SAMPLE COURSE OUTLINE

MATHEMATICS METHODS
ATAR YEAR 11
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Sample course outline
Mathematics Methods – ATAR Year 11

Unit 1

In Unit 1 students will be provided with opportunities to:
• understand the concepts and techniques in algebra, functions, graphs, trigonometric functions, counting and probability
• solve problems using algebra, functions, graphs, trigonometric functions, counting and probability
• apply reasoning skills in the context of algebra, functions, graphs, trigonometric functions, counting and probability
• interpret and evaluate mathematical information and ascertain the reasonableness of solutions to problems
• communicate their arguments and strategies when solving problems.

This course outline assumes an allocation of 4 hours contact time per week for the course. Each semester is based on a 15 week block.

<table>
<thead>
<tr>
<th>Time placement (and allocation)</th>
<th>Topic/s</th>
<th>Key teaching points – Syllabus reference/s</th>
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</thead>
</table>
| **Semester 1 (Unit 1)** | **Lines and linear relationships** (1.1.1 – 1.1.6) | • coordinates of mid-points and end-point  
| | | • direct proportion and linearly related variables  
| | | • features of the graph of \( y = mx + c \)  
| | | • equations of a straight lines given sufficient information, including parallel and perpendicular lines  
| | | • solve linear equations, including those with algebraic fractions and variables on both sides  
| **Week 1** (2 hours) | Topic 1: Functions and graphs | **Quadratic relationships** (1.1.7 – 1.1.12)  
| | | • examine examples of quadratically related variables  
| | | • features of the graphs of \( y = x^2 \), \( y = a(x - b)^2 + c \), and \( y = a(x - b)(x - c) \), including their parabolic nature, turning points, axes of symmetry and intercepts  
| | | • solve quadratic equations, including the use of quadratic formula and completing the square  
| | | • equation of a quadratic, turning points, zeros, discriminant  
| | | • graph of the general quadratic \( y = ax^2 + bx + c \)  
<p>| <strong>Weeks 1–2</strong> (5 hours) | Topic 1: Functions and graphs |</p>
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| **Weeks 2–4** *(7 hours)*    | **Topic 1: Functions and graphs** | Inverse proportion *(1.1.13 – 1.1.14)*  
  • examples of inverse proportion  
  • equations of the graphs of \( y = \frac{1}{x} \) and \( y = \frac{a}{x - b} \) including their hyperbolic shapes and their asymptotes  
  **Powers and polynomials (1.1.15 – 1.1.20)**  
  • graphs of \( y = x^n \) for \( n \in \mathbb{N} \), \( n = -1 \) and \( n = \frac{1}{2} \), shape, behaviour as \( x \to \infty \) and \( x \to -\infty \)  
  • coefficients and the degree of a polynomial  
  • expand quadratic and cubic polynomials from factors  
  • features and equations of the graphs of \( y = x^3 \), \( y = a(x - b)^3 + c \) and \( y = k(x - a)(x - b)(x - c) \); shape, intercepts and behaviour as \( x \to \infty \) and \( x \to -\infty \)  
  • factorise cubic polynomials (in cases where a linear factor is easily obtained)  
  • solve cubic equations using technology, and algebraically in cases where a linear factor is easily obtained  
| **Weeks 4–6** *(8 hours)* | **Topic 1: Functions and graphs** | **Graphs and relations (1.1.21 – 1.1.22)**  
  • features and equations of the graphs of \( x^2 + y^2 = r^2 \) and \( (x - a)^2 + (y - b)^2 = r^2 \), their circular shapes, centres and radii  
  • graph of \( y^2 = x \), shape and axis of symmetry  
  **Functions (1.1.23 – 1.1.28)**  
  • the concept of a function as a mapping and as a rule or a formula that defines one variable quantity in terms of another  
  • use function notation; determine domain and range; recognise independent and dependent variables  
  • the graph of a function  
  • translations and the graphs of \( y = f(x) + a \) and \( y = f(x - b) \)  
  • dilations and the graphs of \( y = cf(x) \) and \( y = f(dx) \)  
  • distinction between functions and relations and the vertical line test  
| **Weeks 6–7** *(5 hours)* | **Topic 2: Trigonometric functions** | **Sine and cosine rules (1.2.1 – 1.2.4)**  
  • right-angled triangles and trigonometric ratios  
  • unit circle definition of \( \cos \theta \), \( \sin \theta \) and \( \tan \theta \) and periodicity using degrees  
  • angle of inclination of a line and the gradient of that line  
  • establish and use the cosine and sine rules, including consideration of the ambiguous case and the formula \( \text{Area} = \frac{1}{2} bc \sin A \) for the area of a triangle  
  **Circular measure and radian measure (1.2.5 – 1.2.6)**  
  • use radian measure and degree measure  
  • calculate lengths of arcs and areas of sectors and segments in circles |
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| **Semester 1 (Unit 1)**      | **Topic 2: Trigonometric functions** | Trigonometric functions (1.2.7 – 1.2.16)  
• understand the unit circle definition of \( \sin \theta \), \( \cos \theta \) and \( \tan \theta \) and periodicity using radians  
• recognise the exact values of \( \sin \theta \), \( \cos \theta \) and \( \tan \theta \) at integer multiples of \( \frac{\pi}{6} \) and \( \frac{\pi}{4} \)  
• recognise the graphs of \( y = \sin x \), \( y = \cos x \) and \( y = \tan x \) on extended domains  
• examine amplitude changes and the graphs of \( y = a \sin x \) and \( y = a \cos x \)  
• examine period changes and the graphs of \( y = \sin bx \), \( y = \cos bx \) and \( y = \tan bx \)  
• examine phase changes and the graphs of \( y = \sin(x-c) \), \( y = \cos(x-c) \) and \( y = \tan(x-c) \)  
• examine the relationships \( \sin \left( x + \frac{\pi}{2} \right) = \cos x \) and \( \cos \left( x - \frac{\pi}{2} \right) = \sin x \)  
• prove and apply the angle sum and difference identities  
• identify contexts suitable for modelling by trigonometric functions and use them to solve practical problems  
• solve equations involving trigonometric functions using technology, and algebraically in simple cases |
| **Weeks 7–9 (10 hours)**    | **Topic 3: Counting and probability** | Combinations (1.3.1 – 1.3.5)  
• understand the notion of a combination as a set of \( r \) objects taken from a set of \( n \) distinct objects  
• use the notation \( \binom{n}{r} \) and the formula \( \binom{n}{r} = \frac{n!}{r!(n-r)!} \) for the number of combinations of \( r \) objects taken from a set of \( n \) distinct objects  
• expand \( (x + y)^n \) for small positive integers \( n \)  
• recognise the numbers \( \binom{n}{r} \) as binomial coefficients (as coefficients in the expansion of \( (x + y)^n \))  
• use Pascal’s triangle and its properties |
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<tbody>
<tr>
<td><strong>Semester 1 (Unit 1)</strong></td>
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<tr>
<td><strong>Weeks 11</strong> (4 hours)</td>
<td>Topic 3: Counting and probability</td>
<td>Language of events and sets (1.3.6 – 1.3.8)</td>
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<td>• review the concepts and language of outcomes, sample spaces, and events, as sets of outcomes</td>
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<td></td>
<td>• use set language and notation for events, including:</td>
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<td></td>
<td></td>
<td>a. $\overline{A}$ (or $A'$) for the complement of an event $A$</td>
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<td>b. $A \cap B$ and $A \cup B$ for the intersection and union of events $A$ and $B$ respectively</td>
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<td></td>
<td>c. $A \cap B \cap C$ and $A \cup B \cup C$ for the intersection and union of the three events $A, B$ and $C$ respectively</td>
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<td></td>
<td>d. recognise mutually exclusive events</td>
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<td></td>
<td>• use everyday occurrences to illustrate set descriptions and representations of events and set operations</td>
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<tr>
<td><strong>Weeks 12</strong> (4 hours)</td>
<td>Topic 3: Counting and probability</td>
<td>Review of the fundamentals of probability (1.3.9 – 1.3.12)</td>
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<td>• review probability as a measure of ‘the likelihood of occurrence’ of an event</td>
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<td>• review the probability scale: $0 \leq P(A) \leq 1$ for each event $A$ with $P(A) = 0$ if $A$ is an impossibility and $P(A) = 1$ if $A$ is a certainty</td>
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<td>• review the rules: $P(\overline{A}) = 1 - P(A)$ and $P(A \cup B) = P(A) + P(B) - P(A \cap B)$</td>
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<td>• use relative frequencies obtained from data as estimates of probabilities</td>
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<tr>
<td><strong>Weeks 13–14</strong> (6 hours)</td>
<td>Topic 3: Counting and probability</td>
<td>Conditional probability and independence (1.3.13 – 1.3.17)</td>
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<td>• understand the notion of a conditional probability and recognise and use language that indicates conditioning</td>
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<td>• use the notation $P(A</td>
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<td>• understand the notion of independence of an event $A$ from an event $B$, as defined by $P(A</td>
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<td>• establish and use the formula $P(A \cap B) = P(A)P(B)$ for independent events $A$ and $B$, and recognise the symmetry of independence</td>
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<td></td>
<td>• use relative frequencies obtained from data as estimates of conditional probabilities and as indications of possible independence of events</td>
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<td><strong>Week 15</strong></td>
<td></td>
<td>Revision and end of Unit 1 assessment</td>
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Sample course outline
Mathematics Methods – ATAR Year 11

Unit 2

In Unit 2 students will be provided with opportunities to:

- understand the concepts and techniques used in algebra, sequences and series, functions, graphs, and calculus
- solve problems in algebra, sequences and series, functions, graphs, and calculus
- apply reasoning skills in algebra, sequences and series, functions, graphs, and calculus
- interpret and evaluate mathematical and statistical information and ascertain the reasonableness of solutions to problems
- communicate arguments and strategies when solving problems.

This course outline assumes an allocation of 4 hours contact time per week for the course.

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<td><strong>Semester 2 (Unit 2 – plus review of Unit 1)</strong></td>
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| **Weeks 16–18 (10 hours)** | **Topic 2.1: Exponential functions** | **Indices and the index laws** (2.1.1 – 2.1.3)
- review indices (including fractional and negative indices) and the index laws
- use radicals and convert to and from fractional indices
- understand and use scientific notation and significant figures**
| | | **Exponential functions** (2.1.4 – 2.1.7)
- establish and use the algebraic properties of exponential functions
- recognise the qualitative features of the graph of \( y = a^x \) (\( a > 0 \)), including asymptotes, and of its translations (\( y = a^x + b \) and \( y = a^{x-c} \))
- identify contexts suitable for modelling by exponential functions and use them to solve practical problems
- solve equations involving exponential functions using technology, and algebraically in simple cases** |
| **Week 18–19 (6 hours)** | **Topic 2.2: Arithmetic and geometric sequences and series** | **Arithmetic sequences** (2.2.1 – 2.2.4)
- recognise and use the recursive definition of an arithmetic sequence \( t_{n+1} = t_n + d \)
- develop and use the formula \( t_n = t_1 + (n - 1)d \) for the general term of an arithmetic sequence and recognise its linear nature
- use arithmetic sequences in contexts involving discrete linear growth or decay, such as simple interest
- establish and use the formula for the sum of the first \( n \) terms of an arithmetic sequence** |
| **Week 20–22 (9 hours)** | **Topic 2.2: Arithmetic and geometric sequences and series** | **Geometric sequences** (2.2.5 – 2.2.9)
- recognise and use the recursive definition of a geometric sequence \( t_{n+1} = t_nr \)
- develop and use the formula \( t_n = t_1r^{n-1} \) for the general term of a geometric sequence and recognise its exponential nature
- understand the limiting behaviour as \( n \to \infty \) of the terms \( t_n \) in a geometric sequence and its dependence on the value of the common
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<td><strong>Semester 2 (Unit 2 – plus review of Unit 1)</strong></td>
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</table>
| **Week 22–24** (9 hours) | Topic 3: Introduction to differential calculus | **Rates of change and the concept of the derivative** (2.3.1 – 2.3.9)  
- interpret the difference quotient \( \frac{f(x+h)-f(x)}{h} \) as the average rate of change of a function \( f \)  
- use the Leibniz notation \( \delta x \) and \( \delta y \) for changes or increments in the variables \( x \) and \( y \)  
- use the notation \( \frac{\delta y}{\delta x} \) for the difference quotient \( \frac{f(x+h)-f(x)}{h} \) where \( y = f(x) \)  
- interpret the ratio \( \frac{f(x+h)-f(x)}{h} \) as the slope or gradient of a chord or secant of the graph of \( y = f(x) \)  
- examine the behaviour of the difference quotient \( \frac{f(x+h)-f(x)}{h} \) as \( h \to 0 \) as an informal introduction to the concept of a limit  
- define the derivative \( f'(x) \) as \( \lim_{h \to 0} \frac{f(x+h)-f(x)}{h} \)  
- use the Leibniz notation for the derivative: \( \frac{dy}{dx} = \lim_{\delta x \to 0} \frac{\delta y}{\delta x} \) and the correspondence \( \frac{dy}{dx} = f'(x) \) where \( y = f(x) \)  
- interpret the derivative as the instantaneous rate of change  
- interpret the derivative as the slope or gradient of a tangent line of the graph of \( y = f(x) \) |
| **Week 24–26** (9 hours) | Topic 3: Introduction to differential calculus | **Computation and properties of derivatives** (2.3.10 – 2.3.15)  
- estimate numerically the value of a derivative for simple power functions  
- examine examples of variable rates of change of non-linear functions  
- establish the formula \( \frac{d}{dx} (x^n) = nx^{n-1} \) for non-negative integers \( n \) expanding \( (x+h)^n \) or by factorising \( (x+h)^n - x^n \)  
- understand the concept of the derivative as a function  
- identify and use linearity properties of the derivative  
- calculate derivatives of polynomials |
| **Week 26–29** (12 hours) | Topic 3: Introduction to differential calculus | **Applications of derivatives and anti-derivatives** (2.3.16 – 2.3.22)  
- determine instantaneous rates of change  
- determine the slope of a tangent and the equation of the tangent  
- construct and interpret position-time graphs with velocity as the slope of the tangent  
- recognise velocity as the first derivative of displacement with respect to time  
- sketch curves associated with simple polynomials, determine stationary points, and local and global maxima and minima, and examine behaviour as \( x \to \infty \) and \( x \to -\infty \) |
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| **Semester 2 (Unit 2 – plus review of Unit 1)** | | • solve optimisation problems arising in a variety of contexts involving polynomials on finite interval domains  
• calculate anti-derivatives of polynomial functions |
| **Week 29–30** | | Revision and end of course assessment |

<table>
<thead>
<tr>
<th>Hours allocated</th>
<th>Functions and graphs</th>
<th>Trigonometric functions</th>
<th>Counting and probability</th>
<th>Exponential functions</th>
<th>Arithmetic and geometric series</th>
<th>Introduction to differential calculus</th>
<th>Total</th>
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<tbody>
<tr>
<td>In this program</td>
<td>22</td>
<td>15</td>
<td>18</td>
<td>10</td>
<td>15</td>
<td>30</td>
<td>110</td>
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<td>Suggested in the syllabus</td>
<td>22</td>
<td>15</td>
<td>18</td>
<td>10</td>
<td>15</td>
<td>30</td>
<td>110</td>
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