VCE General Mathematics 2023-2027 Units 3 and 4

Suggested approaches to implementing the 2023-2027 study design

VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

VICTORIA State Government

Acknowledgement of Country

The VCAA respectfully acknowledges the Traditional Owners of Country throughout Victoria and pays respect to the ongoing living cultures of First Peoples.

VCE Mathematics On-demand Videos

To support the implementation of the 2023-2027 study design for Mathematics, we have developed a series of short on-demand videos outlining approaches that teachers may wish to utilise in the classroom.

The information presented in these on-demand videos has been developed by current VCE teachers, in conjunction with the VCAA, and offer suggestions for ways schools could approach the implementation of the 2023-2027 VCE Mathematics study design.

General Mathematics Units 3 & 4

Structural Changes:

- Name change from Further Mathematics to General Mathematics.
- There are two completely prescribed Units 3 – 4 studies – NO MODULES
- Two Areas of Study

    AoS1: Data analysis, Probability and statistics

    AoS2: Discrete mathematics

General Mathematics Units 3 & 4

- General Mathematics Units 3 and 4 assumes the previous completion of General Mathematics Units 1 and 2.

- Units 1 and 2 contain assumed knowledge and skills for Units 3 and 4 General Mathematics.

General Mathematics Units 3 & 4

Areas of Study:

AoS1: Data analysis, Probability and statistics

- Data analysis

AoS2: Discrete mathematics

- Recursion and financial modelling
- Matrices and their applications
- Networks and decision mathematics

Previous vs New Structure

2022 Further Maths 3&4	2023 – 2027 General Maths 3&4	
AoS1 – Unit 3 CORE: “Data analysis” AND “Recursion and financial modelling”	AoS1 – Data Analysis, Probability and Statistics: • Investigating data distributions • Investigating association between two variables • Investigating modelling linear associations • Investigating and modelling time series	
AoS2 – Unit 4 Applications:		
Module 1 – “Matrices”	AoS2 – Discrete mathematics Recursion and financial modelling • Depreciation of assets • Compound interest investments and loans • Reducing balance loans • Annuities and perpetuities • Compound interest investment with periodic and equal additions to the principal Matrices • Matrices and their applications • Transition matrices	Networks and decision mathematics • Graphs and networks • Exploring travelling problems • Trees and minimum connector problems • Flow problems • Shortest path problems • Matching problems • Scheduling problems and critical path analysis
Module 2 – “Networks and decision mathematics”		
Module 3 – “Geometry and measurement”		
Module 4 – “Graphs and relations”		

General Mathematics Units 3 & 4

The 2023 – 2027 General Mathematics study design is fully prescribed and combines the content for Unit 3 & 4.

Areas of study in Unit 3 and 4

AoS1 Data analysis, probability and statistics

Topic: Data analysis

- Investigating data distributions
- Investigating association between two variables
- Investigating and modelling linear associations
- Investigating and modelling time series data

General Mathematics Units 3 & 4

Areas of study in Unit 3 and 4

AoS2 Discrete Mathematics

Topic: Recursion and financial modelling

- Depreciation of assets
- Compound interest investments and loans
- Reducing balance loans
- Annuities and perpetuities
- Compound interest investment with periodic and equal additions to the principal

General Mathematics Units 3 & 4

Areas of study in Unit 3 and 4

AoS2 Discrete Mathematics

Topic: Matrices

- Matrices and their applications
- Transition matrices

General Mathematics Units 3 & 4

Areas of study in Unit 3 and 4

AoS2 Discrete Mathematics

Topic: Networks and decision mathematics

- Graphs and networks
- Exploring travelling problems
- Trees and minimum connector problems
- Scheduling problems and critical path analysis
- Flow problems
- Shortest path problems
- Matching problems

General Mathematics Units 3 & 4

New:

AoS2: Discrete mathematics

- Matrices: Leslie matrices

Outcome 3: Key knowledge

- The role of computational thinking in problem-solving and its application to mathematical investigations

General Mathematics Units 3 & 4

Reworded/modified:

AoS1: Data analysis, probability and statistics

Investigating and modelling linear associations: explicit description of logarithmic (base 10)

AoS2: Discrete Mathematics

Recursion and financial modelling: recurrence relation periods for an initial sequence from first principles

General Mathematics Units 3 & 4

Removed/deleted/modulated:

AoS1: Data analysis

- Population and sample, random numbers and their use to draw simple random samples and the difference between population parameters and sample statistics
- Non-causal explanations for an observed association including common response, confounding and coincidence.

AoS2: Recursion and financial modelling

- Concept and use of a first-order linear recurrence relation and its use in generating terms of a sequence (clarification of forms and application to financial modelling provided)

AoS2: Matrices

- Use of matrices to represent systems of linear equations and the solutions of these equations.
- Concepts of dependent and inconsistent systems of equations in the context of solving pairs of simultaneous equations.

General Mathematics Units 3 & 4

In Unit 3 & 4, the assessment weighting used to calculate the final study score has weighted more towards the School-assessed Coursework, 40 per cent

General Mathematics Assessment

- Unit 3 School-assessed Coursework: 24 per cent
- Unit 4 School-assessed Coursework: 16 per cent
- Units 3 and 4 Examination 1: 30 per cent
- Units 3 and 4 Examination 2: 30 per cent

General Mathematics Units 3 & 4

Leslie matrices

The Leslie matrix, *L*, is like a transition matrix, *T*, but it is one that is used to model changes in the age distribution of various animal populations over time. Only the female members are considered in this model.

The populations need to be divided into age groups. Each ‘Age group’ must be the same length of time or ‘Age range’ (in days, weeks, years, decades etc) and must cover the life span of the population.

General Mathematics Units 3 & 4

Similarities and difference between Leslie and Transition matrices

T and *L* are the same in that both follow the same matrix recurrence relation and rule for directly calculating S_n from S_o.

S_0 = initial state matrix $\quad S_{n+1} = T \times S_n \quad S_n = T^n \times S_0$

S_0 = initial state matrix $\quad S_{n+1} = L \times S_n \quad S_n = L^n \times S_0$

Where Sn is the state matrix after n iterations (or applications) of the recurrence rule.

General Mathematics Units 3 & 4

Similarities and difference between Leslie and Transition matrices

A Transition matrix is a square matrix describing the probabilities of moving from one state to another for a fixed population. The columns of a Transition matrix each sum to one.

A Leslie matrix is a square matrix listing the survival rates and birth rates of the age groups within a population. The columns of a Leslie matrix do not necessarily sum to one.

A Leslie matrix can be used to model the dynamics of populations that increase or decrease in size over time. L matrices can also be used to model populations that do not change in size or are periodic.

General Mathematics Units 3 & 4

An example using a Leslie matrix

The life cycle of a population of insects has three ages groups. The insect is born as an egg, *E*, hatches as a nymph, *N* and grows into an adult, *A*.

The size and distribution of the population has been observed to change month to month according to the Leslie matrix *L*.

$$\begin{array}{rcl} & \begin{array}{c} \textit{This month} \\ \begin{array}{ccc} E & \quad N & \quad A \end{array} \end{array} & \\ L = & \left[\begin{array}{ccc} 0 & 0 & 1000 \\ 0.02 & 0 & 0 \\ 0 & 0.05 & 0 \end{array}\right] & \begin{array}{l} E \\ N \quad \textit{Next month} \\ A \end{array} \end{array}$$

General Mathematics Units 3 & 4

$$
\begin{array}{cccc}
 & E & N & A \\
L = & \begin{bmatrix} 0 & 0 & 1000 \\ 0.02 & 0 & 0 \\ 0 & 0.05 & 0 \end{bmatrix} & & \begin{array}{ll} E & \text{birth rate} \\ N & \text{survival rate} \\ A & \text{survival rate} \end{array}
\end{array}
$$

Two per cent of eggs, *E*, hatch to become nymphs, *N.*

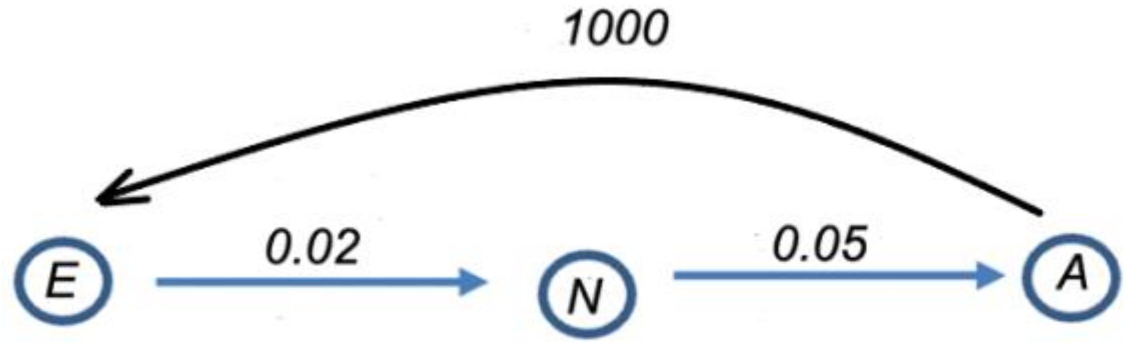
Five per cent of nymphs, *N* survive and grow into adults, *A*.

Each adult, *A*, produces 1000 eggs per month.

General Mathematics Units 3 & 4

$$
\begin{array}{cccc}
 & E & N & A \\
L = & \left[\begin{array}{ccc} 0 & 0 & 1000 \\ 0.02 & 0 & 0 \\ 0 & 0.05 & 0 \end{array}\right] & \begin{array}{l} E \\ N \\ A \end{array} & \begin{array}{l} \text{birth rate} \\ \text{survival rate} \\ \text{survival rate} \end{array}
\end{array}
$$

This information can also be shown in a life-cycle transition diagram.



General Mathematics Units 3 & 4

If on 1 January this year the population consisted of 100 eggs, 100 nymphs and 100 adults we can write the initial state matrix as:

$$S_0 = \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix}$$

We can now investigate this population over time using the matrix recurrence relation:

S_0 = initial state matrix $\qquad S_{n+1} = L \times S_n$ or the rule $S_n = L^n \times S_0$

In this application S_n is the state matrix after n months after 1 January.

General Mathematics Units 3 & 4

What will be the total number of nymphs and adults on 1 February this year?

n=1

$$S_0 = \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix}$$

$$S_1 = L \times S_0$$

$$S_1 = \begin{bmatrix} 0 & 0 & 1000 \\ 0.02 & 0 & 0 \\ 0 & 0.05 & 0 \end{bmatrix} \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix}$$

$$S_1 = \begin{bmatrix} 100000 \\ 2 \\ 5 \end{bmatrix}$$

On 1 February there will be seven nymphs and adults in total.

General Mathematics Units 3 & 4

When will the population have the same number of eggs, nymphs and adults as it did on 1 January?

$$S_0 = \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix}$$

n=1 $S_1 = L^1 \times S_0$ $S_1 = \begin{bmatrix} 100000 \\ 2 \\ 5 \end{bmatrix}$

n=2 $S_2 = L^2 \times S_0$ $S_2 = \begin{bmatrix} 5000 \\ 2000 \\ 0.1 \end{bmatrix}$

n=3 $S_3 = L^3 \times S_0$ $S_3 = \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix}$

On 1 April and every three months there after.

Contact

Michael MacNeill – Curriculum Manager, Mathematics

- Victorian Curriculum and Assessment Authority
  Level 7, 2 Lonsdale Street, Melbourne 3000, Victoria
  T +61 3 7022 5538 M 0438 602 765

- Email: Michael.MacNeill@education.vic.gov.au

Authorised and published by the
Victorian Curriculum and Assessment Authority