Tables showing which M1 Maths modules relate to each Australian Years 11-12 Mathematical Methods topic

Unit 1	Topic 1	Topic 2	Topic 3	**Unit 2**	Topic 1	Topic 2	Topic 3
Unit 3	Topic 1	Topic 2	Topic 3	**Unit 4**	Topic 1	Topic 2	Topic 3

The syllabus element is in the left column and the relevant module is in the right column.

Unit 1 Topic 1 – Functions and Graphs	
Lines and Linear Relationships	
determine the coordinates of the midpoint of two points	A3-8 Linear Functions
examine examples of direct proportion and linearly related variables	N3-3 Proportion A3-8 Linear Functions
recognise features of the graph of $y=mx+c$, including its linear nature, its intercepts and its slope or gradient	A3-8 Linear Functions
find the equation of a straight line given sufficient information; parallel and perpendicular lines	
solve linear equations.	A1-6 to A3-3
Review of Quadratic Relationships	
examine examples of quadratically related variables	A4-2 Quadratic Functions
recognise 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 using the quadratic formula and by completing the square	
find the equation of a quadratic given sufficient information	A5-6 Finding Formulae for Functions
find turning points and zeros of quadratics and understand the role of the discriminant	A4-2 Quadratic Functions
recognise features of the graph of the general quadratic $y=ax^2+bx+c$	
Inverse Proportion	
examine examples of inverse proportion	N3-3 Proportion
recognise features of the graphs of $y = 1/x$ and $y=a/(x-b)$, including their hyperbolic shapes, and their asymptotes	A3-9 Reciprocal Functions
Powers and Polynomials	
recognise features of the graphs of $y=x^n$ for $n \in N$, $n=-1$ and $n=½$ including shape, and behaviour as $x\to\infty$ and $x\to-\infty$	A5-3 Power Functions

identify the coefficients and the degree of a polynomial	A5-1 Polynomial Functions
expand quadratic and cubic polynomials from factors	A4-1 Factorising
recognise features of the graphs of $y=x^3$, $y=a(x-b)^3+c$ and $y=k(x-a)(x-b)(x-c)$, including shape, intercepts and behaviour as $x \to \infty$ and $x \to -\infty$	A5-3 Power Functions C6-14 Graph Sketching
factorise cubic polynomials in cases where a linear factor is easily obtained	A5-1 Polynomial Functions
solve cubic equations using technology, and algebraically in cases where a linear factor is easily obtained.	A5-1 Polynomial Functions A3-5 Solving by Graphing A5-8 Calculator Equation Solving
Graphs of Relations	
recognise features of the graphs of $x^2+y^2=r^2$ and $(x-a)^2+(y-b)^2=r^2$, including their circular shapes, their centres and their radii	A5-10 Further Relations
recognise features of the graph of $y^2=x$ including its parabolic shape and its axis of symmetry.	
Functions	
understand the concept of a function as a mapping between sets, and as a rule or a formula that defines one variable quantity in terms of another	A3-7 Functions
use function notation, domain and range, independent and dependent variables	A1-2 Relations 2 A3-6 Domain and Range A3-7 Functions
understand the concept of the graph of a function	A1-1 Relations 1 A3-7 Functions
examine translations and the graphs of $y=f(x)+a$ and $y=f(x+b)$	A5-9 Algebraic Transformations
examine dilations and the graphs of $y=cf(x)$ and $y=f(kx)$	
recognise the distinction between functions and relations, and the vertical line test.	A3-7 Functions

Unit 1 Topic 2 – Trigonometric Functions	
Cosine and Sine Rules	
review sine, cosine and tangent as ratios of side lengths in right-angled triangles	M3-2 Trigonometry
understand the unit circle definition of $\cos\vartheta$, $\sin\vartheta$ and $\tan\vartheta$ and periodicity using degrees	M5-1 Unit Circle
examine the relationship between the angle of inclination of a line and the gradient of that line	M3-3 Slope
establish and use the sine and cosine rules and the formula $Area = \frac{1}{2}bc\sin A$ for the area of a triangle.	M5-2 Solving Triangles

Circular Measure and Radian Measure	
define and use radian measure and understand its relationship with degree measure	M6-1 Radians
calculate lengths of arcs and areas of sectors in circles.	M2-3 Length, Area and Volume 2
Trigonometric Functions	
unit circle definition of cos ϑ, sin ϑ and tan ϑ and periodicity using radians	M5-1 Unit Circle
recognise the exact values of cos ϑ, sin ϑ and tan ϑ at integer multiples of $\pi/6$ and $\pi/4$	M6-2 Exact Trig Values
recognise the graphs of $y=\sin x$, $y=\cos x$ and $y=\tan x$ on extended domains	A5-11 Trigonometric Functions
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 $y=\tan(x + c)$ and the relationships $\sin (x + \pi/2) = \cos x$ and $\cos (x - \pi/2) = \sin x$	
prove and apply the angle sum and difference identities	
identify contexts suitable for modelling by trigonometric functions and use them to solve practical problems	A5-11 Trigonometric Functions
solve equations involving trigonometric functions using technology, and algebraically in simple cases.	A5-12 Trigonometric Equations

Unit 1 Topic 3 – Counting and Probability

Combinations	
understand the notion of a combination as an unordered set of r objects taken from a set of n distinct objects	A6-1 Combinations and the Binomial Expansion
use the notation $\binom{n}{r}$ and the formula $\binom{n}{r} = n!/r!(n-r)!$ 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.	
Language of Events and Sets	
review the concepts and language of outcomes, sample spaces and events as sets of outcomes	P1-1 Probability P2-1 Compound Events

use set language and notation for events, including $\bar{A}$ or A' for the complement of an event, A, A∩B for the intersection of events A and B, and A∪B for the union, and recognise mutually exclusive events	P6-1 Sets
use everyday occurrences to illustrate set descriptions and representations of events, and set operations.	P6-1 Sets
Review of the Fundamentals of Probability	
review probability as a measure of 'the likelihood of occurrence' of an event	P1-1 Probability
recall the probability scale: $0 \le P(A) \le 1$ for each event A, with $P(A)=0$ if A is an impossibility and $P(A)=1$ if A is a certainty	
review the rules $P(\bar{A})=1-P(A)$ and $P(A \cup B)=P(A)+P(B)-P(A \cap B)$	P2-1 Compound Events
use relative frequencies obtained from data as point estimates of probabilities.	P1-1 Probability
Conditional Probability and Independence	
understand the notion of a conditional probability and recognise and use language that indicates conditionality	P6-2 Conditional Probability
use the notation $P(A\|B)$ and the formula $P(A\|B) = P(A \cap B)/P(B)$	
understand the notion of independence of an event AA from an event BB, as defined by $P(A\|B) = P(A)$	P2-1 Compound Events P6-2 Conditional Probability
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	P2-1 Compound Events P6-2 Conditional Probability
use relative frequencies obtained from data as point estimates of conditional probabilities and as indications of possible independence of events.	

Unit 2 Topic 1 – Exponential Functions

Indices and the Index Laws	
review indices (including fractional indices) and the index laws	A3-10 Index Laws 1-5 A5-2 Index Laws 6-10
use radicals and convert to and from fractional indices	A5-2 Index Laws 6-10
understand and use scientific notation and significant figures.	N3-1 Scientific Notation N1-10 Rounding and Approximation
Exponential Functions	
establish and use the algebraic properties of exponential functions	A5-4 Exponential Functions and Logs
recognise the qualitative features of the graph of $y = a^x$ $(a>0)$ including asymptotes, and of its translations $y = a^x + b$ and $y = a^{x+c}$	A5-4 Exponential Functions and Logs A5-9 Algebraic Transformations

identify contexts suitable for modelling by exponential functions and use them to solve practical problems	A5-4 Exponential Functions and Logs
solve equations involving exponential functions using technology, and algebraically in simple cases.	

Unit 2 Topic 2 – Arithmetic and Geometric Sequences and Series

Arithmetic Sequences	
recognise and use the recursive definition of an arithmetic sequence: $t_{n+1} = t_n + d$	A6-2 Arithmetic Sequences
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.	
Geometric Sequences	
recognise and use the recursive definition of a geometric sequence: $t_{n+1} = rt_n$	A6-3 Geometric Sequences
use the formula $t_n = r^{n-1}t_1$ 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 ratio r	
establish and use the formula $S_n = t_1 r^{n-1}/(r-1)$ for the sum of the first n terms of a geometric sequence	
use geometric sequences in contexts involving geometric growth or decay, such as compound interest.	

Unit 2 Topic 3 – Introduction to Differential Calculus

Rates of Change	
interpret the difference quotient $\frac{f(x+h)-f(x)}{h}$ as the average rate of change of a function f	C6-2 Velocity Algebraically
use the Leibniz notation δx and δy for changes or increments in the variables x and y	
use the notation $\delta y/\delta x$ for the difference quotient $\frac{f(x+h)-f(x)}{h}$ where $y = f(x)$	
interpret the ratios $\frac{f(x+h)-f(x)}{h}$ and $\delta y/\delta x$ as the slope or gradient of a chord or secant of the graph of $y = f(x)$	

The Concept of the Derivative	
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	C6-2 Velocity Algebraically
define the derivative $f'(x)$ as $\lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$	
use the Leibniz notation for the derivative: $dy/dx = \lim_{\delta x \to 0} \delta y/\delta x$ and the correspondence $dy/dx=f'(x)$ 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 $y=f(x)$	
Computation of Derivatives	
estimate numerically the value of a derivative, for simple power functions	C6-1 Velocity Graphically C6-2 Velocity Algebraically
examine examples of variable rates of change of non-linear functions	C6-1 Velocity Graphically
establish the formula $d/dx(x^n)=nx^{n-1}$ for positive integers n by expanding $(x+h)^n$ or by factorising $(x+h)^n-x^n$	C6-2 Velocity Algebraically
Properties of Derivatives	
understand the concept of the derivative as a function	C6-2 Velocity Algebraically
recognise and use linearity properties of the derivative	C6-3 Velocity by Rule
calculate derivatives of polynomials and other linear combinations of power functions.	
Applications of Derivatives	
find instantaneous rates of change	C6-1 Velocity Graphically C6-2 Velocity Algebraically C6-3 Velocity by Rule
find the slope of a tangent and the equation of the tangent	C6-5 Applications of Derivatives
construct and interpret position-time graphs, with velocity as the slope of the tangent	C6-1 Velocity Graphically
sketch curves associated with simple polynomials; find stationary points, and local and global maxima and minima; and examine behaviour as $x\to\infty$ and $x\to-\infty$	C6-13 Graph Sketching
solve optimisation problems arising in a variety of contexts involving simple polynomials on finite interval domains.	C6-5 Applications of Derivatives C6-14 Optimisation
Anti-derivatives	
calculate anti-derivatives of polynomial functions and apply to solving simple problems involving motion in a straight line.	C6-9 Differential Equations

Unit 3 Topic 1 – Further Differentiation and Applications

Exponential Functions	
estimate the limit of $(a^h-1)/h$ as $h \to 0$ using technology, for various values of $a > 0$	C6-7 Other Derivatives
recognise that e is the unique number a for which the above limit is 1	A5-4 Exponential Functions and Logs
establish and use the formula $d/dx(e^x) = e^x$	C6-7 Other Derivatives
use exponential functions and their derivatives to solve practical problems.	
Trigonometric Functions	
establish the formulas $d/dx(\sin x) = \cos x$, and $d/dx(\cos x) = -\sin x$ by numerical estimations of the limits and informal proofs based on geometric constructions	C6-7 Other Derivatives
use trigonometric functions and their derivatives to solve practical problems.	
Differentiation Rules	
understand and use the product and quotient rules	C6-6 Chain, Product and Quotient Rules
understand the notion of composition of functions and use the chain rule for determining the derivatives of composite functions	A5-10 Further Relations C6-8 Mastering Differentiation
apply the product, quotient and chain rule to differentiate functions such as xe^x, $\tan x$, $1/x^n$, $x\sin x$, $e^{-x}\sin x$ and $f(ax + b)$	C6-8 Mastering Differentiation
The Second Derivative and Applications of Differentiation	
use the increments formula: $\delta y \cong dy/dx \times \delta x$ to estimate the change in the dependent variable y resulting from changes in the independent variable x	
understand the concept of the second derivative as the rate of change of the first derivative function	C6-12 Higher-order Derivatives
recognise acceleration as the second derivative of position with respect to time	
understand the concepts of concavity and points of inflection and their relationship with the second derivative	
understand and use the second derivative test for finding local maxima and minima	
sketch the graph of a function using first and second derivatives to locate stationary points and points of inflection	C6-13 Graph Sketching
solve optimisation problems from a wide variety of fields using first and second derivatives.	C6-14 Optimisation

Unit 3 Topic 2 – Integrals	
Anti-differentiation	
recognise anti-differentiation as the reverse of differentiation	C6-9 Differential Equations
use the notation $\int f(x)dx$ for anti-derivatives or indefinite integrals	C6-10 Integration
establish and use the formula $\int x^n dx = (^1/_{n+1})x^{n+1} + c$ for $n \neq -1$	C6-9 Differential Equations
establish and use the formula $\int e^x dx = e^x + c$	
establish and use the formulas $\int \sin(x)dx = -\cos(x)+c$ and $\int \cos(x)dx = \sin(x)+c$	
recognise and use linearity of anti-differentiation	
determine indefinite integrals of the form $\int f(ax+b)dx$	
identify families of curves with the same derivative function	
determine $f(x)$, given $f'(x)$ and an initial condition $f(a) = b$	
determine displacement given velocity in linear motion problems	
Definite Integrals	
examine the area problem, and use sums of the form $\Sigma f(x_i)\ \delta x_i$ as area under the curve $y = f(x)$	C6-10 Integration
interpret the definite integral $\int_a^b f(x)dx$ as area under the curve $y = f(x)$ if $f(x)>0$	
recognise the definite integral $\int_a^b f(x)dx$ as a limit of sums of the form $\Sigma_i f(x_i)\ \delta x_i$	
interpret $\int_a^b f(x)dx$ as a sum of signed areas	
recognise and use the additivity and linearity of definite integrals	C6-9 Differential Equations
Fundamental Theorem	
understand the concept of the signed area function $F(x) = \int_a^x f(t)dt$	C6-10 Integration
understand and use the theorem $F'(x) = d/dx(\int_a^x f(t)dt) = f(x)$, and illustrate its proof geometrically	
understand the formula $\int_a^b f(x)dx = F(b) - F(a)$ and use it to calculate definite integrals	
Applications of Integration	
calculate the area under a curve	C6-10 Integration
calculate total change by integrating instantaneous or marginal rate of change	
calculate the area between curves in simple cases	

determine position given acceleration and initial values of position and velocity	C6-9 Differential Equations

Unit 3 Topic 3 – Discrete Random Variables	
General Discrete Random Variables	
understand the concepts of a discrete random variable and its associated probability function, and their use in modelling data	P6-4 Discrete Random Variables
use relative frequencies obtained from data to obtain point estimates of probabilities associated with a discrete random variable	P1-1 Probability
recognise uniform discrete random variables and use them to model random phenomena with equally likely outcomes	P6-3 Probability Distributions and Expected Values
examine simple examples of non-uniform discrete random variables	
recognise the mean or expected value of a discrete random variable as a measurement of centre, and evaluate it in simple cases	
recognise the variance and standard deviation of a discrete random variable as a measures of spread, and evaluate them in simple cases	S4-1 Quantiles and Spread
use discrete random variables and associated probabilities to solve practical problems.	P6-3 Probability Distributions and Expected Values
Bernoulli Distributions	
use a Bernoulli random variable as a model for two-outcome situations	P6-4 Discrete Random Variables
identify contexts suitable for modelling by Bernoulli random variables	
recognise the mean p and variance $p(1-p)$ of the Bernoulli distribution with parameter p	
use Bernoulli random variables and associated probabilities to model data and solve practical problems.	

Binomial Distributions	
understand the concepts of Bernoulli trials and the concept of a binomial random variable as the number of 'successes' in n independent Bernoulli trials, with the same probability of success p in each trial	P6-4 Discrete Random Variables
identify contexts suitable for modelling by binomial random variables	
determine and use the probabilities $P(X=r) = \binom{n}{r} p^r (1-p)^{n-r}$ associated with the binomial distribution with parameters n and p ; note the mean np and variance $np(1-p)$ of a binomial distribution	
use binomial distributions and associated probabilities to solve practical problems.	

Unit 4 Topic 1 – Logarithmic Functions

Logarithmic Functions	
define logarithms as indices: $a^x = b$ is equivalent to $x = \log_a b$ i.e. $a^{\log_a b} = b$	A5-4 Exponential Functions and Logs
establish and use the algebraic properties of logarithms	
recognise the inverse relationship between logarithms and exponentials: $y = a^x$ is equivalent to $x = \log_a y$	
interpret and use logarithmic scales such as decibels in acoustics, the Richter Scale for earthquake magnitude, octaves in music, pH in chemistry	A5-13 Logs
solve equations involving indices using logarithms	A5-4 Exponential Functions and Logs
recognise the qualitative features of the graph of $y = \log_a x$ $(a>1)$ including asymptotes, and of its translations $y = \log_a x + b$ and $y = \log_a (x + c)$	A5-13 Logs
solve simple equations involving logarithmic functions algebraically and graphically	A5-4 Exponential Functions and Logs
identify contexts suitable for modelling by logarithmic functions and use them to solve practical problems.	A5-13 Logs
Calculus of Logarithmic Functions	
define the natural logarithm $\ln x = \log_e x$	A5-4 Exponential Functions and Logs
recognise and use the inverse relationship of the functions $y = e^x$ and $y = \ln x$	
establish and use the formula $d/dx(\ln x)=1/x$	C6-7 Other Derivatives
establish and use the formula $\int 1/x \, dx = \ln x + c$ for $x>0$	C6-9 Differential Equations
use logarithmic functions and their derivatives to solve practical problems.	A5-13 Logs C6-7 Other Derivatives

Unit 4 Topic 2 – Continuous Random Variables and the Normal Distribution	
General Discrete (?) Random Variables	
use relative frequencies and histograms obtained from data to estimate probabilities associated with a continuous random variable	P6-5 Continuous Random Variables
understand the concepts of a probability density function, cumulative distribution function, and probabilities associated with a continuous random variable given by integrals; examine simple types of continuous random variables and use them in appropriate contexts	
recognise the expected value, variance and standard deviation of a continuous random variable and evaluate them in simple cases	
General Continuous Random Variables	
understand the effects of linear changes of scale and origin on the mean and the standard deviation	P6-5 Continuous Random Variables
Normal Distribution	
identify contexts such as naturally occurring variation that are suitable for modelling by normal random variables	P6-6 Normal Distributions
recognise features of the graph of the probability density function of the normal distribution with mean μ and standard deviation σ and the use of the standard normal distribution	
calculate probabilities and quantiles associated with a given normal distribution using technology, and use these to solve practical problems	

Unit 4 Topic 3 – Confidence Intervals for Proportions	
Random Sampling	
understand the concept of a random sample	S2-1 Data Collection S3-3 Critiquing
discuss sources of bias in samples, and procedures to ensure randomness	
use graphical displays of simulated data to investigate the variability of random samples from various types of distributions, including uniform, normal and Bernoulli	

Sample Proportions	
understand the concept of the sample proportion $\hat{p}$ as a random variable whose value varies between samples, and the formulas for the mean p and standard deviation $\sqrt{p(1-p)/n}$ of the sample proportion $\hat{p}$	P6-6 Confidence intervals for proportions
examine the approximate normality of the distribution of $\hat{p}$ for large samples	
simulate repeated random sampling, for a variety of values of p and a range of sample sizes, to illustrate the distribution of $\hat{p}$ and the approximate standard normality of $\frac{\hat{p}-p}{\sqrt{\hat{p}(1-\hat{p})/n}}$ where the closeness of the approximation depends on both n and p	
Confidence Intervals for Proportions	
the concept of an interval estimate for a parameter associated with a random variable	P6-6 Confidence intervals for proportions
use the approximate confidence interval $\left(\hat{p}-z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}, \hat{p}+z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}\right)$ as an interval estimate for p, where z is the appropriate quantile for the standard normal distribution	
define the approximate margin of error $E = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ and understand the trade-off between margin of error and level of confidence	
use simulation to illustrate variations in confidence intervals between samples and to show that most but not all confidence intervals contain p	