

# General Mathematics

LEVEL 3	15 TCE CREDIT POINTS
COURSE CODE	MTG315115
COURSE SPAN	2015 — 2019
READING AND WRITING STANDARD	NO
MATHEMATICS STANDARD	YES
COMPUTERS AND INTERNET STANDARD	NO

This course was delivered in 2018. Use [A-Z Courses](#) to find the current version (if available).

**General Mathematics aims to develop learners' understanding of concepts and techniques drawn from number and algebra, trigonometry and world geometry, sequences, finance, networks and decision mathematics and statistics, in order to solve applied problems**

Skills in applying reasoning and interpretive skills in mathematical and statistical contexts and the capacity to communicate in a concise and systematic manner using appropriate mathematical and statistical language will be developed. Learners will develop the capacity to choose and use technology appropriately and efficiently.

## Rationale

Mathematics is the study of order, relation and pattern. From its origins in counting and measuring, it has evolved in highly sophisticated and elegant ways to become the language used to describe much of the physical world. Mathematics also involves the study of ways of collecting and extracting information from data and of methods of using that information to describe and make predictions about the behaviour of aspects of the real world, in the face of uncertainty. Mathematics provides a framework for thinking and a means of communication that is powerful, logical, concise and precise. It impacts upon the daily life of people everywhere and helps them to understand the world in which they live and work.

Studying General Mathematics provides the learner with a breadth of mathematical experience that enables the recognition and application of mathematics to real-world situations. General Mathematics is also designed for those learners who want to extend their mathematical skills in order to pursue further study at the tertiary level in mathematics and related fields.

## Aims

General Mathematics aims to develop learners' understanding of concepts and techniques drawn from number and algebra, trigonometry and world geometry, sequences, finance, networks and decision mathematics and statistics, in order to solve applied problems. Skills in applying reasoning and interpretive skills in mathematical and statistical contexts and the capacity to communicate in a concise and systematic manner using appropriate mathematical and statistical language will be developed. Learners will develop the capacity to choose and use technology appropriately and efficiently.



## Learning Outcomes

On successful completion of this course, learners will be able to:

1. be self-directing; be able to plan their study; be organised to complete tasks and meet deadlines; have cooperative working skills
2. understand the concepts and techniques in bivariate data analysis, growth and decay in sequences, loans, investments and annuities, trigonometry and world geometry, and networks and decision mathematics
3. apply reasoning skills and solve practical problems in bivariate data analysis, growth and decay in sequences, loans, investments and annuities, trigonometry and world geometry, and networks and decision mathematics
4. implement the statistical investigation process, a cyclical process that begins with the need to solve a real world problem and aims to reflect the way statisticians work (ACARA General Mathematics, 2013), in contexts requiring the analysis of bivariate data
5. communicate their arguments and strategies when solving mathematical and statistical problems using appropriate mathematical or statistical language
6. interpret mathematical and statistical information and ascertain the reasonableness, reliability and validity of their solutions to problems and answers to statistical questions
7. choose and use technology appropriately and efficiently

## Recommended Prior Learning

It is recommended that learners undertaking this course will have previously achieved a Grade 10 'B' in *Australian Curriculum: Mathematics* or have successfully completed General Mathematics – Foundation Level 2.

## Pathways

General Mathematics is designed for learners who have a wide range of educational and employment aspirations, including continuing their studies at university or TAFE. While the successful completion of this course will gain entry into some post-secondary courses, other courses may require the successful completion of Mathematics Methods Level 4.

## Resource Requirements

Learners must have access to graphics calculators and become proficient in their use. Graphics calculators can be used in all aspects of this course, both in the development of concepts and as a tool for solving problems. Refer to *'What can I take to my exam?'* for the current TASC Calculator Policy that applies to Level 3 courses.

The use of computers is strongly recommended as an aid to the student's learning and mathematical development. A range of software packages is appropriate and, in particular, spreadsheets should be used.

## Course Size And Complexity

This course has a complexity level of 3.

At Level 3, the learner is expected to acquire a combination of theoretical and/or technical and factual knowledge and skills and use judgement when varying procedures to deal with unusual or unexpected aspects that may arise. Some skills in organising self and others are expected. Level 3 is a standard suitable to prepare learners for further study at tertiary level. VET competencies at this level are often those characteristic of an AQF Certificate III.

This course has a size value of 15.



## Course Content

For the content areas of General Mathematics, the proficiency strands – Understanding; Fluency; Problem Solving; and Reasoning – build on students' learning in F-10 *Australian Curriculum: Mathematics*. Each of these proficiencies is essential, and all are mutually reinforcing. They are still very much applicable and should be inherent in the study of five (5) general mathematics topics:

- Bivariate data analysis
- Growth and decay in sequences
- Finance
- Trigonometry
- Networks and decision mathematics.

Each mathematics topic is **compulsory**, however the order of delivery is not prescribed. These mathematics topics relate directly to Criteria 4 – 8. Criteria 1 – 3 apply to all five topics of mathematics.

This course has a design time of 150 hours. The suggested percentage of design time to be spent on each of the five topics of mathematics is indicated under each heading.

## Investigations

For each topic of study, learners are to undertake a series of investigations applicable to the real world that will reinforce, and extend upon, the content of the General Mathematics course.

### ***Bivariate data analysis***

*(Approximately 20% of course time)*

#### **Algebraic skills**

- use substitution to find the value of an unknown variable in an equation given the value of other variables in cases when the unknown is the subject of the equation and when it is not.

## 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).

## Identifying and describing associations between two categorical variables

- construct two-way frequency tables and determine the associated row and column sums and percentages
- 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
- describe an association between two numerical variables in terms of direction (positive/negative), form (linear/non-linear) and strength (strong, moderate, weak)
- calculate and interpret the correlation coefficient ( $r$ ) to quantify the strength of a linear association.

## Fitting a linear model to numerical data

- review of straight line equations and graphs ( $y = mx + c$ )
- determine the slope between two points in a number plane both algebraically and graphically
- interpret, in context, the slope and intercept of a straight-line graph used to model and analyse a practical situation
- construct and analyse a straight-line graph to model a given linear relationship in a practical context
- identify the independent (explanatory) and the dependent (response) variable
- use a scatterplot to identify the nature of the relationship between the variables
- use technology to 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
- use the coefficient of determination ( $r^2$ ) to assess the degree of association between linear variables 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 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
- identify 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.

## The data investigation process

- implement the statistical investigation process to answer questions that involve identifying, analysing and describing associations between two categorical variables or between two numerical variables; for example, is there an association between smoking in public places (agree with, no opinions, disagree with) and gender (male, female)? Is there an association between height and foot length?

## Time series analysis

- construct time series plots
- 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; for example, one-off unanticipated events
- 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
- implement the statistical investigation process to answer questions that involve the analysis of time series data.

### *Possible investigations*

Investigate:

- the relationship between the length of a candle and the time that it has been burning
- the relationship between belly button height and height (da Vinci's Vesuvian man)
- Bungee jumping Barbee
- knots in a rope suspended from a ceiling
- ABS and census data.

### **Growth and decay in sequences**

(Approximately 20% of course time)

#### **The arithmetic sequence**

- use recursion to generate an arithmetic sequence
- display the terms of an arithmetic sequence in both tabular and graphical form
- demonstrate that arithmetic sequences can be used to model linear growth and decay in discrete situations
- deduce a rule for the  $n^{\text{th}}$  term of a particular arithmetic sequence from the pattern of the terms in an arithmetic sequence and use this rule to make predictions,  $t_n = a + (n - 1)d$
- use arithmetic sequences to model and analyse practical situations involving linear growth or decay
- determine the sum (to  $n$  terms) of an arithmetic sequence  $S_n = \frac{n}{2}(a + l)$  or  $S_n = \frac{n}{2}(2a + (n - 1)d)$

## The geometric sequence



- use recursion to generate a geometric sequence
- display the terms of a geometric sequence in both tabular and graphical form
- demonstrate that geometric sequences can be used to model exponential growth and decay in discrete situations
- deduce a rule for the  $n^{\text{th}}$  term of a particular geometric sequence and use this rule to make predictions,  $t_n = ar^{n-1}$
- use geometric sequences to model and analyse (numerically or graphically only) practical problems involving geometric growth and decay
- determine the sum (to  $n$  terms) of a geometric sequence  $S_n = \frac{a(1 - r^n)}{1 - r}$ , where  $r \neq 1$

## Sequences generated by first-order linear recurrence relations

- use a general first-order linear recurrence relation to generate the terms of a sequence and display it in both tabular and graphical form ( $t_{n+1} = at_n + b$ , where  $t_1$  or  $t_0$  is given)
- recognise that a sequence generated by a first-order linear recurrence relation can have a long term increasing, decreasing or a steady-state solution
- use first-order linear recurrence relations to model and analyse (numerically, graphically or technology assisted) practical problems.

### Possible investigations

Investigate:

- Newton's law of cooling
- population modelling using real life data
- exponential decay using 'm and ms'
- decreasing height of a bouncing ball
- Fibonacci series
- the poem, 'the man from St Ives', or 'the Emperor's payment for the chess board', and make a poster that displays either of these, including mathematical reasoning.

### Finance

(Approximately 20% of course time)

#### Compound interest loans and investments

- review simple and compound interest ( $I = PRT$  and  $A = P(1 + i)^n$ )
- use a recurrence relation to model a compound interest loan or investment and investigate (algebraically, numerically or graphically) the effect of the interest rate and the number of compounding periods on the future value of the loan or investment
- calculate the effective annual rate of interest ( $E = (1 + i)^n - 1$ ) and use the results to compare investment returns and cost of loans when interest is paid or charged daily, fortnightly, monthly, quarterly or six-monthly
- solve problems involving compound interest loans or investments, algebraically and with the aid of calculator or computer software
- inflation and depreciation as examples of growth and decay, including depreciation tables and algebraic and graphical models for both cases.

## Reducing balance loans (compound interest loans with periodic repayments)

- use a recurrence relation, (algebraically) 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  $P = \frac{R[1 - (1 + i)^{-n}]}{i}$
- with the aid of calculator or computer 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 (algebraically) and investigate (numerically or graphically) the effect of the amount invested, the interest rate and the payment amount on the duration of the annuity  $P = \frac{R(1 + i)[(1 + i)^n - 1]}{i}$



- with the aid of calculator or computer software, solve problems involving annuities (including perpetuities,  $P = \frac{R}{i}$ ) as a special case, where  $i$  = effective interest rate).

#### Possible investigations

Investigate:

- the value of a car depreciating over a period of time, using a spreadsheet to model and graph it
- the amount outstanding for a long term loan (e.g. a house loan), using a spreadsheet to model and graph it
- the fees and interest rates in short term loans, comparing deals available
- car loans
- credit card repayment schedules and 'minimum repayment warnings'
- effect of changing interest rates on the term of a loan, loan repayments and the total paid
- fixed interest loans versus variable interest loans
- effect of paying half a monthly repayment fortnightly.

### Trigonometry

(Approximately 20% of course time)

#### Applications of trigonometry

- review Pythagoras' theorem
- angle measure in decimal degrees and in degrees and minutes
- review of true and reduced bearings
- review the use of the trigonometric ratios to find the length of an unknown side or the size of an unknown angle in a right-angled triangle
- determine the area of a triangle using:  $Area = \frac{1}{2}base \times height$ ,  $Area = \frac{1}{2}ab \sin C$ , or by using Heron's rule  

$$A = \sqrt{s(s-a)(s-b)(s-c)}, \text{ where } s = \frac{a+b+c}{2}$$
- solve problems involving non-right angled triangles using the sine rule (ambiguous case excluded) and the cosine rule
- solve practical problems involving the trigonometry of right-angled and non-right angled triangles, including problems involving angles of elevation and depression and the use of bearings in navigation.

## World Geometry

- develop a working knowledge of, and perform calculations in relation to, great circles, small circles, latitude, longitude, angular distance, nautical miles and knots
- use arc length and plane geometry to calculate distances, in kilometres and nautical miles, along great and small circles associated with parallels of latitude and meridians of longitude
- calculate great circle distances by performing arc length calculations in association with the use of the cosine rule formula for spherical triangles. The angular separation,  $\theta$ , between points  $P$  and  $Q$  on a great circle is given by:  
 $\cos \theta = \sin(\text{lat}P) \cdot \sin(\text{lat}Q) + \cos(\text{lat}P) \cdot \cos(\text{lat}Q) \cdot \cos(\text{longitude difference})$ , where  $\theta$  is the angle subtended at the centre of the great circle by the great circle arc between  $P$  and  $Q$ . If  $P$  and  $Q$  are in different hemispheres, northern latitude should be taken as positive, southern latitudes as negative.
- investigate zone time (standard time) at different meridians of longitude, and consider the International Date Line. The time zone  $x$  hours ahead of GMT has as its centre  $15x^\circ$  E longitude and extends  $7.5^\circ$  either side of  $15x^\circ$  E. For the purpose of this course, the only exceptions will be for South Australia and the Northern Territory. Other regional time zone arrangements and daylight saving will not be considered. Australian time zones should be known.
- carry out time and distance calculations involving world travel problems, including scenarios involving more than one destination with 'stop overs'.

#### Possible investigations

Investigate:

- the area of an irregular shaped block of land using Google Earth or GPS equipment to obtain dimensions
- the resolving power of the human eye
- a world travel scenario such as 'race around the world' by modelling it
- the relationship between great circle distance and air-fare between international destinations
- the zone time at different longitude, by constructing a conversion wheel
- the great circle using a globe and a piece of string and/or Google Earth



- determining the height of a tall object using two triangles
- finding the distance between two points by measuring distances and angles from a third point (cosine rule).

### **Networks and decision mathematics**

(Approximately 20% of course time)

#### **The definition of a graph, a network and associated terminology**

- recognise and explain the meanings of the terms: graph, edge, vertex, loop, degree of a vertex, directed graph (digraph), bipartite graph, arc, weighted graph and network
- identify practical situations that can be represented by a network and construct such networks.

### **Planar graphs**

- recognise and explain the meaning of the terms planar graph and face
- apply Euler's rule  $v + f - e = 2$  to solve problems relating to planar graphs.

### **Paths and cycles**

- explain the meaning of the terms; path/trail and circuit/cycle
- investigate and solve practical problems to determine the shortest path between two vertices in a weighted graph
- explain the meaning of the terms; Eulerian path, Eulerian circuit, and the conditions for their existence and use these concepts to investigate and solve practical problems; for example, the Königsberg Bridge problem, planning a garbage collection route
- explain the meaning of the terms Hamiltonian paths and Hamiltonian circuits and use these concepts to investigate and solve practical problems.

### **Trees and minimum connector problems**

- explain the meaning of the terms; tree and spanning tree and identify practical examples
- identify a minimum spanning tree in a connected weighted graph either by inspection or by using Prim's algorithm
- use minimal spanning trees to solve minimal connector problems; for example, minimising the length of cable to provide energy from a single power station to substations in several towns.

### **Project planning and scheduling using critical path analysis (CPA)**

- construct a network to represent the durations and interdependencies of activities that must be completed during the project; for example prepare a meal
- use forward and backward scanning to determine the earliest starting time (EST) and latest starting times (LST) of 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/or its tabular or matrix form to represent an assignment/allocation problem; for example, assigning four swimmers to the four places in a medley to maximise the team's chances of winning
- determine the optimum assignment(s), by inspection for small-scale problems, or with the use of an allocation matrix, by row reduction, or column reduction or by using the Hungarian algorithm for larger problems.

*Possible investigations*

Investigate:



- a 'visit' to the Melbourne Zoo, SeaWorld, etc. that includes certain attractions (at certain times?) represented as a network, then analyse the distance walked
- European rail routes that include visiting certain cities, represented as a network, minimising the distance travelled
- Transend network energy flow analysis
- processes that involve time sequencing and critical path analyses, for example, building project plans.

## Assessment

Criterion-based assessment is a form of outcomes assessment that identifies the extent of learner achievement at an appropriate end-point of study. Although assessment – as part of the learning program – is continuous, much of it is formative, and is done to help learners identify what they need to do to attain the maximum benefit from their study of the course. Therefore, assessment for summative reporting to TASC will focus on what both teacher and learner understand to reflect end-point achievement.

The standard of achievement each learner attains on each criterion is recorded as a rating 'A', 'B', or 'C', according to the outcomes specified in the standards section of the course.

A 't' notation must be used where a learner demonstrates any achievement against a criterion less than the standard specified for the 'C' rating.

A 'z' notation is to be used where a learner provides no evidence of achievement at all.

Providers offering this course must participate in quality assurance processes specified by TASC to ensure provider validity and comparability of standards across all awards. To learn more, see TASC's [quality assurance](#) processes and [assessment](#) information.

Internal assessment of all criteria will be made by the provider. Providers will report the learner's rating for each criterion to TASC.

TASC will supervise the external assessment of designated criteria which will be indicated by an asterisk (\*). The ratings obtained from the external assessments will be used in addition to internal ratings from the provider to determine the final award.

## Quality Assurance Process

The following process will be facilitated by TASC to ensure there is:

- a match between the standards of achievement specified in the course and the skills and knowledge demonstrated by learners
- community confidence in the integrity and meaning of the qualification.

**Process** – TASC gives course providers feedback about any systematic differences in the relationship of their internal and external assessments and, where appropriate, seeks further evidence through audit and requires corrective action in the future.

## External Assessment Requirements

The external assessment for this course will comprise:

- a written examination assessing criteria: 4, 5, 6, 7, & 8.

For further information see the current external assessment specifications and guidelines for this course available in the Supporting Documents below.





## Criteria

The assessment for General Mathematics Level 3 will be based on the degree to which the learner can:

1. communicate mathematical ideas and information
2. analysis: demonstrate mathematical reasoning, analysis and strategy in practical and problem solving situations
3. plan, organise and complete mathematical tasks
4. demonstrate knowledge and understanding of bivariate data analysis\*
5. demonstrate knowledge and understanding of growth and decay in sequences\*
6. demonstrate knowledge and understanding of standard financial models\*
7. demonstrate knowledge and understanding of applications of trigonometry\*
8. demonstrate knowledge and understanding of graphs and networks\*

\* = denotes criteria that are both internally and externally assessed



## Criterion 1: communicate mathematical ideas and information

The learner:

Rating A	Rating B	Rating C
presents work that clearly conveys the line of reasoning that has been followed between question and answer, including suitable justification and explanation of methods and processes used	presents work that clearly conveys the line of reasoning that has been followed between question and answer	presents work that conveys the line of reasoning that has been followed between question and answer
consistently presents work that follows mathematical conventions and consistently uses mathematical symbols correctly	consistently presents work that follows mathematical conventions and consistently uses mathematical symbols correctly	generally presents work that follows mathematical conventions and generally uses mathematical symbols correctly
presents work with the final answer clearly identified and articulated in terms of the question where necessary	presents work with the final answer clearly identified	presents work with the final answer apparent
presents work that shows a high level of attention to detail	presents work that shows attention to detail	presents work that shows some attention to detail
consistently presents the final answer with correct units when required	consistently presents the final answer with correct units when required	generally presents the final answer with correct units when required
presents graphs that are meticulous in detail	presents detailed graphs	presents graphs that convey meaning
adds a detailed diagram to supplement a solution.	adds a diagram to supplement a solution.	adds a diagram to a solution when prompted.

## Criterion 2: analysis: demonstrate mathematical reasoning, analysis and strategy in practical and problem solving situations

The learner:

Rating A	Rating B	Rating C
identifies multiple strategies and follows an appropriate strategy to solve unfamiliar problems where several may exist	identifies and follows an appropriate strategy to solve familiar problems where several may exist	identifies an appropriate strategy to solve familiar problems
describes solutions to routine and non-routine problems in a variety of contexts	describes solutions to routine and non-routine problems	describes solutions to routine problems
explores calculator techniques in unfamiliar problems	chooses to use calculator techniques when appropriate	uses calculator techniques to solve familiar problems
given an experiment's aim, sets up an experiment and gathers data, taking care over accuracy and precision	given written instructions, sets up an experiment and gathers data, taking care over accuracy and precision	given written instructions, sets up an experiment and gathers data
assesses the reliability and validity of solutions to problems and experimental results, recognising when	assesses the reliability and validity of solutions to problems and experimental results and	assesses the reliability and validity of

an experiment is producing anomalous data, and initiates steps to improve the experimental design	recognises when an experiment is producing anomalous data	solutions to problems and experimental results
relates experimental findings to real world phenomena, noting differences between the findings and what happens in the real world, and puts forward reasons for these differences, drawing conclusions showing detail, perception and insight	relates experimental findings to real world phenomena, noting differences between the findings and what happens in the real world, and discerns when a conclusion needs to show more detail and thought	relates experimental findings to real world phenomena and draws conclusions using a template approach
sources research data, appropriately references it and evaluates its credibility and usefulness.	sources research data and appropriately references it.	sources research data and references it.

### Criterion 3: plan, organise and complete mathematical tasks

The learner:

Rating A	Rating B	Rating C
evaluates, selects and uses planning tools and strategies to achieve and manage activities within proposed times	selects and uses planning tools and strategies to achieve and manage activities within proposed times	uses planning tools to achieve objectives within proposed times
assists others to divide a task into sub-tasks	divides a task into appropriate sub-tasks	divides a task into sub-tasks as directed
chooses strategies and formulae to successfully complete routine and more complex problems	selects from a range of strategies and formulae to successfully complete routine problems and more complex problems	selects from a range of strategies and formulae to successfully complete routine problems
monitors and critically evaluates goals and timelines and plans future actions	monitors and analyses progress towards meeting goals and timelines and plans future actions	monitors progress towards meeting goals and timelines
meets specified timelines and addresses all required elements of the task with a high degree of accuracy.	meets specified timelines and addresses all required task elements.	meets timelines and addresses most elements of the required task.

### Criterion 4: demonstrate knowledge and understanding of bivariate data analysis

This criterion is both internally and externally assessed.

The learner:

Rating A	Rating B	Rating C
constructs a two way frequency table from given data, determining the associated row and column sums, interpreting these in context	constructs a two way frequency table from given data, determining the associated row and column sums, suggesting the presence of an association	constructs a two way frequency table from given data, determining the associated row and column sums
prepares scatter plots of real data with thorough detail and in both linear and non-linear cases, suggesting the form (linear/non-linear), direction (positive/negative) and strength (strong/moderate/weak)	plots scatter plots of real data in both linear and non-linear cases, suggesting the form (linear/non-linear), direction (positive/negative) and strength (strong/moderate/weak)	plots scatter plots of real data in both linear and non-linear cases

models a linear relationship from given data, interpreting the $r$ and $r^2$ figures. Finds and interprets the residuals for the linear model, assessing the appropriateness of the model.	models a linear relationship from given data, interpreting the $r$ and $r^2$ figures	models a linear relationship from given data, finding $r$ and $r^2$
interpolates and extrapolates results both graphically and algebraically, and discusses the reliability of results, showing an understanding of why a particular indicator renders a result unreliable	interpolates and extrapolates results both graphically and algebraically and, using a templated approach, discusses the reliability of results	interpolates and extrapolates results both graphically and algebraically
interprets the $y$ -intercept and the gradient, using the modelled equation to make predictions. Writes up the results in a systematic and concise manner.	interprets the $y$ -intercept and the gradient, using the modelled equation to make predictions	identifies the $y$ -intercept and the gradient
communicates and explains in a systematic and concise manner, the non-causal relationship between the variables, suggesting reasons for an apparent relationship	identifies and attempts to explain non-causal relationships between the variables	recognises that there can be a non-causal relationship between the variables
constructs a scaled time series plot, describing trends, seasonality, irregular fluctuations, recognising possible outliers	constructs a scaled time series plot, describing trends	constructs a scaled time series plot
deseasonalises a time series using a seasonal index and fits a linear model to it.	uses moving averages to smooth a time series and fits a linear model to it.	uses simple moving averages to smooth a times series.

\* = denotes criteria that are both internally and externally assessed

## Criterion 5: demonstrate knowledge and understanding of growth and decay in sequences

This criterion is both internally and externally assessed.

The learner:

Rating A	Rating B	Rating C
determines the rule for the $n^{\text{th}}$ term of the arithmetic sequence, using this to make predictions	determines the rule for the $n^{\text{th}}$ term of the arithmetic sequence	recognises and generates arithmetic sequences
displays arithmetic sequences in both tabular and graphical form, using the sequence to model and analyse practical linear growth and decay problems	displays arithmetic sequences in both tabular and graphical form, using the sequence to model linear growth and decay problems	displays arithmetic sequences in both tabular and graphical form
determines the rule for the $n^{\text{th}}$ term of the geometric sequence, using this to make predictions	recognises, generates and determines the $n^{\text{th}}$ term of the geometric sequence	recognises and generates geometric sequences
displays geometric sequences in both tabular and graphical form, using the sequence to model and analyse practical exponential growth and decay problems	displays geometric sequences in both tabular and graphical form, using the sequence to model exponential growth and decay problems	displays geometric sequences in both tabular and graphical form
finds the sum of arithmetic and geometric sequence in modelled practical problems	finds the sum of arithmetic and geometric sequence in complex problems	finds the sum of arithmetic and geometric sequence in straight forward problems
uses a first order linear recurrence relation to describe a long term trend, modelling and analysing practical scenarios.	recognises, generates and uses a first order linear recurrence relation to describe a long term trend.	recognises and uses a given first order linear recurrence relation.



\* = denotes criteria that are both internally and externally assessed

## Criterion 6: demonstrate knowledge and understanding of standard financial models

This criterion is both internally and externally assessed.

The learner:

Rating A	Rating B	Rating C
consistently selects the appropriate formula for solving financial maths problems	selects the appropriate formula for solving financial maths problems	from a range of formulae, selects the appropriate formula for solving financial maths problems
applies a recurrence relation to model compound interest loans and investments, investigating the impact of changing interest rates and number of compounding periods	applies a recurrence relation to model compound interest loans and investments	solves simple interest and compound interest calculations
compares investment returns and cost of loans in more complex situations	calculates the effective annual rate of interest to compare investment returns and cost of loans, when interest is paid or charged in differing time periods	calculates the effective annual rate of interest
applies the growth and decay formulae to complex compound interest, depreciation and inflation situations and interprets results or makes recommendations	applies the growth and decay formulae to more complex compound interest, depreciation and inflation situations	applies the growth and decay formulae to straight forward compound interest, depreciation and inflation situations
selects the appropriate recurrence relation and calculates any variable (using technology if necessary) in the context of a more complex scenario for reducing balance loans	selects the appropriate recurrence relation and calculates any variable (using technology if necessary) in the context of a straight-forward scenario for reducing balance loans	uses a suggested recurrence relation (technology enabled) to model a reducing balance loan
performs more complex straight line depreciation, unit cost depreciation, and reducing balance calculations, and compares and contrasts these three methods	performs more complex straight line depreciation calculations, unit cost depreciations and reducing balance calculations	performs straight line depreciation calculations and attempts problems involving the unit cost depreciation methods
selects and uses a recurrence relation to model an annuity, solving more complex problems, including perpetuities.	selects the appropriate recurrence relation and calculates any variable (using technology if necessary) in the context of a straight-forward scenario for annuities.	uses a suggested recurrence relation (technology enabled) to model an annuity.

\* = denotes criteria that are both internally and externally assessed

## Criterion 7: demonstrate knowledge and understanding of applications of trigonometry

This criterion is both internally and externally assessed.

The learner:

Rating A	Rating B	Rating C
uses the trigonometrical ratios and the sine and cosine rules to calculate length,	uses the trigonometrical ratios and the sine and cosine rules to calculate length,	uses the trigonometrical ratios and the sine and cosine rules to calculate length

angles and bearings in more complex two dimensional scenarios	angles and bearings, given a two dimensional diagram	and angles, given a two dimensional diagram
produces a diagram to represent a more complex 2D scenario, including angles of elevation/depression and bearing problems, which may involve more than one triangle	produces a diagram to represent a 2D scenario, including angles of elevation/depression and bearing problems	produces a diagram to represent a straight forward 2D scenario, including angles of elevation/depression problems
uses $A = \frac{1}{2}bh$ , $A = \frac{1}{2}ab \sin C$ and Heron's formula to calculate the area of a triangle where some of the information must first be derived using trigonometrical methods	uses $A = \frac{1}{2}bh$ , $A = \frac{1}{2}ab \sin C$ and Heron's formula to calculate the area of a triangle	uses $A = \frac{1}{2}bh$ and $A = \frac{1}{2}ab \sin C$ to calculate the area of a triangle
selects and uses an appropriate formula to calculate more complex earth distance problems, for example, for a multiple stage journey	uses a suggested formula to calculate the distance between any two points on the earth's surface and express the answer using correct units	uses a suggested formula to calculate the distance between two points on the earth's surface (along same lines of longitude or latitude only) and express the answer using correct units
solves time problems involving standard (zone) time	solves simple time problems involving standard (zone) time	determines the likely time zone of a place on the Earth's surface, given its longitude
applies both time and distance calculations to more complex travel problems, for example, more than one destination with a 'stop over', without prompting to the steps involved.	applies both time and distance calculations to more complex travel problems, for example, more than one destination with a 'stop over', given prompting to the steps involved.	applies both time and distance calculations to simple travel problems.

\* = denotes criteria that are both internally and externally assessed

## Criterion 8: demonstrate knowledge and understanding of graphs and networks

This criterion is both internally and externally assessed.

The learner:

Rating A	Rating B	Rating C
constructs network diagrams representing a real-world scenario, calculating a series of path lengths	from given information constructs more complex network diagrams, calculating a series of path lengths	from given information, constructs simple network diagrams, calculating a series of path lengths
constructs networks modelling practical situations	constructs networks from given information	interprets given directed and undirected networks
investigates complex problems involving weighted graphs, including determining the shortest path between two vertices	investigates problems involving weighted graphs, including determining the shortest path between two vertices	investigates straight forward problems involving weighted graphs
identifies a minimum spanning tree, and uses this to solve minimum connector problems	identifies a minimum spanning tree either by inspection or by using Prim's algorithm	explains the meaning of the terms 'tree' and 'spanning tree', and attempts to identify a minimum spanning tree
constructs complex project networks from a table or a description and vice versa	constructs project networks from a table or a description	constructs straight forward project networks from a table or a description
analyses more complex activity networks, determining ESTs (by forward scanning), LSTs (by backward scanning) and float times	identifies the critical path of an activity network, determining ESTs (by forward scanning)	identifies the critical path of a straight forward activity network by inspection, attempting to use ESTs

determines optimum assignments, using the Hungarian algorithm as applicable, in larger scale problems.	determines optimum assignments for more complex problems, using column and/or row reduction in matrices.	uses bipartite graphs to represent a straight forward assignment problem.
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\* = denotes criteria that are both internally and externally assessed

## Qualifications Available

General Mathematics Level 3 (with the award of):

EXCEPTIONAL ACHIEVEMENT

HIGH ACHIEVEMENT

COMMENDABLE ACHIEVEMENT

SATISFACTORY ACHIEVEMENT

PRELIMINARY ACHIEVEMENT

## Award Requirements

The final award will be determined by the Office of Tasmanian Assessment, Standards and Certification from 13 ratings (8 from the internal assessment, 5 from the external assessment).

The minimum requirements for an award in General Mathematics Level 3 are as follows:

EXCEPTIONAL ACHIEVEMENT (EA)

11 'A', 2 'B' ratings (4 'A', 1 'B' from external assessment)

HIGH ACHIEVEMENT (HA)

5 'A', 5 'B', 3 'C' ratings (2 'A', 2 'B', 1 'C' from external assessment)

COMMENDABLE ACHIEVEMENT (CA)

7 'B', 5 'C' ratings (2 'B', 2 'C' from external assessment)

SATISFACTORY ACHIEVEMENT (SA)

11 'C' ratings (3 'C' from external assessment)

PRELIMINARY ACHIEVEMENT (PA)

6 'C' ratings

A learner who otherwise achieves the ratings for a CA (Commendable Achievement) or SA (Satisfactory Achievement) award but who fails to show any evidence of achievement in one or more criteria ('z' notation) will be issued with a PA (Preliminary Achievement) award.



## Course Evaluation

The Department of Education's Curriculum Services will develop and regularly revise the curriculum. This evaluation will be informed by the experience of the course's implementation, delivery and assessment.

In addition, stakeholders may request Curriculum Services to review a particular aspect of an accredited course.

Requests for amendments to an accredited course will be forwarded by Curriculum Services to the Office of TASC for formal consideration.

Such requests for amendment will be considered in terms of the likely improvements to the outcomes for learners, possible consequences for delivery and assessment of the course, and alignment with Australian Curriculum materials.

A course is formally analysed prior to the expiry of its accreditation as part of the process to develop specifications to guide the development of any replacement course.





## Expectations Defined By National Standards In Content Statements Developed by ACARA

The statements in this section, taken from documents endorsed by Education Ministers as the agreed and common base for course development, are to be used to define expectations for the meaning (nature, scope and level of demand) of relevant aspects of the sections in this document setting out course requirements, learning outcomes, the course content and standards in the assessment.

### Unit 1 – Topic 2: Algebra and matrices

#### Linear and non-linear expressions:

- substitute numerical values into linear algebraic and simple non-linear algebraic expressions, and evaluate (ACMGM010)

### Unit 1 – Topic 3: Shape and Measurement

#### Pythagoras' theorem:

- review Pythagoras' Theorem and use it to solve practical problems in two dimensions and for simple applications in three dimensions (ACMGM017)

### Unit 2 – Topic 2: Applications of Trigonometry

#### Applications of trigonometry:

- review the use of the trigonometric ratios to find the length of an unknown side or the size of an unknown angle in a right-angled triangle (ACMGM034)
- determine the area of a triangle given two sides and an included angle by using the rule  $Area = \frac{1}{2}ab \sin C$ , or given three sides by using Heron's rule, and solve related practical problems. (ACMGM035)
- solve problems involving non-right-angled triangles using the sine rule (ambiguous case excluded) and the cosine rule (ACMGM036)
- solve practical problems involving the trigonometry of right-angled and non-right-angled triangles, including problems involving angles of elevation and depression and the use of bearings in navigation (ACMGM037)

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

#### Linear equations:

- identify and solve linear equations (ACMGM038)
- develop a linear formula from a word description. (ACMGM039)

#### Straight-line graphs and their applications:

- construct straight-line graphs both with and without technology (ACMGM040)
- determine the slope and intercepts of a straight-line graph from both its equation and its plot (ACMGM041)
- interpret, in context, the slope and intercept of a straight-line graph used to model and analyse a practical situation (ACMGM042)
- construct and analyse a straight-line graph to model a given linear relationship; for example, modelling the cost of filling a fuel tank of a car against the number of litres of petrol required (ACMGM043)

### Unit 3 – Topic 1: Bivariate Data Analysis

#### The statistical investigation process:

- review the statistical investigation process; for example, identifying a problem and posing a statistical question, collecting or obtaining data, analysing the data, interpreting and communicating the results (ACMGM048)



### Identifying and describing associations between two categorical variables:

- construct two-way frequency tables and determine the associated row and column sums and percentages (ACMGM049)
- use an appropriately percentaged two-way frequency table to identify patterns that suggest the presence of an association (ACMGM050)
- 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 (ACMGM051)

### Identifying and describing associations between two numerical variables:

- construct a scatterplot to identify patterns in the data suggesting the presence of an association (ACMGM052)
- describe an association between two numerical variables in terms of direction (positive/negative), form (linear/non-linear) and strength (strong/moderate/weak) (ACMGM053)
- calculate and interpret the correlation coefficient ( $r$ ) to quantify the strength of a linear association (ACMGM054)

### Fitting a linear model to numerical data:

- identify the response variable and the explanatory variable (ACMGM055)
- use a scatterplot to identify the nature of the relationship between variables (ACMGM056)
- model a linear relationship by fitting a least-squares line to the data (ACMGM057)
- use a residual plot to assess the appropriateness of fitting a linear model to the data (ACMGM058)
- interpret the intercept and slope of the fitted line (ACMGM059)
- use the coefficient of determination to assess the strength of a linear association in terms of the explained variation (ACMGM060)
- use the equation of a fitted line to make predictions (ACMGM061)
- distinguish between interpolation and extrapolation when using the fitted line to make predictions, recognising the potential dangers of extrapolation (ACMGM062)
- write up the results of the above analysis in a systematic and concise manner (ACMGM063)

### Association and causation:

- recognise that an observed association between two variables does not necessarily mean that there is a causal relationship between them (ACMGM064)
- identify 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 (ACMGM065)

### The data investigation process:

- implement the statistical investigation process to answer questions that involve identifying, analysing and describing associations between two categorical variables or between two numerical variables; for example, is there an association between attitude to capital punishment (agree with, no opinion, disagree with) and sex (male, female)? Is there an association between height and foot length? (ACMGM066)

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

### The arithmetic sequence:

- use recursion to generate an arithmetic sequence (ACMGM067)
- 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 (ACMGM068)
- 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 (ACMGM069)
- use arithmetic sequences to model and analyse practical situations involving linear growth or decay; for example, analysing a simple interest loan or investment, calculating a taxi fare based on the flag fall and the charge per kilometre, or calculating the value of an office photocopier at the end of each year using the straight-line method or the unit cost method of depreciation (ACMGM070)

### The geometric sequence:

- use recursion to generate a geometric sequence (ACMGM071)
- 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 (ACMGM072)



- 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 (ACMGM073)
- use geometric sequences to model and analyse (numerically, or graphically only) practical problems involving geometric growth and decay; for example, analysing a compound interest loan or investment, the growth of a bacterial population that doubles in size each hour, the decreasing height of the bounce of a ball at each bounce; or calculating the value of office furniture at the end of each year using the declining (reducing) balance method to depreciate (ACMGM074)

#### 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 (ACMGM075)
- recognise that a sequence generated by a first-order linear recurrence relation can have a long term increasing, decreasing or steady-state solution (ACMGM076)
- use first-order linear recurrence relations to model and analyse (numerically or graphically only) practical problems; for example, investigating the growth of a trout population in a lake recorded at the end of each year and where limited recreational fishing is permitted, or the amount owing on a reducing balance loan after each payment is made (ACMGM077)

## Unit 3 – Topic 3: Graphs and networks

#### The definition of a graph and associated terminology:

- explain the meanings of the terms: graph, edge, vertex, loop, degree of a vertex, simple graph, complete graph, bipartite graph, directed graph (digraph), arc, weighted graph, and network (ACMGM078)
- identify practical situations that can be represented by a network, and construct such networks; for example, trails connecting camp sites in a National Park, a social network, a transport network with one-way streets, a food web, the results of a round-robin sporting competition (ACMGM079)

#### Planar graphs:

- explain the meaning of the terms: planar graph, and face (ACMGM081)
- apply Euler's formula,  $v + f - e = 2$ , to solve problems relating to planar graphs (ACMGM082)

#### Paths and cycles:

- explain the meaning of 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) (ACMGM084)
- explain the meaning of 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; for example, the Königsberg Bridge problem, planning a garbage bin collection route (ACMGM085)
- explain the meaning of the terms: Hamiltonian graph and semi-Hamiltonian graph, and use these concepts to investigate and solve practical problems; for example, planning a sight-seeing tourist route around a city, the travelling-salesman problem (by trial-and-error methods only) (ACMGM086)

## Unit 4 – Topic 1: Time Series Analysis

#### Describing and interpreting patterns in time series data:

- construct time series plots (ACMGM087)
- 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; for example, one-off unanticipated events (ACMGM088)

#### Analysing time series data:

- smooth time series data by using a simple moving average, including the use of spreadsheets to implement this process (ACMGM089)
- calculate seasonal indices by using the average percentage method (ACMGM090)



- deseasonalise a time series by using a seasonal index, including the use of spreadsheets to implement this process (ACMGM091)
- fit a least-squares line to model long-term trends in time series data (ACMGM092)

#### **The data investigation process:**

- implement the statistical investigation process to answer questions that involve the analysis of time series data (ACMGM093)

### **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 (ACMGM094)
- 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 (ACMGM095)
- with the aid of a calculator or computer-based financial software, solve problems involving compound interest loans or investments; for example, determining the future value of a loan, the number of compounding periods for an investment to exceed a given value, the interest rate needed for an investment to exceed a given value (ACMGM096)

#### **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 (ACMGM097)
- with the aid of a financial calculator or computer-based financial software, solve problems involving reducing balance loans; for example, determining the monthly repayments required to pay off a housing loan (ACMGM098)

#### **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 (ACMGM099)
- with the aid of a financial calculator or computer-based financial software, solve problems involving annuities (including perpetuities as a special case); for example, determining the amount to be invested in an annuity to provide a regular monthly income of a certain amount (ACMGM100)

### **Unit 4 – Topic 3: Networks and Decision Mathematics**

#### **Trees and minimum connector problems:**

- explain the meaning of the terms tree and spanning tree and identify practical examples (ACMGM101)
- identify a minimum spanning tree in a weighted connected graph either by inspection or by using Prim's algorithm (ACMGM102)
- use minimal spanning trees to solve minimal connector problems; for example, minimising the length of cable needed to provide power from a single power station to substations in several towns (ACMGM103)

#### **Project planning and scheduling using critical path analysis (CPA):**

- construct a network to represent the durations and interdependencies of activities that must be completed during the project; for example, preparing a meal (ACMGM104)
- use forward and backward scanning to determine the earliest starting time (EST) and latest starting times (LST) for each activity in the project (ACMGM105)
- use ESTs and LSTs to locate the critical path(s) for the project (ACMGM106)
- use the critical path to determine the minimum time for a project to be completed (ACMGM107)
- calculate float times for non-critical activities (ACMGM108)

#### **Flow networks**

- solve small-scale network flow problems including the use of the 'maximum-flow minimum-cut' theorem; for example, determining the maximum volume of oil that can flow through a network of pipes from an oil storage tank (the source) to a terminal (the sink) (ACMGM109)



## Assignment problems

- use a bipartite graph and/or its tabular or matrix form to represent an assignment/allocation problem; for example, assigning four swimmers to the four places in a medley relay team to maximise the team's chances of winning (ACMGM110)
- determine the optimum assignment(s), by inspection for small-scale problems, or by use of the Hungarian algorithm for larger problems (ACMGM111)



















## Accreditation

The accreditation period for this course is from 1 January 2015 to 31 December 2019.

## Version History

Version 1 – Accredited on 8 April 2014 for use in 2015 to 2019. This course replaces Mathematics Applied (MTA315114) that expired on 31 December 2014.

## Supporting documents including external assessment material

-  [MTG315115 Exam Paper 2015.pdf](#) (2017-07-21 01:05pm AEST)
-  [MTG315115 Exam Paper 2016.pdf](#) (2017-07-21 01:05pm AEST)
-  [MTG315115 Assessment Report 2016.pdf](#) (2017-07-25 03:00pm AEST)
-  [Use Of Calculator Policy 2017.pdf](#) (2017-07-25 03:50pm AEST)
-  [MTA315109 Assessment Report 2012.pdf](#) (2017-07-26 03:36pm AEST)
-  [MTA315114 Assessment Report 2014.pdf](#) (2017-07-26 03:37pm AEST)
-  [MTG315115 Assessment Report 2015.pdf](#) (2017-07-26 03:37pm AEST)
-  [MTA315109 Exam Paper 2012.pdf](#) (2017-07-26 03:37pm AEST)
-  [MTA315109 Exam Paper 2013.pdf](#) (2017-07-26 03:38pm AEST)
-  [MTA315114 Exam Paper 2014.pdf](#) (2017-07-26 03:38pm AEST)
-  [MTG315115 External Assessment Specifications 2015-2018.pdf](#) (2017-08-18 08:46am AEST)
-  [MTG315115 Exam Paper 2017.pdf](#) (2017-11-21 04:11pm AEDT)
-  [MTG315115 Assessment Report 2017.pdf](#) (2018-03-02 09:49am AEDT)
-  [MTG315115 Exam Solutions 2017.pdf](#) (2018-06-04 04:28pm AEST)
-  [MTG315115 Information Sheet.pdf](#) (2019-09-17 03:02pm AEST)
-  [MTG315115 TASC Exam Paper 2018.pdf](#) (2018-11-22 12:29pm AEDT)
-  [MTG315115 - Assessment Panel Report and Solutions 2018.pdf](#) (2019-03-05 01:08pm AEDT)
-  [MTG315115 General Mathematics TASC Exam Paper 2019.pdf](#) (2019-11-15 02:56pm AEDT)

