M1Maths

M1Maths.com – Explanations and Practice for all school maths topics

# Western Australia
# Years 11-12 Mathematics Applications
## Table showing which M1Maths modules relate to each curriculum element

Correlation Completed by Jessica Hooper

## Contents



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

| Unit 1 Topic 1 – Consumer Arithmetic | |
|---|---|
| **Applications of rates, percentages and use of spreadsheets** | |
| review definitions of rates and percentages | N1-2 Fraction Meanings<br>N2-3 Rates |

| | |
|---|---|
| calculate weekly or monthly wages from an annual salary, and wages from an hourly rate, including situations involving overtime and other allowances and earnings based on commission or piecework | |
| calculate payments based on government allowances and pensions | |
| prepare a personal budget for a given income, taking into account fixed and discretionary spending | |
| compare prices and values using the unit cost method | |
| apply percentage increase or decrease in various contexts, e.g. determining the impact of inflation on costs and wages over time, calculating percentage mark-ups and discounts, calculating GST, calculating profit or loss in absolute and percentage terms, and calculating simple and compound interest | N2-2 Fractions of Numbers |
| use currency exchange rates to determine the cost in Australian dollars of purchasing a given amount of a foreign currency, or the value of a given amount of foreign currency, when converted to Australian dollars | |
| calculate the dividend paid on a portfolio of shares given the percentage dividend or dividend paid for each share, and compare share values by calculating a price-to-earnings ratio | |
| use a spreadsheet to display examples of the above computations when multiple or repeated computations are required; for example, preparing a wage-sheet displaying the weekly earnings of workers in a fast food store where hours of employment and hourly rates of pay may differ, preparing a budget, or investigating the potential cost of owning and operating a car over a year | S3-1 Spreadsheets |

| **Unit 1 Topic 2 – Algebra and Matrices** | |
|---|---|
| **Linear and non-linear relationships** | |
| substitute numerical values into algebraic expressions, and evaluate (with the aid of technology where complicated numerical manipulation is required) | A1-5 Substitution |
| determine the value of the subject of a formula, given the values of the other pronumerals in the formula (transposition not required) | |
| ~~transpose linear equations and simple non-linear algebraic equations, e.g. order two polynomials, proportional, inversely proportional~~ | ~~A3-4 Rearranging Formulae~~ |

| | |
|---|---|
| use a spreadsheet or an equivalent technology to construct a table of values from a formula, including tables for formulas with two variable quantities; for example, a table displaying the body mass index (BMI) of people of different weights and heights | S3-1 Spreadsheets |
| **Matrices and matrix arithmetic** | |
| use matrices for storing and displaying information that can be presented in rows and columns; for example, databases, links in social or road networks | |
| recognise different types of matrices (row, column, square, zero, identity) and determine their size | |
| perform matrix addition, subtraction, multiplication by a scalar, and matrix multiplication, including determining the power of a matrix using technology with matrix arithmetic capabilities when appropriate | |
| use matrices, including matrix products and powers of matrices, to model and solve problems; for example, costing or pricing problems, squaring a matrix to determine the number of ways pairs of people in a communication network can communicate with each other via a third person | |

| **Unit 1 Topic 3 – Shape and Measurement** | |
|---|---|
| **Pythagoras' Theorem** | |
| use Pythagoras' theorem to solve practical problems in two dimensions and for simple applications in three dimensions | M3-1 Pythagoras |
| **Mensuration** | |
| solve practical problems requiring the calculation of perimeters and areas of circles, sectors of circles, triangles, rectangles, parallelograms and composites | M1-4 Length, Area and Volume 1<br>M2-3 Length, Area and Volume 2<br>M3-4 Length, Area and Volume 3<br>M4-1 Length, Area and Volume 4 |
| calculate the volumes of standard three-dimensional objects, such as spheres, rectangular prisms, cylinders, cones, pyramids and composites in practical situations, for example, the volume of water contained in a swimming pool | |
| calculate the surface areas of standard three-dimensional objects, such as spheres, rectangular prisms, cylinders, cones, pyramids and composites in practical situations; for example, the surface area of a cylindrical food container | |
| **Similar figures and scale factors** | |
| review the conditions for similarity of two-dimensional figures, including similar triangles | G2-6 Congruence<br>G3-1 Similarity |

| | |
|---|---|
| use the scale factor for two similar figures to solve linear scaling problems | |
| obtain measurements from scale drawings, such as maps or building plans, to solve problems | G2-1 Maps and Scales<br>G3-1 Similarity |
| obtain a scale factor and use it to solve scaling problems involving the calculation of surface areas and volumes of similar solids | |

| Unit 2 Topic 1 – Univariate Data Analysis | |
|---|---|
| **The statistical investigation process** | |
| review the statistical investigation process; identifying a problem and posing a statistical question, collecting or obtaining data, analysing the data, interpreting and communicating the results | |
| **Making sense of data relating to a single statistical variable** | |
| classify a categorical variable as ordinal, such as income level (high, medium, low) or nominal, such as place of birth (Australia, overseas) and use tables and bar charts to organise and display data | S3-4 Data Types |
| classify a numerical variable as discrete, such as the number of rooms in a house, or continuous, such as the temperature in degrees Celsius | |
| with the aid of an appropriate graphical display (chosen from dot plot, stem plot, bar chart or histogram), describe the distribution of a numerical data set in terms of modality (uni or multimodal), shape (symmetric versus positively or negatively skewed), location and spread and outliers, and interpret this information in the context of the data | |
| with the aid of an appropriate graphical display (chosen from dot plot, stem plot, bar chart or histogram), describe the distribution of a numerical data set in terms of modality (uni or multimodal), shape (symmetric versus positively or negatively skewed), location and spread and outliers, and interpret this information in the context of the data | S1-1 Data Displays 1<br>S3-2 Data Displays 2<br>S6-1 Data Distributions |
| determine the mean and standard deviation of a data set using technology and use these statistics as measures of location and spread of a data distribution, being aware of their limitations | S1-2 Data Summary |
| use the number of deviations from the mean (standard scores) to describe deviations from the mean in normally distributed data sets | S4-1 Quantiles and Spread |
| calculate quantiles for normally distributed data with known mean and standard deviation in practical situations | S4-1 Quantiles and Spread |

| | |
|---|---|
| use the 68%, 95%, 99.7% rule for data one, two and three standard deviations from the mean in practical situations | |
| calculate probabilities for normal distributions with known mean (mew) and standard deviation (sigma) in practical situations | |
| **Comparing data for a numerical variable across two or more groups** | |
| construct and use parallel box plots (including the use of the 'Q1 – 1.5 x IQR' and 'Q3 + 1.5 x IQR' criteria for identifying possible outliers) to compare groups in terms of location (median), spread (IQR and range) and outliers, and interpret and communicate the differences observed in the context of the data | S4-1 Quantiles and Spread |
| compare datasets using medians, means, IQRs, ranges or standard deviations for a single numerical variable, interpret the differences observed in the context of the data and report the findings in a systematic and concise manner | |
| implement the statistical investigation process to answer questions that involve comparing the data for a numerical variable across two or more groups; for example, are Year 11 students the fittest in the school? | |

## Unit 2 Topic 2 – Applications of Trigonometry

| | |
|---|---|
| **Applications of Trigonometry** | |
| use trigonometric ratios to determine the length of an unknown side, or the size of an unknown angle in a right-angled triangle | M3-2 Trigonometry<br>M5-4 Solving Triangles |
| determine the area of a triangle, given two sides and an included angle by using the rule *area = ½ bc sinA*, or given three sides by using Heron's rule, and solve related practical problems | |
| solve problems involving non-right-angled triangles using the sine rule (acute triangles only when determining the size of an angle) and the cosine rule | |
| solve practical problems involving right-angled and non-right-angled triangles, including problems involving angles of elevation and depression and the use of bearings in navigation | |

## Unit 2 Topic 3 – Linear Equations and their Graphs

| | |
|---|---|
| **Linear Equations** | |
| identify and solve linear equations (with the aid of technology where complicated manipulations are required) | A1-5 to A3-3 |

| | |
|---|---|
| develop a linear formula from a word description and solve the resulting equation | A2-1 Writing Equations |
| **Straight-line graphs and their applications** | |
| construct straight-line graphs both with and without the aid of technology | A3-8 Linear Functions |
| determine the slope and intercepts of a straight-line graph from both its equation and its plot | |
| determine the slope and intercepts of a straight-line graph from both its equation and its plot | |
| interpret, in context, the slope and intercept of a straight-line graph used to model and analyse a practical situation | |
| **Simultaneous linear equations and their applications** | |
| solve a pair of simultaneous linear equations graphically or algebraically, using technology when appropriate | A4-3 Simultaneous Equations - Linear |
| solve practical problems that involve determining the point of intersection of two straight-line graphs; for example, determining the break-even point where cost and revenue are represented by linear equations | |
| **Piece-wise linear graphs and step graphs** | |
| sketch piece-wise linear graphs and step graphs, using technology when appropriate | |
| interpret piece-wise linear and step graphs used to model practical situations; for example, the tax paid as income increases, the change in the level of water in a tank over time when water is drawn off at different intervals and for different periods of time, the charging scheme for sending parcels of different weights through the post | |

| | |
|---|---|
| **Unit 3 Topic 1 – Bivariate Data Analysis** | |
| **The statistical investigation process** | |
| review the statistical investigation process: identify a problem; pose a statistical question; collect or obtain data; analyse data; interpret and communicate results | |
| **Identifying and describing associations between two categorical variables** | |
| construct two-way frequency tables and determine the associated row and column sums and percentages | S4-3 Data Types |

| | |
|---|---|
| use an appropriately percentaged two-way frequency table to identify patterns that suggest the presence of an association | |
| describe an association in terms of differences observed in percentages across categories in a systematic and concise manner, and interpret this in the context of the data | |
| **Identifying and describing associations between two numerical variables** | |
| construct a scatterplot to identify patterns in the data suggesting the presence of an association | S4-1 Linear Regression |
| describe an association between two numerical variables in terms of direction (positive/negative), form (linear/non-linear) and strength (strong/moderate/weak)nderstand an association between two numerical variables in terms of direction (positive/negative), form (linear) and strength (strong/moderate/weak) | |
| calculate, using technology, and interpret the correlation coefficient (r) to quantify the strength of a linear association | |
| **Fitting a linear model to numerical data** | |
| identify the response variable and the explanatory variable for primary and secondary data | S4-1 Linear Regression |
| use a scatterplot to identify the nature of the relationship between variables | |
| model a linear relationship by fitting a least-squares line to the data | |
| use a residual plot to assess the appropriateness of fitting a linear model to the data | |
| interpret the intercept and slope of the fitted line | S4-1 Linear Regression |
| use the coefficient of determination to assess the strength of a linear association in terms of the explained variation | |
| use the equation of a fitted line to make predictions | |
| distinguish between interpolation and extrapolation when using the fitted line to make predictions, recognising the potential dangers of extrapolation | |
| write up the results of the above analysis in a systematic and concise manner | |
| **Association and causation** | |
| recognise that an observed association between two variables does not necessarily mean that there is a causal relationship between them | S4-1 Linear Regression |
| recognise possible non-causal explanations for an association, including coincidence and confounding due to a common response to another variable, and communicate these explanations in a systematic and concise manner | |

## Unit 3 Topic 2 – Growth and Decay in Sequences

| | |
|---|---|
| **The arithmetic sequence** | |
| use recursion to generate an arithmetic sequence | A6-2 Arithmetic Sequences |
| display the terms of an arithmetic sequence in both tabular and graphical form and demonstrate that arithmetic sequences can be used to model linear growth and decay in discrete situations | |
| Deduce a rule for the $n^{th}$ term of a particular arithmetic sequence from the pattern of the terms in an arithmetic sequence, and use this rule to make predictions | |
| use arithmetic sequences to model and analyse practical situations involving linear growth or decay | |
| **The geometric sequence** | |
| use recursion to generate a geometric sequence | A6-3 Geometric Sequences |
| display the terms of a geometric sequence in both tabular and graphical form and demonstrate that geometric sequences can be used to model exponential growth and decay in discrete situations | |
| deduce a rule for the $n^{th}$ term of a particular geometric sequence from the pattern of the terms in the sequence, and use this rule to make predictions | |
| use geometric sequences to model and analyse (numerically or graphically only) practical problems involving geometric growth and decay | |
| **Sequences generated by first-order linear recurrence relations** | |
| use a general first-order linear recurrence relation to generate the terms of a sequence and to display it in both tabular and graphical form | |
| generate a sequence defined by a first-order linear recurrence relation that gives long term increasing, decreasing or steady-state solutions | |
| use first-order linear recurrence relations to model and analyse (numerically or graphically only) practical problems | |

## Unit 3 Topic 3 – Graphs and Networks

| | |
|---|---|
| **The definition of a graph and associated terminology** | |
| demonstrate the meanings of, and use, the terms: graph, edge, vertex, loop, degree of a vertex, subgraph, simple graph, complete graph, bipartite graph, directed graph (digraph), arc, weighted graph, and network | |

| | |
|---|---|
| identify practical situations that can be represented by a network, and construct such networks | |
| construct an adjacency matrix from a given graph or digraph and use the matrix to form multi stage matrices to solve associated problems | |
| **Planar graphs** | |
| demonstrate the meanings of, and use, the terms: planar graph and face | |
| apply Euler's formula, $v + f - e = 2$ to solve problems relating to planar graphs | |
| **Paths and cycles** | |
| demonstrate the meanings of, and use, the terms: walk, trail, path, closed walk, closed trail, cycle, connected graph, and bridge | |
| investigate and solve practical problems to determine the shortest path between two vertices in a weighted graph (by trial-and-error methods only) | |
| demonstrate the meanings of, and use, the terms: Eulerian graph, Eulerian trail, semi-Eulerian graph, semi-Eulerian trail and the conditions for their existence, and use these concepts to investigate and solve practical problems | |
| demonstrate the meanings of, and use, the terms: Hamiltonian graph and semi-Hamiltonian graph, and use these concepts to investigate and solve practical problems | |

| | |
|---|---|
| **Unit 4 Topic 1 – Time Series Analysis** | |
| **Describing and interpreting patterns in time series data** | |
| construct time series plots | S3-4 Data Types |
| describe time series plots by identifying features such as trend (long term direction), seasonality (systematic, calendar-related movements), and irregular fluctuations (unsystematic, short term fluctuations), and recognise when there are outliers | |
| **Analysing time series data** | |
| smooth time series data by using a simple moving average, including the use of spreadsheets to implement this process | |
| calculate seasonal indices by using the average percentage method | |
| deseasonalise a time series by using a seasonal index, including the use of spreadsheets to implement this process | |
| fit a least-squares line to model long-term trends in time series data | |

| | |
|---|---|
| predict from regression lines, making seasonal adjustments for periodic data | |
| **The data investigation process** | |
| implement the statistical investigation process to answer questions that involve the analysis of time series data | |

| **Unit 4 Topic 2 – Loans, Investments and Annuities** | |
|---|---|
| **Compound interest loans and investments** | |
| use a recurrence relation to model a compound interest loan or investment and investigate (numerically or graphically) the effect of the interest rate and the number of compounding periods on the future value of the loan or investment | N4-1 Compound Interest<br>S3-1 Spreadsheets |
| calculate the effective annual rate of interest and use the results to compare investment returns and cost of loans when interest is paid or charged daily, monthly, quarterly or six-monthly | N4-1 Compound Interest |
| with the aid of a calculator or computer-based financial software, solve problems involving compound interest loans, investments and depreciating assets | |
| **Reducing balance loans (compound interest loans with periodic repayments)** | |
| use a recurrence relation to model a reducing balance loan and investigate (numerically or graphically) the effect of the interest rate and repayment amount on the time taken to repay the loan | S3-1 Spreadsheets |
| with the aid of a financial calculator or computer-based financial software, solve problems involving reducing balance loans | |
| **Annuities and perpetuities (compound interest investments with periodic payments made from the investment)** | |
| use a recurrence relation to model an annuity, and investigate (numerically or graphically) the effect of the amount invested, the interest rate, and the payment amount on the duration of the annuity | S3-1 Spreadsheets |
| with the aid of a financial calculator or computer-based financial software, solve problems involving annuities (including perpetuities as a special case) | |

| Unit 4 Topic 3 – Networks and Decision Mathematics | |
|---|---|
| **Trees and minimum connector problems** | |
| identify practical examples that can be represented by trees and spanning trees | |
| identify a minimum spanning tree in a weighted connected graph, either by inspection or by using Prim’s algorithm | |
| use minimal spanning trees to solve minimal connector problems | |
| **Project planning and scheduling using critical path analysis (CPA)** | |
| construct a network diagram to represent the durations and interdependencies of activities that must be completed during the project | |
| use forward and backward scanning to determine the earliest starting time (EST) and latest starting times (LST) for each activity in the project | |
| use ESTs and LSTs to locate the critical path(s) for the project | |
| use the critical path to determine the minimum time for a project to be completed | |
| calculate float times for non-critical activities | |
| **Flow networks** | |
| solve small-scale network flow problems, including the use of the ‘maximum flow-minimum cut’ theorem | |
| **Assignment problems** | |
| use a bipartite graph and its tabular or matrix form to represent an assignment/allocation problem | |
| determine the optimum assignment(s), by inspection for small-scale problems, or by use of the Hungarian algorithm for larger problems | |