COURSE OUTLINE
MATHEMATICS APPLICATIONS – ATAR YEAR 12: 2021
UNIT 3 AND UNIT 4

Term	Week	Topic and key teaching points	Syllabus content	Assessment
1	1	**Bivariate Data** **Identifying and describing associations between two categorical variables**	3.1.1 review the statistical investigation process: identify a problem; pose a statistical question; collect or obtain data; analyse data; interpret and communicate results 3.1.2 construct two-way frequency tables and determine the associated row and column sums and percentages 3.1.3 use an appropriately percentaged two-way frequency table to identify patterns that suggest the presence of an association. 3.1.4 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 3.1.8 identify the response variable and the explanatory variable for primary and secondary data	
1	2	**Identifying and describing associations between two numerical variables** **Fitting a linear model to numerical data**	3.1.5 construct a scatterplot to identify patterns in the data suggesting the presence of an association 3.1.9 use a scatterplot to identify the nature of the relationship between variables 3.1.11 use a residual plot to assess the appropriateness of fitting a linear model to the data 3.1.12 interpret the intercept and slope of the fitted line 3.1.14 use the equation of a fitted line to make predictions 3.1.15 distinguish between interpolation and extrapolation when using the fitted line to make predictions, recognising the potential dangers of extrapolation	
1	3	**Identifying and describing associations between two numerical variables**	3.1.6 describe an association between two numerical variables in terms of direction (positive/negative), form (linear/non-linear) 3.1.7 calculate, using technology, and interpret the correlation coefficient (*r*) to quantify the strength of a linear association	
1	4	**Fitting a linear model to numerical data**	3.1.10 model a linear relationship by fitting a least-squares line to the data 3.1.13 use the coefficient of determination to assess the strength of a linear association in terms of the explained variation 3.1.17 recognise that an observed association between two variables does not necessarily mean that there is a causal relationship between them 3.1.18 identify possible non-causal explanations for an association, including coincidence	**Test 1: Bivariate Data Analysis** **(U3 Chapters 1 - 2)** (Friday)

		Association and causation	and confounding due to a common response to another variable, and communicate these explanations in a systematic and concise manner 3.1.16 write up the results of the above analysis in a systematic and concise manner	
1	5	**Bivariate Data Investigation**	3.1.19 implement the statistical investigation process to answer questions that involve identifying, analysing and describing associations between two categorical variables or between two numerical variables	**Week 5** **Investigation 1: Bivariate Data Analysis- out**
1	5-6	**Sequences** **Recursion**	3.2.1 use recursion to generate an arithmetic sequence 3.2.5 use recursion to generate a geometric sequence 3.2.2 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 3.2.3 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 3.2.6 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	
1	7-8	**Sequences generated by first-order linear recurrence relations**	3.2.7 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 3.2.4 use arithmetic sequences to model and analyse practical situations involving linear growth or decay 3.2.8 use geometric sequences to model and analyse (numerically, or graphically only) practical problems involving geometric growth and decay 3.2.9 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 3.2.10 generate a sequence defined by a first-order linear recurrence relation that gives long term increasing, decreasing or steady-state solutions 3.2.11 use first-order linear recurrence relations to model and analyse (numerically or graphically only) practical problems	**Week 7** **Investigation 1: Bivariate Data Analysis - due** **Week 8** **Test 2: Growth & Decay (U3 Chapters 3 - 4) (Wednesday)**
1	9	**Networks**	3.3.1 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	

2	1-2	**The definition of a graph and associated terminology** **Planar graphs**	3.3.2 identify practical situations that can be represented by a network, and construct such Networks 3.3.4 demonstrate the meanings of, and use, the terms: planar graph and face 3.3.5 apply Euler's formula, $v + f - e = 2$ to solve problems relating to planar graphs 3.3.3 construct an adjacency matrix from a given graph or digraph and use the matrix to solve associated problems 3.3.6 demonstrate the meanings of, and use, the terms: walk, trail, path, closed walk, closed trail, cycle, connected graph, and bridge	
2 2	3-4	**Paths and cycles** **Shortest Path**	3.3.8 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 3.3.9 demonstrate the meanings of, and use, the terms: Hamiltonian graph and semi-Hamiltonian graph, and use these concepts to investigate and solve practical problems 3.3.7 investigate and solve practical problems to determine the shortest path between two vertices in a weighted graph (by trial-and-error methods only)	**Week 4:** **Test 3: Graphs and Networks (U3 Chapters 5 - 6)** **Friday**
2	5		**Revision for exams**	
2	6		**Revision and School Exams**	**Exams starts from Wednesday**
2	7		**School Exams**	**Unit 3 School Exam**
2	8	**Time Series Data**	4.1.1 construct time series plots 4.1.2 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	
2	9		4.1.3 smooth time series data by using a simple moving average, including the use of spreadsheets to implement this process 4.1.5 deseasonalise a time series by using a seasonal index, including the use of spreadsheets to implement this process	

2	10	**The data investigation process**	4.1.4 calculate seasonal indices by using the average percentage method 4.1.6 fit a least-squares line to model long-term trends in time series data 4.1.7 predict from regression lines, making seasonal adjustments for periodic data 4.1.8 implement the statistical investigation process to answer questions that involve the analysis of time series data	**Week 10** **Test 4: Time Series Analysis (U4 Chapters 1 - 2) (Friday)**
2	11	**Compound interest loans and investments**	4.2.1 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 4.2.2 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	
3	1	**Reducing balance loans (compound interest loans with periodic repayments)**	4.2.3 with the aid of a calculator or computer-based financial software, solve problems involving compound interest loans, investments and depreciating assets 4.2.4 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 4.2.5 with the aid of a financial calculator or computer-based financial software, solve problems involving reducing balance loans	
3	2-3	**Annuities and perpetuities (compound interest investments with periodic payments made from the investment)**	4.2.6 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 4.2.7 with the aid of a financial calculator or computer-based financial software, solve problems involving annuities (including perpetuities as a special case)	**Week 3** **Test 5: Loans, investments & annuities (U4 Chapters 3 - 4) (Friday)**
3	4	**Trees and minimum connector problems** **Flow networks**	4.3.1 identify practical examples that can be represented by trees and spanning trees 4.3.2 identify a minimum spanning tree in a weighted connected graph, either by inspection or by using Prim's algorithm 4.3.3 use minimal spanning trees to solve minimal connector problems 4.3.9 solve small-scale network flow problems, including the use of the 'maximum flow minimum cut' theorem	**Week 4** **Investigation 2: Loans, investments and annuities (out)**

3	5	**Project planning and scheduling using critical path analysis (CPA)**	4.3.4 construct a network to represent the durations and interdependencies of activities that must be completed during the project 4.3.5 use forward and backward scanning to determine the earliest starting time (EST) and latest starting times (LST) for each activity in the project 4.3.6 use ESTs and LSTs to locate the critical path(s) for the project 4.3.7 use the critical path to determine the minimum time for a project to be completed 4.3.8 calculate float times for non-critical activities	**Week 6 -Monday** **Investigation 2: Loans, investments and annuities (due)**
3	6-7	**Assignment problems**	4.3.10 use a bipartite graph and/or its tabular or matrix form to represent an assignment/ allocation problem 4.3.11 determine the optimum assignment(s), by inspection for small-scale problems, or by use of the Hungarian algorithm for larger problems	**Week 7** **Test 6: Networks and decision Mathematics (U4 Chapters 5 - 8)** **Friday**
3	8		**Revision**	
3	9		**Revision and Practice Exams/School Exams**	**Exams starts from Wednesday**
3	10		**School Exams**	**Final School Exam – U3 & U4**
4	1		**Revision & WACE Examination Preparation**	