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

DRAFT FOR CONSULTATION

MATHEMATICS METHODS

ATAR course

Year 12 syllabus for teaching from 2029

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 2029.

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.

Contents

Rationale

The Mathematics Methods ATAR course covers the study of calculus and statistical analysis in applied and theoretical contexts. It focuses on developing students' ability to use mathematical concepts and techniques to solve problems, analyse data and model real-world phenomena.

The course focuses on exploring differentiation and integration techniques to solve practical problems, including those involving exponential and logarithmic functions. The course furthers the application of statistics through probability distributions in applied and theoretical contexts and statistical inference.

By studying this course, students develop a strong foundation in mathematical reasoning, critical thinking and analytical problem-solving. They gain fluency in manipulating algebraic expressions, interpreting mathematical models and using statistical methods and probability techniques to draw meaningful conclusions from data. The course fosters students' ability to communicate mathematical arguments clearly and logically.

The mathematical skills and concepts covered in the course have broad applications in daily life and various professional fields. Students apply their knowledge of calculus to analyse and optimise real-world situations, such as understanding growth rates, motion and measurement calculations. Their understanding of probability and statistical inference allows students to make informed decisions by estimating outcomes and assessing risks in various contexts.

The Mathematics Methods ATAR course provides a strong foundation for students intending to pursue tertiary studies in engineering, computer science, physics, economics, health sciences and data analytics. Careers in areas such as actuarial science, medicine, finance and research heavily depend on mathematical reasoning and statistical analysis, making the study of Mathematics Methods highly beneficial.

Aims

The Mathematics Methods ATAR course aims to develop students':

- understanding of concepts and techniques drawn from algebra, functions, calculus, probability and statistics
- ability to apply mathematical knowledge to solve applied and theoretical problems
- proficiency in reasoning and interpretation within mathematical and statistical contexts
- capacity to communicate findings clearly and systematically, using precise and appropriate mathematical and statistical language
- confidence to select and use digital tools appropriately and efficiently to support problem-solving and data analysis.

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.

Organisation of content

Unit 3

Contains three topics:

- Exponential and logarithmic functions
- Further differentiation and applications
- Integration.

Unit 4

Contains three topics:

- Discrete random variables
- Continuous random variables
- Sample proportions.

Each unit includes:

- a unit description – a short description of the focus of the unit
- 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.

Role of technology

It is assumed that students will be taught this course with an extensive range of technological applications and techniques. If appropriately used, these technologies have the potential to enhance the teaching and learning of the course; however, students also need to continue to develop skills that do not depend on technology. The ability to choose when or when not to use some form of technology, and being 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 support students to live and work successfully now and into the future. They are not assessed unless identified within the specified unit content. Teachers should find opportunities to incorporate the following General Capabilities into the teaching and learning program for the Mathematics Methods ATAR course.

Critical and creative thinking

Students identify and clarify information from a range of sources, including visual information and digital sources. They identify the relevant aspects of a concept or problem, understanding that a single mathematical process can be used in seemingly different situations and that approaches may change depending on the context or nature of the problem. Students draw conclusions and make choices when completing tasks by connecting evidence from within and across the mathematical content to provide reasons and evaluate arguments for choices made.

Digital literacy

Students use appropriate digital tools to support the development of mathematical understanding and to apply mathematical knowledge to a range of problems. They use technologies aligned with areas of work they may be involved with such as statistical and graphical analysis, generation of algorithms, algebraic manipulation and complex calculations. Students use digital tools to make connections between mathematical theory, practice and application.

Literacy

Students develop literacy skills and strategies that enable them 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. They can apply and further develop their literacy skills and strategies by shifting between verbal, graphical, numerical and symbolic forms of representing problems to formulate, understand and solve problems, and communicate results. Students learn to communicate their findings in different ways, using multiple systems of representation to illustrate the relationships they have observed or constructed.

Numeracy

Students develop their numeracy skills at a more sophisticated level, making decisions about the relevant mathematics to use, following through with calculations, selecting appropriate methods and being confident of their results. This course contains topics that will equip students for the increasing demands of the information age, developing the skills of critical evaluation of numerical information. They enhance their numerical operation skills by solving practical problems using the calculus of trigonometric, exponential and logarithmic functions, and by working with discrete and continuous random variables and associated data distributions.

Addressing the other General Capabilities

Although the following General Capabilities have not been identified as a focus in the Mathematics Methods ATAR Year 12 syllabus, teachers may find opportunities to incorporate them into the teaching and learning program.

- Ethical understanding
- Intercultural understanding
- Personal and social capability

Such opportunities may occur through the application of different contexts, pedagogical practices and/or assessment strategies that relate to the syllabus as part of the teaching and learning program.

Summary representation of the General Capabilities in the Mathematics Methods ATAR course

The unit content and assessment types for this course provide students with the opportunity to develop the General Capabilities summarised in the table below.

Year	Course	Course type	General Capabilities						
			CCT	DL	EU	IU	L	N	PSC
Year 11	Mathematics Methods (AEMAM)	ATAR	✓	✓			✓	✓	
Year 12	Mathematics Methods (ATMAM)	ATAR	✓	✓			✓	✓	

Key
CCT: Critical and creative thinking, DL: Digital literacy, EU: Ethical understanding, IU: Intercultural understanding, L: Literacy, N: Numeracy, PSC: Personal and social capability

Representation of the Cross-curriculum Priorities

The Cross-curriculum Priorities address the contemporary issues that students face in a globalised world. Teachers may find opportunities to incorporate them into the teaching and learning program for the Mathematics Methods ATAR 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 and their past and ongoing contributions to contemporary Australian society and culture. Through the study of mathematics within relevant contexts, students develop an 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. By analysing relevant data, students further develop an understanding of the diverse nature of Asia's environments and traditional and contemporary cultures.

Sustainability

Each of the mathematics courses provides students with the opportunity to develop informed and reasoned points of view, discuss issues, research and problem-solve. Teachers are therefore encouraged to select contexts for discussion that are connected with sustainability. Through the analysis of data, students have the opportunity to research and discuss sustainability and learn the importance of respecting and valuing a wide range of world perspectives.

Unit 3

Unit description

The unit has three topics:

- Exponential and logarithmic functions are introduced and their properties and graphs are examined. The natural logarithm is defined, and practical problems are modelled by these functions.
- Further differentiation and applications continues the study of calculus with the derivatives of exponential, logarithmic and trigonometric functions, together with differentiation rules. The concept of a second derivative, its meaning and application to optimisation problems and graph sketching is introduced.
- Integration is explored, both as a process that reverses differentiation and as a way of calculating areas. The fundamental theorem of calculus as a link between differentiation and integration is emphasised.

Classroom access to the technology necessary to support the computational and graphical aspects of the topics in this unit is assumed.

Learning outcomes

By the end of this unit, students:

- demonstrate the concepts and techniques used in functions and calculus
- solve problems in functions and calculus
- apply reasoning skills in functions and calculus
- interpret and evaluate mathematical and statistical information and ascertain the reasonableness of solutions to problems
- communicate their arguments and strategies when solving problems.

Unit content

An understanding of the Year 11 content is assumed knowledge for students in Year 12. It is recommended that students studying Unit 3 and Unit 4 have completed Unit 1 and Unit 2.

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

Topic 3.1: Exponential and logarithmic functions

Exponential functions

3.1.1 establish and define Euler's number, e, as the natural base of the exponential function, through the use of a practical application, such as continuous compounding, growth and decay or rate of change models

3.1.2 identify and use the qualitative features of the graph of $y = ka^x$ and $y = ka^{-x}$ $(a > 0,$ including $a = e)$, such as the y-intercept and horizontal asymptote, and examine the effect of the translations $y = a^x + b$ and $y = a^{x-c}$ on these features

Logarithmic functions

3.1.3 define logarithms using the relationship $a^x = b$ is equivalent to $x = \log_a b$

3.1.4 use the algebraic properties of logarithms, including the change of base formula, to simplify expressions and solve equations, such as exponential equations with unlike bases

3.1.5 define the logarithm with base e as the natural logarithm $\ln x$ and compare the graphs of the functions $y = e^x$ and $y = \ln x$

3.1.6 identify and use the qualitative features of the graph of $y = \log_a x$ $(a > 1)$ such as the x-intercept and vertical asymptote, and examine the effect of the translations $y = \log_a x + b$ and $y = \log_a(x - c)$ on these features

3.1.7 interpret logarithmic scales on semi-log plots, including plotting and reading values

3.1.8 solve practical problems that can be modelled by exponential and logarithmic functions

Topic 3.2: Further differentiation and applications

Further differentiation

3.2.1 establish and use the formula $\frac{d}{dx}(e^x) = e^x$ and $\frac{d}{dx}(\ln x) = \frac{1}{x}$

3.2.2 establish and use the formula $\frac{d}{dx}(\sin x) = \cos x$ and $\frac{d}{dx}(\cos x) = -\sin x$

3.2.3 use the product rule and/or the quotient rule to differentiate the product and/or quotient of known functions

3.2.4 use the chain rule to differentiate a composition of known functions in the form $f\big(g(x)\big)$, including power, exponential, logarithmic and trigonometric functions

3.2.5 use exponential functions of the form $f(x) = Ae^{kx}$ and their derivatives to solve applied problems

3.2.6 model and solve applied problems using functions and their derivatives, including power, exponential, logarithmic and trigonometric functions

3.2.7 use the increments formula $\delta y \approx \frac{dy}{dx} \times \delta x$ to estimate the change, including percentage change, in the dependent variable y resulting from changes in the independent variable x

The second derivative and applications

3.2.8 apply the concept of the second derivative as the rate of change of the first derivative function

3.2.9 use the second derivative to identify the concavity and points of inflection of a function

3.2.10 solve applied problems in linear motion recognising acceleration as the rate of change of velocity and as the second derivative of displacement, with respect to time

3.2.11 apply appropriate calculus techniques (the sign, second derivative and concavity tests) to determine the location and nature of stationary points and points of inflection, and sketch graphs of functions

3.2.12 solve optimisation problems by modelling situations using functions and their first and second derivatives to locate and identify local and global maxima and minima

Topic 3.3: Integration

Anti-differentiation

3.3.1 determine antiderivatives of power functions using the notation $\int f(x)dx$ and the formula $\int x^n dx = \frac{1}{n+1}x^{n+1} + c$ for $n \neq -1$, recognising anti-differentiation as the inverse of differentiation

3.3.2 identify families of curves with the same derivative function and determine the constant of integration using given conditions, such as a point on the curve

3.3.3 use linearity properties of the integral $\int \big(f(x) \pm g(x)\big)dx = \int f(x)dx \pm \int g(x)dx$ and $\int kf(x)dx = k\int f(x)dx$ to integrate functions

3.3.4 establish and use the formula for $\int e^x dx$, $\int \sin x\, dx$, $\int \cos x\, dx$, and $\int \frac{1}{x}dx$ where $x \neq 0$

3.3.5 determine indefinite integrals of the form $\int g'(x)f\big(g(x)\big)dx$ by recognising anti-differentiation as the inverse of differentiation

Integrals and applications

3.3.6 use inscribed and circumscribed rectangles to determine underestimates and overestimates for the area under the curve $y = f(x)$ where $f(x) > 0$

3.3.7 use the limiting sum of rectangles with area $f(x_i)\ \delta x$ as $\delta x \to 0$ to define the definite integral $\int_a^b f(x)dx$ as the area under the curve $y = f(x)$ for $a \leq x \leq b$, where $f(x) > 0$

3.3.8 examine the concept of the signed area function $F(x) = \int_a^x f(t)dt$

3.3.9 interpret and use $\int_a^b f(x)dx$ as a sum of signed areas, extending the use of the linearity properties of the integral to definite integrals

3.3.10 use the additivity property of definite integrals $\int_a^c f(x)dx = \int_a^b f(x)dx + \int_b^c f(x)dx$

Fundamental theorem of calculus (FTC)

3.3.11 establish and use the relationship, $F'(x) = \frac{d}{dx}\big(\int_a^x f(t)dt\big) = f(x)$ for any continuous function $f(t)$

3.3.12 use FTC with the chain rule where $F'(x) = \frac{d}{dx}\left(\int_a^{g(x)} f(t)dt\right) = f(g(x))\ g'(x)$ and $g(x)$ is a power, exponential, logarithmic or trigonometric function

3.3.13 use the relationship $\int_a^b f'(x)dx = f(b) - f(a)$ to calculate definite integrals for any function $f(x)$ continuous in the domain $a \leq x \leq b$

Applications of integration

3.3.14 calculate the area between known functions and the x-axis and between functions

3.3.15 solve applied problems in linear motion to determine velocity from acceleration and displacement from velocity using given conditions

3.3.16 solve applied problems in linear motion to determine displacement and total distance travelled

3.3.17 solve applied problems involving net change by integrating the rate of change functions

Unit 4

Unit description

The unit has three topics:

- Discrete random variables are introduced, together with their uses in modelling random processes involving chance and variation. Probabilities associated with general discrete distributions are calculated and binomial distributions are examined.
- Continuous random variables are introduced and their applications examined. Probabilities associated with general continuous distributions are calculated using definite integrals and normal distributions are examined. This supports the development of a framework for statistical inference.
- Sample proportions introduces one of the most important parts of statistics, in which the goal is to estimate an unknown parameter associated with a population using a sample of data drawn from that population. In the Mathematics Methods ATAR course, statistical inference is restricted to estimating proportions in two-outcome populations.

Classroom access to the technology necessary to support the computational and statistical aspects of the topics in this unit is assumed.

Learning outcomes

By the end of this unit, students:

- demonstrate the concepts and techniques in calculus, probability and statistics
- solve problems in calculus, probability and statistics
- apply reasoning skills in calculus, probability and statistics
- interpret and evaluate mathematical and statistical information and ascertain the reasonableness of solutions to problems
- communicate their arguments and strategies when solving problems.

Unit content

This unit builds on the content covered in Unit 3.

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

Topic 4.1: Discrete random variables

General discrete random variables

4.1.1 use relative frequencies from discrete datasets to obtain estimates of probabilities

4.1.2 define discrete probability distributions, including uniform distributions with equally likely outcomes, and simple non-uniform distributions, using tables, graphs and functions

4.1.3 calculate and interpret the mean (expected value), variance and standard deviation of a discrete random variable

4.1.4 use and establish the effect of linear changes of scale and origin on the mean, standard deviation and variance of a discrete random variable

4.1.5 solve applied problems that involve discrete random variables, including calculation of probabilities for intervals, conditional probabilities, mean, variance and standard deviation

Binomial distribution

4.1.6 identify situations that can be modelled by a Bernoulli random variable that represents a single trial where exactly one of two outcomes (success or failure) are possible

4.1.7 establish that the Bernoulli distribution with parameter p, representing the probability of success, has mean p and variance $p(1-p)$

4.1.8 identify situations that represent the number of successes in n independent and identical Bernoulli trials with the same probability of success p for each trial, are modelled as binomial random variables and use the notation $X \sim Bin(n, p)$ to represent a binomial random variable with parameters n (the fixed number of trials) and p (the probability of success)

4.1.9 use the notation $\binom{n}{r}$ and establish the formula $\binom{n}{r} = \frac{n!}{r!(n-r)!}$ to determine the number of combinations of r objects taken from a set of n distinct objects

4.1.10 establish and use the formula $\mathrm{P}(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$ to determine the probability of x successes in n trials associated with the binomial distribution with parameters n and p

4.1.11 calculate and interpret the mean (expected value) np, variance $np(1-p)$ and standard deviation $\sqrt{np(1-p)}$ of a binomial distribution

4.1.12 solve applied problems that involve binomial distributions including calculation and interpretation of probabilities for intervals, conditional probability, mean, variance and standard deviation

Topic 4.2: Continuous random variables

General continuous random variables

4.2.1 use histograms for continuous data to estimate the probability that the value of a random variable falls within a given interval

4.2.2 use the properties of a probability density function $f(x)$; $f(x) \geq 0$ and $\int_{-\infty}^{\infty} f(x)dx = 1$ where $f(x)$ is continuous

4.2.3 use the cumulative distribution function $F(x) = P(X \leq x) = \int_{-\infty}^{x} f(t)dt$ to evaluate probabilities

4.2.4 calculate and interpret the mean (expected value), variance and standard deviation of a continuous random variable

4.2.5 use and establish the effect of linear changes of scale and origin on the mean, standard deviation and variance of a continuous random variable

4.2.6 solve applied problems that involve continuous random variables, including the calculation and interpretation of probabilities for continuous intervals within the domain of $f(x)$, $P(c < X < d) = \int_{c}^{d} f(x)dx$, conditional probabilities, mean, median, variance and standard deviation

Normal distributions

4.2.7 identify the normal distribution as a continuous probability distribution that models naturally occurring variation

4.2.8 identify the features of the graph of the normal distribution and use the notation $X \sim N(\mu, \sigma^2)$ to represent the normally distributed random variable with mean μ and standard deviation σ

4.2.9 define the standard normal distribution, $Z \sim N(0, 1)$, and use standardised scores to compare different sets of data and draw conclusions

4.2.10 calculate probabilities and percentiles associated with a given normal distribution using technology, and use these to solve applied problems

Topic 4.3: Sample proportions

Random sampling

4.3.1 identify the purpose of random samples of data when estimating population proportions

4.3.2 discuss common sources of bias in sampling, and methods to eliminate them

4.3.3 use graphical displays, means and standard deviations of simulated data to explain the variability in random samples and estimates of population proportions

Sample proportions

4.3.4 define the sample proportion $\hat{p} = \frac{X}{n}$ as a random variable where X is the number of successes in a sample of size n, and establish that it has mean p and standard deviation $\sqrt{\frac{p(1-p)}{n}}$, where p is the population proportion

4.3.5 identify that for large samples, $n \geq 30$, and with $p \approx 0.5$, or satisfying the conditions $np \geq 10$ and $n(1-p) \geq 10$, the sampling distribution of $\hat{p}$ will approximate a normal distribution and use the approximate normality of this distribution to calculate probabilities and solve problems involving population proportions

Confidence intervals for proportions

4.3.6 use the sample proportion $\hat{p}$ as a point estimate of the population proportion p, and construct an approximate confidence interval for the population proportion as $\left(\hat{p} - z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}, \hat{p} + z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}\right)$, where z represents the appropriate critical value from the standard normal distribution

4.3.7 determine and interpret the approximate margin of error, $E = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$, of a confidence interval and explain the relationship between margin of error and level of confidence, sample size and the value of $\hat{p}$

4.3.8 interpret and explain the expected proportion of intervals that will contain the true population proportion for a given level of confidence, if many intervals are constructed from samples of the same size from the same population

4.3.9 use approximate confidence intervals to make inferences about claimed population proportions and compare samples

Assessment

Assessment is an integral part of teaching and learning that in the senior secondary years:

- provides evidence of student achievement
- identifies opportunities for further learning
- connects to the standards described for the course
- contributes to the recognition of student achievement.

Assessment for learning (formative) and assessment of learning (summative) enable teachers to gather evidence to support students and make judgements about student achievement. These are not necessarily discrete approaches and may be used individually or together, and formally or informally.

Formative assessment involves a range of informal and formal assessment procedures used by teachers during the learning process to improve student achievement and to guide teaching and learning activities. It often involves qualitative feedback (rather than scores) for both students and teachers, which focuses on the details of specific knowledge and skills that are being learned.

Summative assessment involves assessment procedures that aim to determine students' learning at a particular time; for example, when reporting against the standards or after completion of a unit or units. These assessments should be limited to eight or less and made clear to students through the assessment outline.

Appropriate assessment of student work in this course is underpinned by reference to a set of predetermined course standards. These standards describe the level of achievement required to achieve each grade from A to E. Teachers use these standards to determine how well a student has demonstrated their learning.

Where relevant, higher order cognitive skills (e.g. application, analysis, synthesis and evaluation) and the General Capabilities should be included in the assessment of student achievement in this course. All assessment should be consistent with the requirements identified in the course assessment table.

Assessment should not generate workload or stress that, under fair and reasonable circumstances, would unduly diminish the performance of students.

School-based assessment

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

School-based assessment involves teachers gathering, describing and quantifying information about student achievement.

Teachers design school-based assessment tasks to meet the needs of students. As outlined in the *WACE Manual*, school-based assessment of student achievement in this course must be based on the Principles of Assessment:

- Assessment is an integral part of teaching and learning.
- Assessment should be educative.
- Assessment must be fair.
- Assessment should be designed to meet its specific purpose/s.
- Assessment should lead to informative reporting.
- Assessment should lead to school-wide evaluation processes.
- Assessment should provide significant data for improvement of teaching practices.

The table below provides details of the assessment types and their weighting for the Mathematics Methods ATAR Year 12 syllabus.

Summative assessments in this course must:

- be limited to eight tasks or less
- allow for the assessment of each assessment type at least once over the year/pair of units
- have a minimum value of five per cent of the total school assessment mark
- provide a representative sampling of the syllabus content.

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

Assessment table – Year 12

Type of assessment	Weighting
Response Students apply mathematical knowledge and understanding of concepts, techniques and relationships to solve a mix of routine and non-routine questions, demonstrating their interpretation of concepts and results in applied and theoretical contexts. Response tasks can include tests, assignments and multimedia representations.	40%
Investigation Students use the mathematical thinking process to plan, research, conduct and communicate the findings of an investigation. They can investigate problems to identify the underlying mathematics, or select, adapt and apply models and procedures to solve problems. This assessment type provides for the assessment of the mathematical thinking process using course-related knowledge and modelling skills. Evidence can include observation and interview, written work or multimedia presentations.	20%
Examination Students apply mathematical understanding and skills to analyse, interpret and respond to questions and situations. Examinations provide for the assessment of conceptual understandings, knowledge of mathematical facts and terminology, problem-solving skills and the use of algorithms. Examination questions can range from those of a routine nature, assessing lower-level concepts, through to those that require responses at the highest level of conceptual thinking. Examinations are typically conducted at the end of each semester and/or unit and reflecting the examination design brief for this syllabus.	40%

Teachers are required to use the assessment table to develop an assessment outline for the pair of units (or for a single unit where only one is being studied).

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.

Reporting

Schools report student achievement, underpinned by a set of pre-determined standards, using the following grades:

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

The grade descriptions for the Mathematics Methods ATAR Year 12 syllabus are provided in Appendix 1. They are used to support the allocation of a grade. They can also be accessed, together with annotated work samples, on the course page of the Authority website (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.

The grade is determined by reference to the standard, not allocated on the basis of a predetermined range of marks (cut-offs).

ATAR course examination

All students enrolled in the Mathematics Methods ATAR Year 12 course are required to sit the ATAR course examination. The examination is based on a representative sampling of the content for Unit 3 and Unit 4. Details of the ATAR course examination are prescribed in the examination design brief on the following page.

Refer to the *WACE Manual* for further information.

Examination design brief – Year 12

This examination consists of two sections.

Section One: Calculator-free

Time allowed

Reading time before commencing work: five minutes

Working time for section: fifty minutes

Permissible items

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: nil

Additional information

Changeover period during which the candidate is not permitted to work: up to 15 minutes

Section Two: Calculator-assumed

Time allowed

Reading time before commencing work: ten minutes

Working time for section: one hundred minutes

Permissible items

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper, and up to three calculators, which can include scientific, graphic and Computer Algebra System (CAS) calculators, are permitted in this ATAR course examination

Provided by the supervisor

Formula sheet

Additional information

It is assumed that candidates sitting this examination have a calculator with CAS capabilities for Section Two.

The candidate is required to demonstrate knowledge of mathematical facts, conceptual understandings, use of algorithms, use and knowledge of notation and terminology, and problem-solving skills.

Questions can require the candidate to solve problems, investigate mathematical patterns, apply reasoning skills, interpret results and communicate their arguments and strategies to justify mathematical relationships. Examination questions can range from those of a routine nature, assessing lower-level concepts, through to those that require responses at the highest level of conceptual thinking.

Instructions to candidates indicate that, for any question or part question worth more than two marks, valid working or justification is required to receive full marks.

Sections	Supporting information
Section One: Calculator-free 35% of the total examination 5–10 questions Working time: 50 minutes	Questions examine content and procedures that can reasonably be expected to be completed without the use of a calculator, i.e. without undue emphasis on algebraic manipulations or time-consuming calculations. The candidate is required to provide answers that include calculations, tables, graphs, interpretation of data, descriptions and/or conclusions. Stimulus material can include diagrams, tables, graphs, drawings, print text and/or data gathered from the media.
Section Two: Calculator-assumed 65% of the total examination 8–13 questions Working time: 100 minutes	Questions examine content and procedures for which the use of a calculator is assumed. The candidate is required to provide answers that include calculations, tables, graphs, interpretation of data, descriptions and conclusions. Stimulus material can include diagrams, tables, graphs, drawings, print text and/or data gathered from the media. The candidate is required to solve problems, investigate mathematical patterns, apply reasoning skills, interpret results and communicate their arguments and strategies to justify mathematical relationships. The candidate is required to solve problems from unfamiliar situations, choosing and using mathematical models with adaptations where necessary, comparing their solutions with the situations concerned, and then presenting their findings in context.

Appendix 1 – Grade descriptions Year 12*

A	**Identifies and organises relevant information** Identifies and organises relevant information from previous parts of a problem and brings them together to solve subsequent problems. Defines variables and equations from text and diagrams. Organises data in a concise, clear format and appropriately presents it in tabular, diagrammatic and/or graphical form. Identifies the underlying assumptions related to the relevant mathematics of an investigation.
	Chooses effective models and methods and carries through the methods correctly Selects an appropriate strategy and applies mathematical knowledge to solve non-routine problems. Generalises and extends models from previous parts of the question. Translates between representations in unpractised ways. Selects appropriate calculator techniques to solve multi-step problems in unfamiliar contexts. Selects and appropriately uses numerical, graphical, symbolic and statistical methods to develop mathematical ideas. Produces results, carries out analysis and generalises in situations requiring investigative techniques.
	Follows mathematical conventions and attends to accuracy Follows mathematical conventions and attends to accuracy in non-routine situations. Completes concise and accurate solutions to mathematical problems set in applied and theoretical contexts. Selects, extends and applies mathematical and/or statistical procedures to investigate a problem.
	Links mathematical results to data and contexts to reach reasonable conclusions Recognises implied conditions in extended responses, and defines and explains the limitations of models. Interprets the result and draws the correct conclusion about the effect of changing conditions. Considers the strengths and limitations of an investigation and refines the results to make sensible conclusions.
	Communicates mathematical reasoning, results and conclusions Sets out the steps of the solution in a clear and logical sequence, including suitable justification and explanation of methods and processes used. Adds a detailed diagram to illustrate and use in the solution of a problem. Presents work with the final answer clearly identified, using the correct units and relating to the context of the question. Communicates investigation findings with a comprehensive interpretation of mathematical results in the context of the investigation.

B	**Identifies and organises relevant information** Identifies and organises relevant information for problems involving a few steps or processes. Draws a diagram and labels it with appropriate variables. Organises data clearly and appropriately presents it in tabular, diagrammatic and/or graphical form. Identifies suitable variables and constant parameters related to various aspects of an investigation.
	Chooses effective models and methods and carries through the methods correctly Selects an appropriate strategy and applies mathematical knowledge to solve simple non-routine problems. Translates between representations in practised ways. Selects appropriate calculator techniques to solve multi-step problems. Selects and appropriately uses numerical, graphical, symbolic and statistical methods to develop mathematical ideas. Attempts to analyse and calculate specific cases of generalisation in situations requiring investigative techniques.
	Follows mathematical conventions and attends to accuracy Interprets and uses mathematical terminology, symbols and conventions in routine situations. Rounds, unprompted, to suit context or correctly to specified accuracy. Completes mostly accurate solutions to mathematical problems set in applied and theoretical contexts. Selects and applies mathematical and/or statistical procedures previously learned to investigate a problem.
	Links mathematical results to data and contexts to reach reasonable conclusions Identifies specified conditions, recognises and rejects inappropriate solutions. Links the effect of changing conditions to the original solution. Uses examples in mathematical analysis of an investigation and draws valid conclusions related to a given context.
	Communicates mathematical reasoning, results and conclusions Carries through calculations and simplifications in a clear sequence, showing a logical line of reasoning. Defines variables associated with a given diagram and uses them in the working of a problem. Presents work with the final answer clearly identified and using the correct units. Communicates investigation findings in a systematic and concise way using mathematical language and relating the solution to the original problem or statement.

C	**Identifies and organises relevant information** Identifies and extracts key information needed to solve a familiar problem. Identifies variables in a given diagram. Organises some data and presents it in tabular, diagrammatic and/or graphical form. Identifies the key mathematical content related to various aspects of an investigation in a given context.
	Chooses effective models and methods and carries through the methods correctly Selects from a range of strategies and formulae, and applies mathematical knowledge in practised ways to solve routine problems. Recognises and uses information in different representations. Uses familiar calculator applications to solve routine problems. Selects appropriate numerical, graphical, symbolic and statistical methods to carry through a single thread of reasoning in situations requiring investigative techniques.
	Follows mathematical conventions and attends to accuracy Applies mathematical definitions, rules and procedures in practised situations. Applies basic conventions for diagrams and graphs. Rounds appropriately in a given context and to specified accuracy in short responses. Generates some accurate and generally complete solutions to mathematical problems set in applied and theoretical contexts. Selects and applies, with direction, mathematical and/or statistical procedures previously learned to investigate a problem.
	Links mathematical results to data and contexts to reach reasonable conclusions Identifies specified conditions and recognises inappropriate solutions in routine problems. Recognises that changing conditions will affect the outcome. Makes inferences from analysis and uses these to draw conclusions related to a given context for investigation.
	Communicates mathematical reasoning, results and conclusions Shows adequate working and supports answers with simple or routine statements. Relates the working to a labelled diagram that has been given as part of the question. Presents work with the final answer, but not always clearly identified. Communicates investigation findings in a systematic way using some mathematical expression and everyday language.

D	**Identifies and organises relevant information** Uses given information to solve some simple routine problems. Identifies variables in a simple diagram. Displays data using an inappropriate presentation format. Identifies some mathematical content of an investigation.
	Chooses effective models and methods and carries through the methods correctly Follows an appropriate strategy to solve simple routine and familiar problems that require short responses. Deals with information in familiar representations only. Uses a calculator for straightforward problems. Makes some attempt to select appropriate numerical, graphical, symbolic and statistical methods in situations requiring investigative techniques.
	Follows mathematical conventions and attends to accuracy Applies limited mathematical conventions to practised problems. Rounds inconsistently or inappropriately. Generates partly accurate and generally incomplete solutions to mathematical problems set in applied and theoretical contexts. Attempts to apply, with direction, mathematical and/or statistical procedures previously learned to investigate a problem.
	Links mathematical results to data and contexts to reach reasonable conclusions Does not recognise specified or changing conditions in routine problems. Draws some conclusions from the results of an investigation.
	Communicates mathematical reasoning, results and conclusions Shows some working in an attempt to answer simple questions. Sets out calculations in a manner that is difficult to check for accuracy. Presents working with no clear indication of the final answer evident. Offers simple conclusions that are not supported by data or calculations.

E	Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.

* These grade descriptions will be reviewed at the end of the second year of implementation of this syllabus.

Appendix 2 – Glossary

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

Unit 3

Exponential and logarithmic functions

Logarithmic scales
A logarithmic scale shows units increasing by a multiplicative factor rather than a linear unit.

Semi-log plots
A graphical display that uses a linear scale on one axis and a logarithmic scale on the other axis.

Further differentiation and applications

Concavity
Concavity describes the nature of a curve as opening upwards (concave up) or opening downwards (concave down).

Point of inflection
A point on the curve is a point of inflection if the concavity changes from heading up to heading down or vice-versa at that point.

Stationary point
A stationary point is a point on the curve where the derivative equals zero.

Integration

Constant of integration
The constant of integration is the real number value added to the antiderivative of a function.

Unit 4

Discrete random variables

Discrete random variable
A discrete random variable is an outcome of a chance experiment that can take on distinct values only.

Probability distribution
The probability distribution of a discrete random variable is the set of probabilities for each of its possible values.

Standard deviation of a random variable
The standard deviation of a random variable is the square root of its variance and measures how closely scores are grouped around the mean.

Variance of a random variable
The variance of a random variable is a measure of the ‘spread’ of its distribution.

Linear change of scale and origin
A linear change of scale involves multiplying all data points by a constant amount and a linear change of origin involves adding a constant amount to all data points.

Continuous random variables

Continuous random variable

A continuous random variable is an outcome of a chance experiment that can be an infinite number of possible values in some interval.

Probability density function

The probability density function of a continuous random variable is a function that describes the relative likelihood that the random variable takes a particular value. If $f(x)$ is the probability density function of the continuous random variable X, then the probability that X takes a value in some interval $[a, b]$ is given by $\int_a^b f(x)\, dx$.

Standardised score

A score, sometimes referred to as a Z-score, indicates how many standard deviations a data point is above or below the population mean.

Percentiles

Percentiles indicate the percentage of scores that fall below a particular value. A percentile score is the score for which the given percentage of values falls below.

Interval estimates for proportions

Confidence interval

The confidence interval is a range of values calculated from a sample, that is likely to contain the true population proportion at a specified level of confidence.

Level of confidence

The proportion of confidence intervals that would contain the true population proportion, based on repeated random samples of a given sample size.

Point estimate

A single statistic calculated from a sample to estimate an unknown population parameter.

Margin of error

The margin of error of a confidence interval describes how much the sample proportion may differ from the true proportion.

Sampling distribution

A distribution of a sampling parameter (sample proportions) calculated from the collection of multiple samples of data.