes the knowledge, understandings and skills described below.

For topic 4.1 students apply the statistical investigation process to real-world tasks relating to the topic content.

Students:

- clarify the problem and pose one or more questions that can be answered with data
- design and implement a plan to collect or obtain appropriate data
- select and apply appropriate graphical or numerical techniques to analyse the data
- interpret the results of this analysis and relate the interpretation to the original question
- communicate the findings in a systematic and concise manner.

Topic 4.1: Probability and relative frequencies (20 hours)

Probability expressions

- 4.1.1 interpret commonly used probability statements, including 'possible', 'probable', 'likely', 'certain'
- 4.1.2 describe ways of expressing probabilities formally using fractions, decimals, ratios and percentages

Simulations

- 4.1.3 perform simulations of experiments using technology
- 4.1.4 recognise that the repetition of chance events is likely to produce different results
- 4.1.5 recognise the law of large numbers and identify relative frequency as probability
- 4.1.6 identify factors that may cause the simulation to no longer model the real world event

Simple probabilities in practical situations

- 4.1.7 construct a sample space for an experiment which represents a practical situation
- 4.1.8 use a sample space to determine the probability of outcomes for an experiment
- 4.1.9 use arrays or tree diagrams to determine the outcomes and the probabilities for experiments

Probability applications

- 4.1.10 identify situations in real-life contexts where probability is used for decision making
- 4.1.11 determine and use probabilities (relative frequencies) from given data to predict proportions and the number of outcomes that are likely to occur

Examples in context:

- using data to calculate the relative frequencies of the different countries of origin of visitors to a particular tourist venue or country
- using data to calculate the relative frequencies of the amounts of household expenditure
- using data to predict the number of people likely to be infected with a strain of flu or experience side effects with a certain medication

For topics 4.2 and 4.3 students apply the mathematical thinking process to real-world problems relating to the topic content.

Students:

- interpret the task and gather the key information
- identify the mathematics which could help to complete the task
- analyse information and data from a variety of sources
- apply existing mathematical knowledge and strategies to obtain a solution
- verify the reasonableness of the solution
- communicate findings in a systematic and concise manner.

Topic 4.2: Earth geometry and time zones (15 hours)

Location

- 4.2.1 locate positions on the earth's surface given latitude and longitude using a range of methods; for example, a global positioning system (GPS), a globe, an atlas and digital technologies
- 4.2.2 use the arc length formula to calculate distances between two places on Earth on the same longitude
- 4.2.3 determine distances between two places on Earth using appropriate technology

Time

- 4.2.4 understand the link between longitude and time
- 4.2.5 solve problems involving time zones in Australia and neighbouring nations making any necessary allowances for daylight saving
- 4.2.6 solve problems involving Greenwich Mean Time and the International Date Line
- 4.2.7 determine time differences between two places on Earth
- 4.2.8 solve problems associated with time zones; for example, internet and phone usage
- 4.2.9 solve problems relating to travelling east and west, incorporating time zone changes

Examples in context:

- plan for a phone call/skype to an interstate/international location, including daylight saving conditions
- plan a schedule for interstate travel, including daylight saving conditions
- design an itinerary involving up to five different places in the world accounting for distances between places, mode of transport: by air, land or sea, arrival and departure times, international time zones, climate/seasonal changes
- use a GPS application to determine time and distance between two locations

Topic 4.3: Loans and compound interest (20 hours)

Compound interest

- 4.3.1 review the principles of simple interest
- 4.3.2 understand the concept of compound interest as a recurrence relation
- 4.3.3 consider similar problems involving compounding; for example, population growth
- 4.3.4 use technology to calculate the future value of a compound interest loan or investment and the total interest paid or earned
- 4.3.5 use technology to compare, numerically and graphically, the growth of simple interest and compound interest loans and investments
- 4.3.6 use technology to investigate the effect of changing the interest rate and the number of compounding periods on the future value of a loan or investment

Reducing balance loans (compound interest loans with periodic repayments)

4.3.7 use technology and a recurrence relation to model a reducing balance loan

4.3.8 investigate the effect of the interest rate and repayment amount on the time taken to repay a loan

Examples in context:

- using formula, graphs and spreadsheets to calculate the outcomes of investment accounts with compound interest
- using percentages, rates and spreadsheets to investigate personal loan calculations
- calculating and analysing the costs, hidden traps, advantages and disadvantages for payment plans with interest free periods using rates and percentages

School-based assessment

The *Western Australian Certificate of Education (WACE)* Manual contains essential information on principles, policies and procedures for school-based assessment that needs to be read in conjunction with this syllabus.

Teachers design school-based assessment tasks to meet the needs of students. The table below provides details of the assessment types for the Mathematics Essential General Year 12 syllabus and the weighting for each assessment type.

Assessment table – Year 12

Type of assessment	Weighting
<p>Response Students apply mathematical knowledge and understanding of concepts and relationships to solve a mix of routine and non-routine questions in real-life contexts. Response tasks can include: tests, assignments and multimedia representations.</p>	40%
<p>Practical applications (included in both Unit 3 and Unit 4) Students are required to practically apply mathematics understandings and skills using the mathematical thinking process to develop solutions or arrive at conclusions, to real-world tasks. Evidence should include data and information sources, mathematical strategies/calculations and a written solution or conclusion. Evidence forms can include: written work, observation checklists, spreadsheets, pictures, diagrams, tables or graphs, media, photographs, video and/or models created by the student.</p> <p>Statistical investigation process Students apply the statistical investigation process to solve real-world problems in Unit 3 and with a focus on probability for Unit 4. Evidence should include data collection, information sources, statistical/probability analysis and a written conclusion. Evidence forms can include: written work, spreadsheets, tables and graphs.</p> <p>Note: Tasks can be of short or long duration. While these assessment tasks may require scaffolding, eventually responsibility is given to the student to select and use appropriate mathematics/statistics.</p>	45%
<p>Externally set task A written task or item or set of items of 50 minutes duration developed by the School Curriculum and Standards Authority and administered by the school.</p>	15%

Teachers are required to use the assessment table to develop an assessment outline for the pair of units.

The assessment outline must:

- include a set of assessment tasks
- include a general description of each task
- indicate the unit content to be assessed
- indicate a weighting for each task and each assessment type

- include the approximate timing of each task (for example, the week the task is conducted, or the issue and submission dates for an extended task).

In the assessment outline for the pair of units, each assessment type must be included at least once over the year/pair of units. The externally set task occurs in Term 2.

In addition to this advice on the minimum number of assessments, students must complete one practical application and one statistical investigation to meet the minimum requirement in the practical assessment section of the assessment table.

The set of assessment tasks must provide a representative sampling of the content for Unit 3 and Unit 4.

Assessment tasks not administered under test/controlled conditions require appropriate validation/authentication processes.

Externally set task

All students enrolled in the Mathematics Essential General Year 12 course will complete the externally set task developed by the Authority. Schools are required to administer this task in Term 2 at a time prescribed by the Authority.

Externally set task design brief – Year 12

Time	50 minutes
Format	Written
	Conducted under invigilated conditions
	Typically between four and eight questions
	Questions may require students to refer to source material
Content	The Authority informs schools during Term 3 of the previous year of the Unit 3 syllabus content on which the task will be based

Refer to the *WACE Manual* for further information.

Grading

Schools report student achievement in terms of the following grades:

Grade	Interpretation
A	Excellent achievement
B	High achievement
C	Satisfactory achievement
D	Limited achievement
E	Very low achievement

The teacher prepares a ranked list and assigns the student a grade for the pair of units. The grade is based on the student's overall performance as judged by reference to a set of pre-determined standards. These standards are defined by grade descriptions and annotated work samples. The grade descriptions for the Mathematics Essential General Year 12 syllabus are provided in Appendix 1. They can also be accessed, together with annotated work samples, through the Guide to Grades link on the course page of the Authority website at www.scsa.wa.edu.au.

To be assigned a grade, a student must have had the opportunity to complete the education program, including the assessment program (unless the school accepts that there are exceptional and justifiable circumstances).

Refer to the *WACE Manual* for further information about the use of a ranked list in the process of assigning grades.

Appendix 1 – Grade descriptions Year 12

A	<p>Interpret the tasks and choose the maths</p> <p>Identifies relevant information from multiple sources or within concentrated sources.</p> <p>Chooses the appropriate mathematical and statistical investigation techniques to solve a range of problems in unstructured situations.</p>
	<p>Apply mathematical knowledge to obtain a solution</p> <p>Incorporates information from multiple sources and demonstrates a systematic approach to accurately solve multi-step problems, including those from unfamiliar situations.</p> <p>Uses appropriate data collection techniques, and recognises and adjusts for sources of bias or inconsistencies in data.</p> <p>Modifies calculated results or conclusions when conditions are changed.</p> <p>Verifies the reasonableness of solutions and makes adjustments when necessary.</p>
	<p>Interpret and communicate</p> <p>Uses accurate mathematical and statistical language and expressions to communicate methods and solutions to multi-step problems.</p> <p>Accesses a comprehensive range of mathematical and statistical concepts to validate conclusions which are related to the original question or context.</p>
B	<p>Interpret the tasks and choose the maths</p> <p>Identifies and links more than one piece of information.</p> <p>Chooses the appropriate mathematical and statistical investigation techniques to solve problems in mostly familiar and sometimes unstructured situations.</p>
	<p>Apply mathematical knowledge to obtain a solution</p> <p>Applies information and calculates mostly accurate solutions for multi-step problems.</p> <p>Applies appropriate graphing techniques and determines appropriate scales based on the data.</p> <p>Uses appropriate data collection techniques and recognises sources of bias or inconsistencies in data.</p> <p>Incorporates some changed conditions when solving problems in familiar situations.</p> <p>Checks calculated results and makes adjustments where necessary.</p>
	<p>Interpret and communicate</p> <p>Accesses a range of mathematical and statistical concepts to communicate solutions and justify conclusions which relate to the original question or context, including for some non-routine problems.</p>

C	<p>Interpret the tasks and choose the maths</p> <p>Identifies relevant information and chooses the appropriate mathematics, or statistical concepts to solve a problem in straightforward or familiar situations.</p> <p>Plans the solution of real problems in Practical applications and Statistical investigations when an overview of the mathematical thinking process has been provided.</p>
	<p>Apply mathematical knowledge to obtain a solution</p> <p>Applies information and calculates mostly accurate solutions for problems in familiar situations involving one or more steps.</p> <p>Applies appropriate graphing and data collection techniques.</p> <p>Rounds to an appropriate level for everyday contexts.</p> <p>Seldom checks results in the light of the original problem.</p>
	<p>Interpret and communicate</p> <p>Shows working, including intermediate steps and/or expressions entered into a calculator or spreadsheet.</p> <p>Provides short statements based on straightforward observations which are related to the original question or context.</p>
D	<p>Interpret the tasks and choose the maths</p> <p>Identifies some relevant information and sometimes chooses the appropriate mathematics, or statistical concepts to solve a problem in straightforward or familiar situations.</p>
	<p>Apply mathematical knowledge to obtain a solution</p> <p>Applies information and calculates some accurate solutions for routine and practised problems with one or more steps.</p> <p>Uses appropriate graphing techniques with support.</p> <p>Rarely, checks results.</p>
	<p>Interpret and communicate</p> <p>Shows limited working, including some intermediate steps and/or expressions entered into a calculator or spreadsheet.</p> <p>Provides short statements which may not be related to the original question or context.</p>
E	<p>Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.</p>

Appendix 2 – Glossary

This glossary is provided to enable a common understanding of the key terms in this syllabus.

Unit 3

Measurement

Capacity

Capacity versus volume. Volume refers to the space taken up by an object itself, while capacity refers to the amount of a liquid or other pourable substance a container can (or does) hold.

Clark's formula

A formula used to calculate the dosage of medicine for children aged 2-17 years (general) when given only the adult dose.

Dosage for children (general formula) = adult dosage $\times \frac{\text{weight (in kg)}}{70}$

Fried's formula

A formula used to calculate the correct dose of medication for a child aged 1-2 years when given only the adult dose.

Dosage for children (1-2 years) = adult dosage $\times \frac{\text{age (in months)}}{150}$

Young's formula

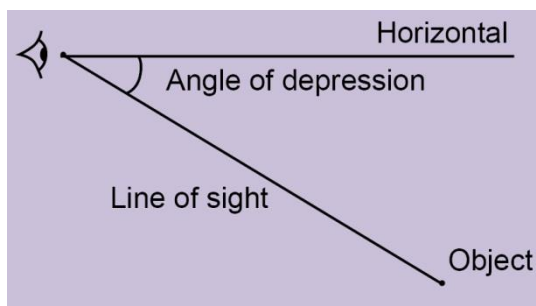
A formula used to calculate the dose of medication for a child under 12 years of age when given only the adult dose.

Dosage for children (2-12) years = adult dosage $\times \frac{\text{age (in years)}}{\text{age (in years)}+12}$

Scales, plans and models

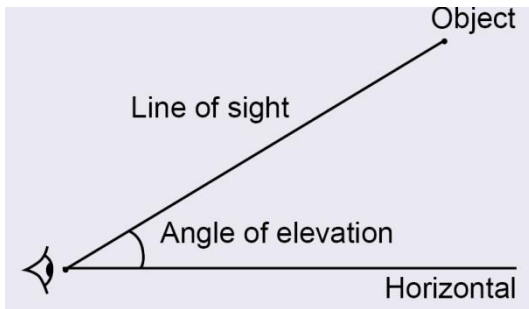
Angle of depression

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.



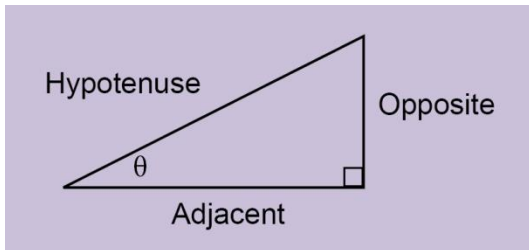
Angle of elevation

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.

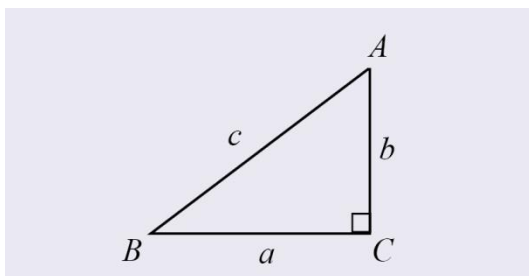
**Cosine ratio**

In any right-angled triangle,

$$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}} \text{ where } 0^\circ < \theta < 90^\circ$$

**Pythagoras' theorem**

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, $c^2 = a^2 + b^2$

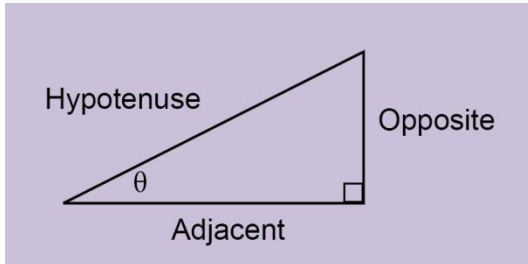


The converse: If $c^2 = a^2 + b^2$ in a triangle ABC, then $\angle ACB$ is a right angle.

Sine ratio

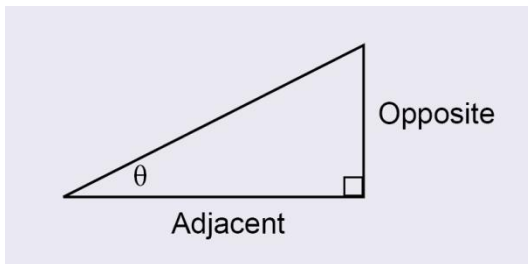
In any right-angled triangle,

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

**Tangent ratio**

In any right-angled triangle,

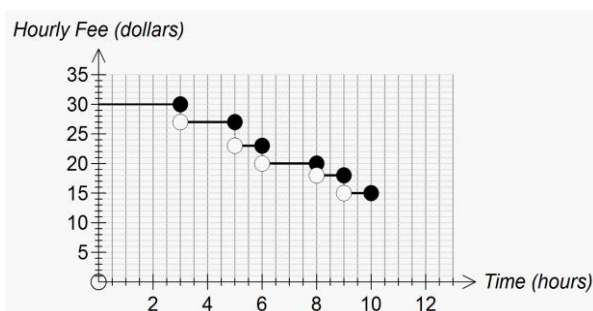
$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}}, \text{ where } 0^\circ < \theta < 90^\circ$$

**Graphs in practical situations****Break-even point**

The break-even point is the point at which revenue begins to exceed the cost of production.

Step graph

A graph consisting of one or more non-overlapping horizontal line segments that follow a step-like pattern.

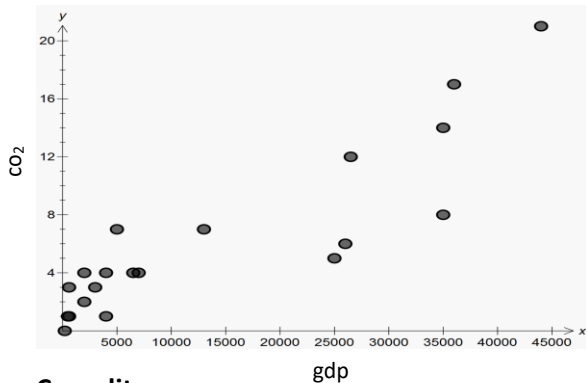
**Data collection****Association**

A general term used to describe the relationship between two (or more) variables. The term association is often used interchangeably with the term correlation. The latter tends to be used when referring to the strength of a linear relationship between two numerical variables.

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.



Causality

A relationship between an explanatory and a response variable is said to be causal if the change in the explanatory variable actually causes a change in the response variable. Simply knowing that two variables are associated, no matter how strongly, is not sufficient evidence by itself to conclude that the two variables are causally related.

Possible explanations for an observed association between an explanatory and a response variable include:

- the explanatory variable is actually causing a change in the response variable
- there may be causation, but the change may also be caused by one or more uncontrolled variables whose effects cannot be disentangled from the effect of the response variable; this is known as confounding
- there is no causation, the association is explained by at least one other variable that is associated with both the explanatory and the response variable; this is known as a common response
- the response variable is actually causing a change in the explanatory variable.

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.

Explanatory variable

When investigating relationships in bivariate data, the explanatory variable is the variable used to explain or predict a difference in the response variable.

For example, when investigating the relationship between the temperature of a loaf of bread and the time it has spent in a hot oven, temperature is the response variable and time is the explanatory variable.

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.

Population

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

Interpolation

In the context of fitting a linear relationship between two variables, interpolation occurs when the fitted model is used to make predictions using values of the explanatory variable that lie within the range of the original data. See also extrapolation.

Sample

A sample is part of a population. It is a subset of the population, often randomly selected for the purpose of estimating the value of a characteristic of the population as a whole.

Unit 4

Probability and relative frequencies

Array

An array is an ordered collection of objects or numbers.

Law of large numbers

The basic justification for statistical sampling is that the distribution which is obtained from a random sample tends to resemble the distribution of the population from which it was drawn. The tendency increases as the size of the sample increases. This tendency of distributions of random samples to resemble the distribution of their parent population more closely as sample size increases is called the law of large numbers.

Relative frequency

Relative frequency is given by the ratio, $\frac{f}{n}$ where f is the frequency of occurrence of a particular data value or group of data values in a data set and n is the number of data values in the data set.

Sample

See Unit 3.

Sample space

A sample space is the set of all possible outcomes of a chance experiment. For example, the set of outcomes (also called sample points) from tossing two heads is { HH, HT, TH, TT }, where H represents a 'head' and T a 'tail'.

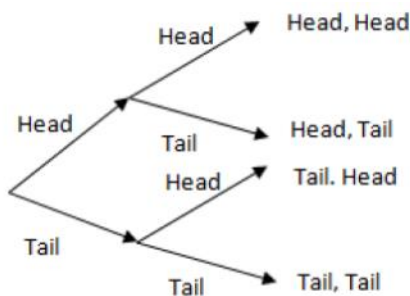
Simulation

A simulation is an experiment which imitates the chance behavior of some phenomenon.

Tree diagram

A tree diagram is a diagram that can be used to enumerate the outcomes of a multi-step random experiment.

The diagram below shows a tree diagram that has been used to enumerate all of the possible outcomes when a coin is tossed twice. This is an example of a two-step random experiment.



Loans and compound interest

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 $r\%$ per period, then after t periods the accumulated simple interest is

$$\text{Interest} = \frac{P \times r \times t}{100}$$

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.

Recurrence relation

A recurrence relation is an equation that recursively defines a sequence; that is, once one or more initial terms are given, each further term of the sequence is defined as a function of the preceding terms.

