Formal Response

Subject: Feedback about the Australian Curriculum Draft Senior Secondary Mathematics July 2012

To: The Australian Curriculum, Assessment and Reporting Authority

Date: Wednesday, 25 July 2012

Report by: Mathematical Association of Victoria, with responses co-ordinated by Councillors Elizabeth Burns, Kelly Gallivan and Dave Tout and Philip Swedosh

Source

This feedback by the Mathematical Association of Victoria to the Australian Curriculum Draft Senior Secondary Mathematics being developed by the Australian Curriculum, Assessment and Reporting Authority is presented by the Council of the MAV on behalf of the members of the Association. Four well qualified and experienced senior mathematics teachers who have all actively contributed to curriculum development in mathematics education and have participated in the various consultation processes for the development of the Australian Curriculum were asked by the Council of the Mathematical Association of Victoria to coordinate preparation of this formal response. The MAV Council gratefully acknowledges the leadership and advice of Elizabeth Burns, Kelly Gallivan, Philip Swedosh and Dave Tout. The advice provided by Robert Money and Peter Fox is also acknowledged.

Through MAVlist, an newsletter e-mail to over 11,000 mathematics educators, members were invited to respond to the consultation questions posed by ACARA, both at the ACARA consultation site and at http://www.mav.vic.edu.au. Margaret Bigelow, Senior Project Officer Mathematics, ACARA, generously agreed to meet with the MAV Council and provided valuable contextual information. The responses received by the MAV were used by the expert panel to challenge and shape the perspectives already developed by the Council through several conversations at Council level, formal meetings to discuss the Curriculum, the advice of both Dr Ian Lowe and Helen Haralambous, MAV Professional Officers responsible for secondary mathematics, discussion at a meeting of Melbourne's "Heads of Faculty" (all members of the Association), additional correspondence from members to the Council and the work of the MAV Executive in framing and coordinating the MAV response.

Preliminaries

In general, the main issues relating to the Australian Curriculum in mathematics is that there needs to be a great deal of flexibility built in. A significant percentage of the cohort commence studying a subject, do not cope well, and change to a different subject after Unit 1. The most common situation for this sort of change is when a student enroils in Maths Methods 1 & 2 and moves to General Maths after Semester 1.
The sequencing of topics needs to accommodate this common scenario. This can also be an issue with other subjects where a student needs to move ‘down a level’. The order of topics should allow for the transition to be as easy as possible.

There are many students whose current pathways are not accommodated.

One suggestion to accommodate this viewpoint is that the order of unit 1 and 2 is changed for General Mathematics (so that some algebra takes place in semester 1 of Year 11 in all courses). It would then be possible for a) a student attempting Mathematical Methods to switch to General Mathematics after one or two units or, b) a student attempting General Mathematics to switch to Essential Mathematics after one or two units. It would certainly make sense in General Mathematics to at least swap Graphs and Networks in unit one, with Linear Equations and their Graphs in unit two.

Those who do Maths Methods 1 & 2 while in Year 10 and then elect not do Maths Methods 3 & 4 in Year 11 commonly enrol in a form of General Maths in Year 11 (soon to be Specialist Maths 1 & 2) to prepare them well for Maths Methods 3 & 4 in Year 12 and to open the possibility of Specialist Maths 3 & 4 in Year 12. Making Specialist Maths 1 & 2 more flexible in that schools could choose from a basket of topics what would best meet the needs of their students would accommodate this. It would also keep open the prospect of students doing six units of maths in NSW.

Making Units 1 and 2 more flexible would allow schools to run a course which suits their cohort and prepares their students for their future studies. Having a selection of topics available for this course would achieve this end.

It has also been suggested that there be stand-alone units so that the possibility of a 3 unit mathematics sequence could be developed. For example, NSW has a 3 unit mathematics course. In Victoria, this would depend on a VCAA ruling to allow it to occur.

**Essential Mathematics**

1. **The rationale provides clarity about the subject’s broad scope, distinctive nature and importance.**

   We agree with the aim in the rationale that says that the emphasis is to “provide students with the mathematical knowledge, skills and understanding to solve problems in real contexts for a range of workplace, personal, further learning and community settings. This subject provides the opportunity for students to prepare for post-school options of employment and further training”. We know from the results of many investigations and reports that this target group of students are disengaged from maths, and we need a different strategy and approach from the traditional content based approach to teaching maths to attract them to the world of mathematics and to achieve the aims for this course (e.g. see Peter Sullivan’s report: http://www.acer.edu.au/media/teachers-must-prepare-students-for-using-mathematics-in-the-real-world/).

   The rationale needs to reflect this need, and provide a relevant and clear outline for teachers to understand that the use and application of relevant and engaging mathematics is what is crucial for students who will undertake Essential Mathematics based studies in the States and Territories. Apart from the last paragraph, there needs to be a stronger emphasis and description about teachers explicitly supporting learners to be able to problem solve in the real world and to be able to identify and excavate the mathematics from where it is situated in the real world. This real world problem solving and excavating of mathematics is a skill that needs to be taught and supported. Teachers need to then have this spelt out in the structure.
and descriptions so that this will be taught as an essential and integrated aspect of teaching this cohort of learners.

The rationale and structure needs to reflect the way that we believe maths for this target group needs to be structured. That is, that the teaching and learning should start from the context (which can be tailored to the interests of the students) – so that the students can see the need and purpose for understanding and applying the maths. This approach is outlined in the ACER book, *Foundation Numeracy in Context*, by Tout and Motteram, which is one of the few resources to be listed as a reference for the Years 11 and 12 maths curriculum. However, this approach is not how the Essential Mathematics curriculum is structured or described. We therefore believe that the rationale and aim of the curriculum will not be met by the current draft and its structure.

2. **The aims comprehensively describe the intended learning as a result of studying the subject.**

Two fundamental and crucial areas are missing – the ability to mathematise, to formulate the mathematics from a real world context, to identify and extract the mathematics prior to using the required maths skills. The other important aspect of using and applying maths in the real world is the ability to reflect on the outcomes of the mathematical thinking and work to see if they fit the context – are the solutions realistic and reasonable? These should be added in as new aims.

3. **The four unit structure has internal logic and coherence.**

No – we don’t believe it has internal logic and coherence. It needs to be re-organised, and a possible suggestion is made below, although we believe much more thinking and detail is required. We would be happy to contribute further if requested.

We believe there are some good and established models around for such a curriculum structure and content. For example, three are Victoria’s VCE Foundation maths, the two higher levels of VCAL and the two higher level Certificates in General Education for Adults (CGEA). These vary from curriculum that are highly focussed on applying maths in a context as their organising structure (VCAL, which is now delivered to over 20,000 year 11 and 12 students across Victoria) through to both VCE Foundation maths and CGEA curriculum frameworks which have a content based structure but with context as a vital and important part. They have successfully targeted the same groups and types of students as for Essential Maths – why not build on this experience and successes?

The structure appears to be based on what is seen as a set of “essential” maths skills and content where it is expected to apply or practise those maths skills in a context. However, there are two Topics that contradict this approach – where the content of a topic becomes a context. Why in Unit 4 suddenly have two context based Topics – Earth Geometry and Time Zones and Loans and Compound Interest? Both of these Topics are contexts that can be used as such, if appropriate and relevant, from within other maths content topics – e.g. Earth Geometry and Time Zones from within Time and Motion (and Location and Direction if it was included) and Loans and Compound Interest should be seen as applications of a range of topics such as Percentages, Algebra and Graphs. Both these topics are highly unlikely to be engaging or attractive to students in most settings – but especially, for example, to remote indigenous learners or those from lower socio-economic backgrounds.

One issue with the draft structure and the accompanying outline is that it avoids the issue of explicitly supporting learners to be able to problem solve in the real world and to be able to identify and excavate the mathematics from where it is situated, often buried within the messiness of the real world. This is one of the key aims of the course: “… to solve problems
in real contexts for a range of workplace, personal, further learning and community settings. This subject provides the opportunity for students to prepare for post-school options of employment and further training”. This real world problem solving and excavating of mathematics is a skill that needs to be taught and supported – this curriculum framework appears to ignore that issue of teaching mathematics to the group of students who struggle with this the most – the skills and knowledge (and confidence) to engage with maths and to tackle situations in the real world where maths is involved. Teachers need to have this spelt out in the structure and descriptions so that this will be taught as an essential and integrated aspect of teaching this cohort of learners. As the curriculum is currently written, it supports a traditional approach of teaching a set of isolated maths skills and then assuming students can and will apply it to some contexts – and this system has not worked for this group of students. There is an assumption that teachers know how to teach this way, yet evidences is that they do not.

Another structural issue is that there is one maths content area that is treated in a strange way – location and direction. This area is glossed over, and only gets a small look in as part of a very big single topic – Time and Motion. Why on earth have the only dedicated location and direction topic appear in Unit 4 as a topic about Earth Geometry and Time Zones? As mentioned above this is a context to apply maths and not a content area, and is also unlikely to be attractive to the student cohort. Needs to be deleted and replaced with other content areas.

There is repetition and duplication of both the content and the contexts. There are some jumps from one Unit to the next that are extremely large, and/or there is no foundation for the expected skills within a later Unit. A good example of this is the expected use and understanding of the standard deviation as a measure of spread in Unit 2, Topic 1. The Algebra unit in Unit 1 is not a sufficient basis for using and applying such a formula – especially if it is to be used for both ungrouped and grouped data.

Some of the Units and topics seem to be very different in their weight – both in terms of the amount of the content and in terms of the depth/breadth of the content both in regards to Units and Topics. For example, at a Unit level: Unit 1 is very slim in content compared to Unit 2; and at a Topic level in Unit 2: Representing and Comparing Data is very large vs Percentages which is very small and minor in comparison. A couple of topics such as Unit 2, Topic 1 Representing and comparing data, and Unit 4, Topic 4 Data Collection are extremely large in terms of content and quite excessive compared to a number of the others.

**A possible structure**

A possible structure for the Units and Topics (without going into too much detail) could be as in the table below. This includes most of the existing content but spreads it out more evenly and adds in location and direction. It also removes the need to have two context based Topics in Unit 4.

<table>
<thead>
<tr>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4</th>
</tr>
</thead>
</table>
| Quantity and number I  
• Integers, fractions, decimals, percentages  
• Four operations | Quantity and number II  
• Percentage increase and decrease  
• Rates  
• Ratios | Location and Direction II  
• use scales to find distances on maps  
• bearings  
• Speed, average speed, travel times and distances | Probability and relative frequencies  
• Probability expressions  
• Simulations  
• Simple probabilities  
• Probability applications |
Contexts

We believe very strongly that the value and purpose for the students of such an Essential Maths course is provided by the contexts which would need to be up front and not seen as an optional, add on, that teachers might get around to incorporating and addressing. In the current draft, there is little encouragement for teachers to be flexible and to customise and choose a variety of contexts to base their teaching around, and allow students to have a choice in where they might apply their mathematical learning. There needs to be a much

<table>
<thead>
<tr>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data and statistics I</td>
<td>Data and statistics II</td>
<td>Graphs</td>
<td>Algebra II</td>
</tr>
<tr>
<td>Types of data</td>
<td>Collecting, comparing and analysing data</td>
<td>Carteisian plane</td>
<td>Use a range of algebraic techniques to analyse and solve problems</td>
</tr>
<tr>
<td>Drawing graphs</td>
<td>Summarizing and interpreting data (ungrouped data only and not standard deviation)</td>
<td>Using graphs</td>
<td>Develop and use a range of algebraic graphs to analyse relationships between variables</td>
</tr>
<tr>
<td>Reading and Interpreting graphs</td>
<td></td>
<td>Straight line graphs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement I</td>
<td>Algebra I</td>
<td>Measurement II</td>
<td>Data and statistics III</td>
</tr>
<tr>
<td>Understanding and practical applications of length, mass, volume/capacity</td>
<td>Writing, understanding, using and interpreting formulas and algebraic expressions</td>
<td>Understanding and practical applications of area, volume, energy and other relevant measures</td>
<td>Samples and surveying</td>
</tr>
<tr>
<td>Conversions (within the metric system)</td>
<td>Substituting into equations and solving equations</td>
<td>Conversions within and between systems</td>
<td>Summarizing and interpreting data (including grouped data and standard deviation)</td>
</tr>
<tr>
<td></td>
<td>Practical applications</td>
<td></td>
<td>Algebraic and graphical representations of bivariate data</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time, Location and Direction I</td>
<td>Shape and design I</td>
<td>Shape and design II</td>
<td>Geometry &amp; measurement (Trig and Pythagoras)</td>
</tr>
<tr>
<td>Time duration, scheduling and time zones</td>
<td>Properties of 2D geometric shapes and 3D solids</td>
<td>construct and interpret scale drawings, sketch elevation views</td>
<td>Pythagoras’ theorem</td>
</tr>
<tr>
<td>Reading maps</td>
<td>3D design and 2D representations</td>
<td>Symmetry and similarity</td>
<td>Simple trigonometry</td>
</tr>
<tr>
<td>Giving and following directions</td>
<td></td>
<td></td>
<td>angle of elevation and angle of depression</td>
</tr>
</tbody>
</table>
greater emphasis on the role and importance of selecting and choosing relevant and attractive contexts for discovering, using and applying maths than in the current draft. Teachers must be encouraged as much as possible to apply the maths skills to a wide range of contexts of interest to young adults. It is essential for teachers to customise the curriculum to meet the needs and interests of their students – whether they are in a big metropolitan city, a rural town or remote Australia. A vital part of this is to find relevant, appropriate and interesting contexts for the group of students. And this includes the need for teachers to offer the same class of students a range of contexts in which to apply the maths – this aspect does not come across at all in the current draft.

Both the two contexts suggested in the current draft in the introduction to each Unit and those in the list of “Examples in Context” at the end of each unit are very limited in their scope and are very dry. These need to be reworked to be more interesting and wide ranging, and made more project based and investigative – not simply tasks such as “analysing and interpreting a range of graphical information of global weather patterns that affect food growth” and “expressing ingredients of particular food types as percentages of the total quantity, or per serving size, or per 100 grams, presenting the information in different formats. For example, column graphs, and pie graph”. These could be combined, for example, as an investigation such as “Prepare a report based on an analysis and interpretation of the performance of your favourite sports player or team using a range of statistical data and supported by tables of data and graphs”. A range of such styles of tasks and investigations about topics such as cars and driving, work, sport, fashion, design, catering, music, community based interactions and activities, environmental issues, vocational contexts, etc. are potential contexts for discovering, using and applying maths that will be more interesting and relevant to students.

4. **Units 3 and 4 are more cognitively demanding than units 1 and 2.**

There is an increase in difficulty as you progress from Units 1 and 2 through to Units 3 and 4. However, there are inconsistencies as you progress from one level to another, across and within Topics and Units. E.g. the expected use and understanding of the standard deviation as a measure of spread in Unit 2, Topic 1 – this should be in Unit 3 at a minimum.

5. **There is a clear link between this senior secondary curriculum and the relevant F-10 Australian Curriculum.**

Not necessarily clear, as there are definite overlaps in content - some of the content in Essential maths are skills and knowledge covered in earlier years. This should probably be spelt out in more detail.

6. **The achievement standards across units 1 and 2 and units 3 and 4 are organised in an order consistent with your experience.**

Yes, although we did not get a lot of detailed feedback regarding this area.

7. **CONTENT: UNIT 1. The unit description clearly describes the focus and scope for this unit.**

Disagree with content. The two contexts mentioned are too narrow and dry and not necessarily engaging to the target group – these need to be expanded.
8. **CONTENT: UNIT 1. The unit outcomes describe clearly the expected learning for this unit.**

Disagree with content, so hard to answer this question, as we recommend that the Unit and topics need to be re-organised, as outlined above.

9. **CONTENT: UNIT 1. The unit contains relevant and appropriate content (knowledge, understanding and skills).**

Topic 1 and 2 are too large in comparison with the others. We have suggested some alternatives in the structure above. Regarding the suggested contexts, there are only a couple of contexts suggested for each topic and this needs to be expanded to provide more advice and support to teachers, and they should be described more strongly as projects and investigations where the maths skills do need to be fully used and applied within a relevant and interesting context.

Some specific suggestions based on the current descriptions include:

**Topic 1: Calculations, Percentages and Rates**
- Fractions and percentages are emphasised – why not fractions?
- What about converting between fractions, decimals and percentages?
- The descriptors need to be more explicit about the level of mathematics needed for solving practical problems.
- Should a review of positive and negative integers be included in this topic?

**Topic 2: Measurement**
- We think students could handle more area rules and calculations than rectangles and triangles including simple composite shapes.
- Should students not be exposed to the rule for the volume of a rectangular prism? If so, this could be more explicit than the current example that hints at this.

**Topic 3: Algebra**
- Algebra is too thin – needs more details and should include writing, understanding, using and interpreting formulas and algebraic expressions.
- It would be easy to extend this so that students are required to complete and then interpret tables of values. This would not be beyond them and then technology could be used appropriately.

**Topic 4: Graphs**
- Graphs is also a bit thin – needs more about the structure of data and statistical graphs and chart – types of data, use of axes, scales, etc.
- ‘Determine which type of graph is the best one to display a data set’ – students will need a basic understanding of data and variables for this. Perhaps this needs to be included as a descriptor.
10. CONTENT: UNIT 1. The unit contains an appropriate amount of content, that is, can be taught within 50-60 hours.

Probably OK.

11. CONTENT: UNIT 1. The content descriptions are specific about what is to be taught.

Disagree with content, so hard to answer this question.

12. CONTENT: UNIT 2. The unit description clearly describes the focus and scope for this unit.

Disagree with content. The two contexts mentioned are too narrow and dry and not necessarily engaging to the target group – needs to be expanded. These also need to be expanded and made more varied and investigative in the “Examples in Context” at the end of the Unit.

13. CONTENT: UNIT 2. The unit outcomes describe clearly the expected learning for this unit.

Disagree with content, so hard to answer this question, as we recommend that the Unit and topics need to be re-organised, as outlined above.

14. CONTENT: UNIT 2. The unit contains relevant and appropriate content (knowledge, understanding and skills).

Topic 1 is too large and complex for Unit 2. Suggested some alternatives in structure above. Regarding the suggested contexts, there are only a couple of contexts suggested for each topic and this needs to be expanded to provide more advice and support to teachers, and they should be described more strongly as projects and investigations where the maths skills do need to be fully used and applied within a relevant and interesting context.

Some specific suggestions based on the current descriptions include:

**Topic 1: Representing Data and Comparing Data**

- Topic 1 is too large and complex for Unit 2. The expected use and understanding of the standard deviation as a measure of spread is too sophisticated at this stage of the subject. The Algebra unit in Unit 1 is not a sufficient basis for using and applying such a formula – especially if it is to be used for both ungrouped and grouped data.

- Students are required to identify outliers (using the IQR? – this isn’t explicit). It isn’t clear whether or not students are expected to identify outliers when completing their 5-number summary or their box plot.

**Topic 2: Percentages**

- How far will simple interest calculations be expected to go? Will students just be asked to calculate interest? What about final amounts? What about handling deposits? What
about calculating rates, principal amounts and time periods? This needs to be made clear.

Topic 3: Rates and Ratios

• Are there preference in the way ratios are expressed? Should students use colons, fractional representations, etc.? Are all of these symbolic representations expected?

Topic 4: Time and Motion

• Why isn’t ‘different time zones’ part of ‘time’? It is one of the most practical use of mathematics and is even applicable within Australia? It would be a way of explicitly covering the ‘Asia’ part of the cross-curriculum links.

15. CONTENT: UNIT 2. The unit contains an appropriate amount of content, that is, can be taught within 50-60 hours.

Probably OK.

16. CONTENT: UNIT 2. The content descriptions are specific about what is to be taught.

Disagree with content, so hard to answer this question.

17. CONTENT: UNIT 3. The unit description clearly describes the focus and scope for this unit.

Disagree with content. The two contexts mentioned are too narrow and dry and not necessarily engaging to the target group – needs to be expanded. These also need to be expanded and made more varied and investigative in the “Examples in Context” at the end of the Unit.

18. CONTENT: UNIT 3. The unit outcomes describe clearly the expected learning for this unit.

Disagree with content, so hard to answer this question, as we recommend that the Unit and topics need to be re-organised, as outlined above.

19. CONTENT: UNIT 3. The unit contains relevant and appropriate content (knowledge, understanding and skills).

Too much in this unit – needs to be trimmed. Suggested some alternatives in structure above. Regarding the suggested contexts, there are only a couple of contexts suggested for each topic and this needs to be expanded to provide more advice and support to teachers, and they should be described more strongly as projects and investigations where the maths skills do need to be fully used and applied within a relevant and interesting context.
Some specific suggestions based on the current descriptions include:

**Topic 1: Measurement**
- Measurement is large in comparison with the others, and much overlap with the measurement unit in Unit 1
- Should there be something mentioned about accuracy – for example, rounding off too early can cause inaccurate final total surface areas?

**Topic 2: Scales, plans and models**
- Too large – the right-angled triangles section should be moved to a later unit.
- Students are asked to find actual measurements from scale drawings. Should they be required to work backwards too?

**Topic 3: Graphs**
- What is purpose in having students find the equations of parallel lines?
- If so, is this to be done graphically or algebraically (could be conceptually quite difficult)?

**Topic 4: Data Collection**
- Is there too much emphasis on the theory of surveys? Make it more practical focused.

20. **CONTENT: UNIT 3. The unit contains an appropriate amount of content, that is, can be taught within 50-60 hours.**

We feel there is too much content in this Unit and that it needs to be trimmed down.

21. **CONTENT: UNIT 3. The content descriptions are specific about what is to be taught.**

Disagree with content, so hard to answer this question.

22. **CONTENT: UNIT 4. The unit description clearly describes the focus and scope for this unit.**

Disagree with content. We don’t think Unit 4 is at all appropriate or well described. Two of the Topics are actually contexts and not content as with all other Topics. Why in Unit 4 suddenly have two context based Topics – Earth Geometry and Time Zones and Loans and Compound Interest? Both of these Topics are contexts that can be used as such, if appropriate and relevant, from within other maths content topics – e.g. Earth Geometry and Time Zones from within Time and Motion (and Location and Direction if it was included) and Loans and Compound Interest should be seen as applications of a range of topics such as Percentages, Algebra and Graphs. Both these topics are highly unlikely to be engaging or attractive to students in most settings – but especially, for example, to remote indigenous learners or those from lower socio-economic backgrounds.

They need to be replaced with other Topics that are consistent with the overall structure – see suggestions above.
The two contexts are too narrow and dry and not necessarily engaging to the target group – needs to be expanded. These also need to be expanded and made more varied and investigative in the “Examples in Context” at the end of the Unit.

23. CONTENT: UNIT 4. The unit outcomes describe clearly the expected learning for this unit.

Highly disagree with content, so hard to answer this question, as we recommend that the Unit and topics need to be completely re-organised, as outlined above.

24. CONTENT: UNIT 4. The unit outcomes describe clearly the expected learning for this unit.

Too much in this unit – needs to be trimmed. Suggested some alternatives in structure above. Regarding the suggested contexts, there are only a couple of contexts suggested for each topic and this needs to be expanded to provide more advice and support to teachers, and they should be described more strongly as projects and investigations where the maths skills do need to be fully used and applied within a relevant and interesting context.

Some specific suggestions based on the current descriptions include:

**Topic 1: Probability and relative frequencies**

• How many events are students expected to handle when drawing tree diagrams?

• We assume we are talking about “with replacement” problems.

**Topic 2: Earth geometry**

• Not content, but a context.

• Highly unlikely to be engaging or attractive to students in most settings – but especially, for example, to remote indigenous learners or those from lower socio-economic backgrounds.

**Topic 3: Loans and compound interest**

• Not content, but a context.

• Highly unlikely to be engaging or attractive to students in most settings – but especially, for example, to remote indigenous learners or those from lower socio-economic backgrounds.

25. CONTENT: UNIT 4. The unit contains an appropriate amount of content, that is, can be taught within 50-60 hours.

We feel there is too much content in this Unit and that it needs to be trimmed down. Topic 1 is Ok, but as explained above two of the Topics are actually contexts and not content as with all other Topics. They need to be replaced with other Topics that are consistent with the overall structure – see suggestions above. Regarding the suggested contexts, there are only a couple of contexts suggested for each topic and this needs to be expanded to provide more advice and support to teachers, and they should be described more strongly as projects and investigations where the maths skills do need to be fully used and applied within a relevant and interesting context.
26. CONTENT: UNIT 4. The content descriptions are specific about what is to be taught.
Disagree with content, so hard to answer this question.

27. ACHIEVEMENT STANDARDS: UNIT 3 AND 4.
Yes we agree, although we did not get a lot of detailed feedback regarding this area.

28. Representation of General capabilities.
The links between Essential Mathematics and the general capabilities need to be spelt out more clearly so that this is transparent and more supportive to teachers. Apart from in the general introduction, they are not used or developed further within the Units or Topics.

29. Representation of Cross-curriculum priorities.
The links between Essential Mathematics and the Cross-curriculum priorities need to be spelt out more clearly so that this is transparent and more supportive to teachers. Apart from in the general introduction, they are not used or developed further within the Units or Topics.

30. The glossary is comprehensive.
The MAV agrees that the glossary is comprehensive, but needs to be updated to reflect any changes to content.

General Mathematics
The comments in this response broadly reflect views and values offered by Victorian mathematics teachers, who are also MAV members, in the independent, government and Catholic sectors. Please note that a significant number of specific recommendations in this summary were made by Robert Money. Recommendations were also made by Ian Lowe, Peter Fox, other respondents to the MAV survey and me – Kelly Gallivan.

1. The rationale provides clarity about the subject’s broad scope, distinctive nature and importance.

MAV believes that the General Mathematics rationale aims to provide clarity about the subject’s broad scope, distinctive nature and importance. We believe that the rationale achieves this aim to a reasonable extent but would make the following recommendations for improvement.

MAV contends that the rationale should begin with a positive statement that is specific to General Mathematics. This statement could be similar to the one that has been written for Mathematical Methods: "The subject Mathematical Methods is designed for students whose future pathways may involve mathematics and statistics and their applications in a range of disciplines at the tertiary level." We believe that the emphasis of this statement should be positive and should reflect the tertiary possibilities for students who have completed Units 3 and 4 of General Mathematics. We believe that this statement should focus on what students ‘can do’ as opposed to what they ‘cannot do’. For this reason, MAV would suggest that the first sentence of the second paragraph is unnecessarily negative in nature: “but whose future studies or employment pathways do not require knowledge of calculus”. This statement is unnecessary because a brief examination of the curriculum makes it crystal clear that
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calculus is not a key topic. Again, we would recommend that ACARA is specific about the pathways that students (social sciences, etc.) can take through having completed General Mathematics. If the first paragraph is amended according to our recommendation, it may not even be necessary to include this statement in the first place. To be honest, one complete paragraph dealing with the post-secondary school opportunities for General Mathematics students would be appropriate – better than one sentence in the first paragraph and a couple more in the second paragraph. The structure of the rationale would be more logical this way and the paragraphing would be better (important for an Australian Curriculum document).

The second paragraph attempts to explain the links between the F-10 proficiency strands (understanding, fluency, problem solving and reasoning) and General Mathematics. Ideally, this should be a paragraph in its own right. MAV also believes that the development of the ideas in this paragraph could be more logical and thorough. Firstly, the development of ideas neglects to specifically cover how students’ conceptual understanding of mathematics will be enhanced. Instead, the paragraph focuses on the other proficiencies. In the rationale, problem solving is linked to fluency, “fluency with algorithmic processes is part of learning to become an effective and efficient problem solver”, and making connections, “understanding that a single mathematical process can be used in seemingly different situations”. MAV agrees that problem solving skills are enhanced by fluency with algorithms and making connections. However, we believe problem solving also involves higher-order thinking skills (such as creativity and deep analysis) that go beyond being able to identify the appropriate rule to use and being able to follow that strategy through to its end. We would suggest that an incomplete discussion of these proficiencies with regards to General Mathematics undermines both the capacity for rich learning within this subject and the students who will endeavour to complete General Mathematics. Students studying Mathematical Methods and Specialist Mathematics may be (generally) more capable but this does not mean that General Mathematics students are incapable of thinking deeply and solving problems within the conceptual scope of the subject. The description in the rationale seems to ‘dumb down’ problem solving and suggest that students will merely be solving routine worded questions. We believe General Mathematics candidates are capable of more and that the curriculum should reflect this. We believe that this paragraph should be re-drafted to more thoroughly and logically deconstruct the proficiencies and their links to General Mathematics.

MAV finds that the summary of content in the rationale is adequate but would still like to make the following recommendations. Firstly, basic linear algebra and graphing should be mentioned under the description of Number and Algebra. Similarly, trigonometry should be named when summarizing Measurement and Geometry. Under Probability and Statistics, MAV finds the comment “comparing groups” to be ambiguous. Reading the topic outlines, we take this to mean comparing data for different groups using stem and leaf plots, parallel box plots, etc. However, this could also be interpreted as comparing groups when working with grouped data (discrete or continuous). By its very nature, a rationale should make some attempt to explain the reason the course contains the content that it does. We wonder why the focus of financial modelling is discrete data and not data with continuous domains. Also with regards to financial modelling, we wonder why basic exponential relationships have not been included. MAV also feels that the normal distribution fits nicely into statistics and it is a distribution that is relevant as the ‘bell-curve’ is commonly referred to in everyday society. Some MAV members have questioned the need for the basic measurement rules in the General Mathematics curriculum in light of the fact that it is covered so extensively in the F-10 curriculum and in light of the fact that there isn’t a strong link to the Units 3 and 4 content. Other MAV representatives have recommended the inclusion of quadratics in the course. This would be a good challenge that is not beyond many of the students who would take General Mathematics. It would also discourage schools from neglecting to teach the quadratics content to their weaker Year 10 students taking Year 10 or Year 10A Mathematics.
2. **The aims comprehensively describe the intended learning as a result of studying the subject.**

MAV agrees that the aims describe the intended learning as a result of studying General Mathematics. We disagree that this has been done comprehensively. We would suggest adding the phrase “including ascertaining the reasonableness of solutions to problems” (as per Mathematical Methods) because we also believe it to be relevant to those students studying General Mathematics. MAV members have commented that incorporating this statement will make the aims more consistent with the achievement standards and thus more comprehensive. We think that the aims could more comprehensively address cross-curriculum pursuits and general capabilities. With regards to the aims suggested, MAV would like to make the following comments. We question the omission of the terms ‘probability’ and ‘algebra’ in the first two bullet points. We also suggest that the aims should reflect our hope that students are solving both routine and non-routine problems and believe this sentiment should be reflected in the second bullet point.

3. **The four unit structure has internal logic and coherence.**

MAV believes that the four unit structure has basic internal logic and coherence. We believe, though, that there are some general and specific issues that need to be considered when writing the next draft of the senior curriculum.

The first concern that Victorian teachers have expressed is the lack of flexibility in the course. Currently, the Victorian Curriculum and Assessment Authority offer General Mathematics as a subject in Victoria. This subject offers a range of topics and schools organise their General Mathematics subjects based on their cohorts and their interests. For example, schools can offer General Mathematics as a pre-cursor to Specialist Mathematics Units 3 & 4, a pre-cursor to Further Mathematics Units 3 & 4 and as hybrid subject where students taking General Mathematics are getting extra practice for Mathematical Methods and either Specialist Mathematics or Further Mathematics. Schools can also simply offer General Mathematics with a range of topics. Already in Victoria, it is not uncommon for a Government school not to offer Specialist Mathematics. Many schools that do offer Specialist Mathematics Units 3 & 4 currently cannot sustain a General Mathematics Specialist class in Year 11 and thus offer a combined subject for students wanting to do either Specialist Mathematics or Mathematical Methods in Year 12. This flexibility is possible because of the range of topics and possible structures to an individual school’s curriculum. Many government teachers are concerned that a consequence of the proposed General Mathematics course will be a reduction in the number of government schools that can offer Specialist Mathematics. This would not be preferable. Australia’s future prosperity relies on a knowledge economy where the demand will be for more able mathematicians. Cutting short prospective careers because schools are unable to offer a Specialist Mathematics program as a result of the narrowing of the General Mathematics course would be counter productive. We recommend, therefore, that more flexibility be considered for the General Mathematics course.

Considering another aspect of flexibility, the sequence of topics and units presented will negatively affect opportunities Victorian students have to change mathematics subjects between semesters and between Years 11 and 12. Students at the age of 15 and 16 are often misguided as to their mathematical capability. It is not uncommon for them to underestimate their ability or to find a subject more challenging than they expected and decide to change subjects between semesters or years. MAV finds that the proposed sequence of the curriculum for General Mathematics would make such transitions difficult. For instance, there is little overlap between topics. An example of this is in Financial Mathematics. In Unit 1, students cover up to and including compound interest. Unit 4 begins...
with reducing balance loans. A student would be less likely to take up Units 3 and 4 in General Mathematics (moving from a Mathematical Methods class that was too difficult for them) because they won’t necessarily have the prerequisite knowledge. While some of Units 1 and 2 are also covered in the F-10 curriculum, not all of it is. We would recommend that there is more overlap and review of Units 1 and 2 (during Units 3 and 4) to assist students who are changing subjects. With this in mind, we also believe that changing the sequence of topics is in order. We would recommend moving the algebra (General Mathematics) to Unit 1. This would mean that Victorian students could better move between courses. For instance, Mathematical Methods students could change to General Mathematics at the end of Semester One of Year 11. Similarly, the General Mathematics students could change to Essential Mathematics at the end of Semester One of Year 11.

Some specific topics could also be organised in a more logical fashion. For example, it would make sense to cover normal distribution when discussing standard deviation within statistics. This is because normal distribution helps students understand standard deviation in a more meaningful way. Similarly, it needs to be made more explicit, in statistics units, as to the types of data students should be working with. MAV members have also suggested that ‘growth and decay’ should also cover questions with continuous domains.

4. **Units 3 and 4 are more cognitively demanding than units 1 and 2.**

MAV members agree that Units 3 and 4 are more cognitively demanding than Units 1 and 2. We would recommend some overlap and some review of the material from Units 1 and 2 (relevant to Units 3 and 4) to assist weaker students and to assist students moving between subjects.

5. **There is a clear link between this senior secondary curriculum and the relevant F-10 Australian Curriculum.**

Most MAV survey respondents agreed that there is a clear link between this senior curriculum and the relevant F-10 Australian curriculum.

One respondent queried the need for Measurement in Units 1 and 2. This was questioned for two reasons. Firstly, the Mensuration formulae covered in General Mathematics have already been comprehensively covered in the F-10 Australian Curriculum. Secondly, the Measurement and Geometry focus of Units 3 and 4 is completely different. This response, from a respected MAV member, suggested that unless Measurement is connected directly to a concept studied later, it should be removed for the benefit of covering other topics more comprehensively.

Another respondent was pleased that Matrices and Networks have been included in the General Mathematics course. Their concern was the apparent lack of a link to Year 9 or Year 10 Mathematics. The MAV advises ACARA to make this link more explicit so that teachers can plan their scope and sequence documents more effectively when managing the transition from Year 10 to Year 11.
6. **The achievement standards across units 1 and 2 and units 3 and 4 are organised in an order consistent with your experience.**

The MAV generally agrees that the achievement standards across Units 1, 2, 3 and 4 are organised in an order consistent with our experience. We would make the following recommendations though.

The MAV would suggest that there is a more detailed description of the carrying out of a statistical investigation. Furthermore, some clarification is needed about the reasoning and communication sections of the standards as we believe teachers may find it hard to interpret. We similarly think that the achievement standard that discusses recognising representations of mathematical and statistical information needs work as this is unclear and ambiguous. Also, a MAV member noted that the phrase ‘practical problems’ is used a lot within the topic descriptions but not at all here. Perhaps ‘practical applications (of learnt procedures)’ would be better in some cases. This member also requests that ACARA please give examples of ‘problems that require the synthesis of ideas from mathematics and statistics’. Where do such problems occur within the topic descriptions? Additionally, the phrase ‘non-standard problems’ is used for the first time here and without a definition. A definition needs to be given here, perhaps using phrases such as ‘open investigations’ or ‘problems in contexts new to the student’. ACARA could easily provide a range of examples of ‘non-standard problems’ within the topic descriptions. We also recommend that the phrase ‘routine problems’ could well be replaced with ‘routine applications of the skills and procedures outlined in the topic descriptions’.

7. **CONTENT: UNIT 1. The unit description clearly describes the focus and scope for this unit.**

MAV members mostly agree that the unit description clearly describes the focus and scope for this unit. We would like to make the following recommendations though.

The MAV believes that the comment “‘Matrices and ‘Graphs and networks 1’ will be new to students but the mathematics involved follows naturally from the mathematics in the Algebra and Number strand of the F-10 curriculum” needs to be adapted. Firstly, through extension and enrichment programs, it is highly possible that students will have been exposed to matrices and some basic graph theory. For this reason, we believe the phrase “will be new to students” is too strong a statement. Furthermore, acknowledging that these topics may new to students, it is important that ACARA does more than simply assert that there are links to the F-10 curriculum. These links need to be made clear to Australian teachers. Related to this, applications of graphs and networks have been included in this statement but applications of matrices have not been included. These need to be laid out clearly for teachers.

8. **CONTENT: UNIT 1. The unit outcomes describe clearly the expected learning for this unit.**

The MAV contends that most of the unit outcomes describe clearly the expected learning for this unit. We would like to make a recommendation about the second unit outcome: “apply reasoning skills and solve practical problems in Financial mathematics, Matrices, and Graphs and networks”. We would suggest that “solve practical problems” is amended to “solve routine, non-routine and practical problems”.

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9. **CONTENT: UNIT 1. The unit contains relevant and appropriate content (knowledge, understanding and skills).**

Topic 1: MAV recommends the inclusion of ratio problems and comparison rate of interest problems. MAV believes that there seems to be a large jump in complexity between Unit 1 Financial Mathematics and Unit 3 Financial Mathematics. MAV recommends that something (introducing basic reducing balance loans perhaps) needs to be done to bridge this gap. MAV also wonders whether there is too much of a time difference between the two Financial Mathematics units.

Topic 2: MAV wonders whether the “coding and de-coding of messages” is the most practical application of matrices. Other (and perhaps better) applications could come from Topic 1 or from later (simultaneous equations). Generally, MAV would like ACARA to be more specific about the types of practical problems that need to be solved. MAV additionally suggests that many General Mathematics students would be able to calculate the inverse of a $2\times2$ matrix by hand. MAV also wonders whether the inverse of Matrices would be more appropriately placed within the linear equations topic. This is not a difficult skill for an average Year 10 student and thus would be pitched appropriately at a Year 11 General Mathematics student.

Topic 3: MAV believes that the statement “identify practical situations that can be represented by a graph” is somewhat ambiguous. What does ACARA really want students to be able to identify? MAV would add the following statement to the topic description: “recognize identical and different connected graphs, planar graphs and trees and explain how the number of different such graphs are related to the number of vertices.” MAV recommends moving “planning an efficient garbage bin collection route” to the bullet point about weighted graphs. Here “Mei-ko Kwan’s postman problem” could be added. We also suggest that the two dot points under minimum connector problems could be amalgamated with the ‘or’ words being replaced with ‘and’ words. MAV members have suggested that this would require students to know the difference between the two algorithms. MAV also recommends adding an extra dot point about finding the shortest path between two given vertices in a weighted graph.

10. **CONTENT: UNIT 1. The unit contains an appropriate amount of content, that is, can be taught within 50-60 hours.**

On this point, two key viewpoints have been expressed by MAV members. Some Victorian teachers are worried about covering the course content within 50 – 60 hours. Others call for more content to be included. Suggestions involve incorporating one in-depth investigation of an extended or non-routine problem, either in Topic 1 or in Topic 3. MAV believes that this would accord with the Achievement Standards and could involve examples with an ethical or cross-curriculum focus. MAV also believes that this type of investigation could be built into the learning (rather than taking extra curriculum time).

11. **CONTENT: UNIT 1. The content descriptions are specific about what is to be taught.**

The MAV recommends that “effective annual rate” is more specifically explained.
12. CONTENT: UNIT 2. The unit description clearly describes the focus and scope for this unit.

The MAV disagrees with the Unit Description dealing with Measurement and Space. The claim that ‘The emphasis in this topic is on applying these skills in a range of practical contexts’ is not borne out by the topic detail.

13. CONTENT: UNIT 2. The unit outcomes describe clearly the expected learning for this unit.

One MAV member strongly disagrees with the statement that the unit outcomes describe clearly the expected learning for this unit. This member claimed that ‘the emphasis in this topic is on applying these skills in a range of practical contexts’ are not borne out by the topic detail. This same member states that “I particularly like the phrase ‘implement the statistical investigation process’ and think that this should come as the first dot point under the heading ‘Comparing data for a numerical variable across two or more groups’”.

14. CONTENT: UNIT 2. The unit contains relevant and appropriate content (knowledge, understanding and skills).

Topic 1: The MAV finds that the name “Statistics 1: Comparisons” is somewhat confusing. Is this topic only dealing with discrete, univariate data? The topic name could more appropriately describe its content. When students are asked to identify discrete data, will they be comparing it to continuous data? Therefore, should students be asked to also identify continuous data? MAV recommends that ACARA include basic graphs and representations such as histograms, bar and column graphs, ogives and frequency tables in the topic. The MAV finds that the bullet points need to be more specific as to whether or not a study of grouped discrete data is appropriate and they need to be specific as to when technology is and isn’t appropriate. For example, will a teacher be required to teach standard deviation by hand or is the use of a hand-held CAS calculator sufficient? The MAV recommends that ACARA includes a couple of dot points about the properties of a normal distribution, in particular calculating (using technology) and interpreting the 66%, 95% and 3 sigma probability limits. This gives students the means to interpret their calculations of standard deviation and to discuss how well their data sets are modelled by ‘normal’ assumptions. Furthermore, ACARA should take the chance here to suggest more fitting investigation questions than are Year 10 students the fittest in the school? Consider examples involving Personal and social capability, Ethical behaviour and Cross curriculum priorities.

Topic 2: The MAV recommends that ACARA emphasises the review aspect of this topic given its links to the F-10 curriculum. The MAV recommends that ACARA make the statements about technology more consistent across dot points. Victorian teachers have queried the methods students will be required to know when solving simultaneous equations. They have questioned whether or not technology is always appropriate and whether students will need to work through simultaneous linear equations using algebra. Here, the MAV recommends that matrix methods be included as an extension to Unit 1. Thus, the inverse of matrices should be included as a dot point. Furthermore, the MAV suggests that ACARA could recommend more examples related to finance, cross-curriculum content, personal and social capability or ethical behaviour.

Topic 3: There is a debate amongst MAV members as to whether this topic should or should not be included in General Mathematics. Proponents see it as a useful, confidence building topic. Opponents question its links to Units 3 and 4 and claim that it has already been taught during F-10. If this topic was removed, time would be available for other topics such as the
normal distribution. MAV members have queried why basic trigonometry hasn’t been included in Unit 2. The MAV contends that there is a big jump between Year 10 trigonometry and Unit 2 of General Mathematics. The MAV is concerned about the requirements associated with the statement that students complete scaled diagrams – what does this mean?

15. **CONTENT: UNIT 2.** The unit contains an appropriate amount of content, that is, can be taught within 50-60 hours.

Most MAV members agreed that the unit contains an appropriate amount of content, that is, it can be taught within 50 – 60 hours.

16. **CONTENT: UNIT 2.** The content descriptions are specific about what is to be taught.

The last dot point for Topic 1 needs to be more clearly stated as a requirement to carry out a statistical investigation. This could become the heading for all of Topic 1, with the other dot points to be covered within the context of the investigation. An extended list of possible questions and data sets could be given, with more focussed options than the ‘Year 10 fitness’ question.

17. **CONTENT: UNIT 3.** The unit description clearly describes the focus and scope for this unit.

Limiting content to discrete models is tidy but offers a limit on approaches to problem solving, even within the theme of financial mathematics. Some MAV members would have preferred the topic to be Modelling growth and decay in both discrete and continuous systems. MAV would recommend that the word ‘geometry’ is deleted from the learning outcomes as trigonometry (not geometry) is the focus of the unit. Alternatively, some of the Units 1 & 2 content needs to be re-visited or extended.

18. **CONTENT: UNIT 3.** The unit outcomes describe clearly the expected learning for this unit.

MAV agrees that the unit outcomes describe clearly the expected learning for this unit. Our only recommendation would be removing the word ‘geometry’ if no ‘geometry’ is added to the curriculum for this unit.

19. **CONTENT: UNIT 3.** The unit contains relevant and appropriate content (knowledge, understanding and skills).

Topic 1: The MAV believes that it needs to be made clear that students are dealing with bi-variate data. The terms “response variable” and “explanatory variable” need to be more clearly explained. Victorian teachers are more used to hearing “dependent variable” and “independent variable” and these terms are more consistent with the Science curriculum. We wonder why the coefficient of determination has not been included when it is a logical extension of Pearson’s correlation coefficient. We also believe that the statement “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” is somewhat ambiguous and needs to be spelt out more clearly or the content requirement needs to be
adapted. Students would not have the knowledge required to justify significant difference between any two percentages derived from categorical data. Would they be expected to simulate using a model based on a null hypothesis? One MAV member recommends that to adapt the statement, part or all of the reference to categorical data be deleted. The MAV would support this unit being wholly about numerical data. If this was the case, the phrase “two categorical variables” could be deleted from the requirements of the data investigation. It may be worth placing this investigation process paragraph at the start of this topic as the teaching of many concepts and skills can be done via this mechanism.

Topic 2: The MAV agrees that the unit contains relevant and appropriate content with regards to trigonometry. We would argue that ACARA should either take “geometry” out of the title or add some geometry to the unit to follow up and extend what is covered in Units 1 and 2.

Topic 3: the MAV wonders whether or not students are going to be required to find difference equations. This should be made clear. Under our comments regarding the rationale, we suggested the inclusion of exponential growth and decay. This study could also include polynomial and reciprocal growth and decay and even extend to a discussion of variation. This topic could be opened up more broadly, therefore, by deleting the word ‘discrete’. The MAV would support this move as it would lead to a more rich understanding of growth and decay. Time would be made for this if the study of bivariate categorical data was removed from the statistics unit.

20. CONTENT: UNIT 3. The unit contains an appropriate amount of content, that is, can be taught within 50-60 hours.

A small number of MAV survey respondents felt that the unit does not contain an appropriate amount of content that can be taught within 50 – 60 hours. On balance, the MAV believes, though, that the amount of content is appropriate.

21. CONTENT: UNIT 3. The content descriptions are specific about what is to be taught.

Topic 1: The MAV again reiterates that the section on categorical variables should be deleted as students would not have the knowledge required to justify significant difference between any two percentages. This would ensure time for the recommendation below for an expansion of Topic 3 to be engaged. We again reinforce the idea that the data investigation process section should be placed first to emphasize that students are required to implement a statistical investigation.

Topic 2: Geometry should not be part of the title or geometry should be included more comprehensively in the topic. Move (perhaps) to a dot point the bit about reviewing K-10 knowledge about Pythagoras theorem and trigonometry for right angled triangles.

Topic 3: Make changes to expand the topic to include continuous models. For instance, change the heading ‘The arithmetic sequences to ‘Linear relationships’. Then, include a dot point about comparing discrete models (arithmetic sequences) with continuous models \( y = mx + c \). Similarly, change the heading ‘The geometric sequence’ to ‘Exponential models’. Then, add a dot point about comparing the discrete model (geometric sequence) with continuous models \( y = a + be^{nt} \). The MAV would support the breadth of this expanded topic.
22. **CONTENT: UNIT 4. The unit description clearly describes the focus and scope for this unit.**

The MAV agrees that the unit description clearly describes the focus and scope for this unit.

23. **CONTENT: UNIT 4. The unit outcomes describe clearly the expected learning for this unit.**

The MAV agrees that the unit outcomes describe clearly the expected learning for this unit.

24. **CONTENT: UNIT 4. The unit outcomes describe clearly the expected learning for this unit.**

Topic 1: The MAV would recommend slightly more overlap in content between the Unit 1 topic and the Unit 4 topic as they are so far apart and as students may have moved into the subject General Mathematics after Unit 1. MAV would recommend that the annuities equation is included in the curriculum. Students could use numerical methods to solve for the exponent if they have not been previously exposed to logarithms. This way, students would be able to solve for any of the unknowns in the equation. We support using technology to find these values as well. We believe that both methods – technology and using the formula – should be emphasised.

Topic 2: Our only recommendation here would be to emphasise the data investigation process by moving its detail to the beginning of the section.

Topic 3: The MAV would recommend moving some of the matrices content to Unit 1 and simply including a review of it here. We believe that more dot points should be included about the possible applications of networks – stressing that these can be solved using inspection techniques.

25. **CONTENT: UNIT 4. The unit contains an appropriate amount of content, that is, can be taught within 50-60 hours.**

Most MAV members agree that the unit contains an appropriate amount of content to be taught within 50 – 60 hours.

26. **CONTENT: UNIT 4. The content descriptions are specific about what is to be taught.**

Topic 1: MAV would support the recommendation: change the dot point about annuities to: “Solve problems involving annuities using the annuities equation or with the aid of calculator or computer based financial software. Include 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.” Add another example to illustrate the flexibility required. For example, determining the monthly repayment required to repay a loan of $200,000 over 10 years with interest charged at 6% pa, compounded monthly.

Topic 3: Consider moving two of the matrix dot points to unit 1, with a review here for matrices of directed graphs. Add one or more dot points about directed digraphs and their applications, but limit solution to ‘by inspection’. For example:- Understand the properties of
directed digraphs. Construct directed digraphs to represent practical situations, including assignment and transport problems. Use inspection methods to solve small scale assignment and transportation problems.

27. ACHIEVEMENT STANDARDS: UNIT 3 AND 4.

The MAV believes that the achievement standards for Units 3 and 4 can be improved in light of the following comments. Unfortunately the Achievement Standards make only vague reference to what appears to be the key work requirement of carrying out a statistical investigation. One respected MAV member is particularly dissatisfied with the Reasoning and Communication sections of the Achievement Standards. Hopefully a major effort can go into writing this section in a way that is easier for teachers to interpret. MAV finds that the word ‘problems’ is used a lot with or without a whole range of preceding adjectives and in some cases followed by limiting clauses—simple, familiar, non-routine. MAV suggests that the distinctions hard to recognize. Clarification is needed, here and perhaps also in the topic descriptions.

28. Representation of General capabilities.

There is some disagreement as to whether or not the general capabilities that naturally fit with this subject are appropriately represented. The MAV recommends that the links between General Mathematics and the general capabilities need to be spelt out more clearly so that this is transparent.

29. Representation of Cross-curriculum priorities.

There is some disagreement as to whether the cross-curriculum priorities that naturally fit with this subject are appropriately represented. MAV members query this in particular reference to "ethical behaviour" and would like ACARA to be clear on how this is reflected in the curriculum statement.

30. The glossary is comprehensive.

The MAV agrees that the glossary is comprehensive but that it should be adapted as per changes to content.

Mathematical Methods

1. The rationale provides clarity about the subject's broad scope, distinctive nature and importance

One can think of mathematics in many guises. It is a lens for viewing the world; it is a wondrous art; and it is a toolbox for helping us construct solutions to problems. While the rationale does mention that mathematics is "highly sophisticated and elegant" the rational does little to celebrate its beauty, or to acknowledge, just as in History and English, how one’s life can be enriched by the study of Mathematics. The Literature document suggests that the study of text “enriches students’ understanding of human experiences”; History "contributes to an understanding of changing interpretations and issues related to the ethical study, ownership and conservation of the past"; Physics “emphasises how models have been developed”, “how they have been applied”, and “how they have been challenged and reconceptualised over time”. Mathematics is much more than a toolbox or pathway and the rational should emphasise this, not only in this course but in others. Learning Mathematics is enjoyable and uplifting, whatever pathway one chooses.
That said, the rational speaks clearly to the course detail that follows. There does seem to be some contradictions with the divisions in the course. In the second paragraph, it states that the major themes in this Mathematics course are *calculus and statistics*. Yet in the first paragraph, statistics is described as something separate from mathematics. We suggest that statistics is a subset of mathematics, as is calculus, number theory, linear algebra etc, and should be described consistently in this document. Some MAV members actually questioned when had Mathematics become Mathematics and Statistics? MAV has consistently rejected the teaching of statistics in courses such as these.

2. **The aims comprehensively describe the intended learning as a result of studying the subject.**

MAV members believe that the aims do clearly describe the intended learning as a result of studying the subject.

3. **The four unit structure has internal logic and coherence**

MAV members agreed that the four unit structure has logic and coherence. Victoria has had a similar system for many years and the members feel that there are enough similarities between this structure and the current VCE structure for teachers to manage it.

4. **Units 3 and 4 are more cognitively demanding than units 1 and 2.**

There is an increase in difficulty as you progress from Units 1 and 2 through to Units 3 and 4. There is a clear link between this senior secondary curriculum and the relevant F-10 Australian Curriculum.

5. **The achievement standards across units 1 and 2 and units 3 and 4 are organised in an order consistent with your experience.**

Yes, although we did not get a lot of detailed feedback regarding this area.

6. **CONTENT: UNIT 1 and Unit 2**

*The unit descriptions clearly describe the focus and scope for this unit.*

Content descriptors are very brief, though again generally in line with what teachers are used to from VCAA documents

*The unit outcomes describe clearly the expected learning for these units.*

List of outcomes is comprehensive though more detail such as “key knowledge and skills” as described in VCAA documents would be useful

*The units contains relevant and appropriate content (knowledge, understanding and skills).*

Note point below. There is too much content and removal of the some of the statistics content is recommended by many MAV members. Topic 3, Discrete Random Variables
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should be cut down. Perhaps just deal with Random variables for discrete data and leave the Bernoulli distributions until Unit 3. Why not teach combinatorics here? Algebra, Functions and graphs is explicitly needed for Mathematical Methods Units 3&4 and should have its own section, not implicitly under calculus.

**The units contain an appropriate amount of content, that is, can be taught within 50-60 hours.**

There is concern that there will not be enough time to complete the work as prescribed, particularly if we wish to enrol as many students from Year 10 as possible. See comment later

**The content descriptions are specific about what is to be taught.**

Content descriptors are adequate, though teachers will rely on the provision of well written text books to accompany these descriptors.

**ACHIEVEMENT STANDARDS: UNIT 1 AND 2.**

Little feedback given by members so assume fine. It will be essential to provide exemplars for each of the standards, and these in a variety of models of assessment.

**7. CONTENT: UNITS 3&4. The unit descriptions clearly describes the focus and scope for this unit.**

Fine but note comment from Units 1&2

**The unit outcomes describe clearly the expected learning for this unit.**

Agree but suggest that the content should be changed

**The units contain relevant and appropriate content (knowledge, understanding and skills).**

There are concerns from MAV members:

1. Sampling and Confidence levels have been taught in Victoria (pre 2000) and there is a general consensus that they should be removed from this course. The students did not manage this topic despite competent teaching.
2. Matrices would be better here than in SM
3. Move Calculus 5 to SM
4. Move discrete distributions from Unit 2 to Unit 3
5. The course structure does not facilitate appropriate content for examination questions. It allows for shallow content based questions

**The units contain an appropriate amount of content, that is, can be taught within 50-60 hours.**

MAV members concur that as listed, there is too much content to be covered in the time specified
The content descriptions are specific about what is to be taught.

Agree

The unit descriptions clearly describes the focus and scope for this unit.

Some expansion including key knowledge and skills would be useful

8. ACHIEVEMENT STANDARDS: UNIT 3 AND 4.

Little feedback given by members so assume fine. It will be essential to provide exemplars for each of the standards, and these in a variety of models of assessment.

9. Links to Years F – 10

It is not necessary to complete all of 10A to access this course. Most Year 10 students will complete course 10 not 10 A and it was felt that with a little tweaking of the course, many students could be able to attempt it.

10. Representation of General capabilities

The draft curriculum does little to represent these capabilities and priorities. It states that in devising activities, teachers will be able to explore all of these key objectives but does not give any indication of how, or of how one can assess these priorities. If ACARA and the Ministers think that these are important objectives, then is it reasonable to leave their implementation to the whim of teachers? How does one assess the worthwhileness of such activities? And what of issues with equity? For example, how can teachers in Victoria, particularly in cities like Melbourne, how to write/source/evaluate meaningful activities to look at Indigenous and TS culture? And hope that the students in their care gain a greater appreciation and understanding?

We acknowledge that because of the constantly changing nature of ICT, it may be difficult to specify. But in this curriculum, could essential “by hand” skills be identified? Or will that be up to the States and Territories to specify?

11. Representation of Cross-curriculum priorities

The links between Mathematical methods and the Cross-curriculum priorities need to be spelt out more clearly so that this is transparent and more supportive to teachers. Apart from in the general introduction, they are not used or developed further within the Units or Topics.

12. The glossary is comprehensive.

The MAV agrees that the glossary is comprehensive, but will need to be updated to reflect any changes to content.

Specialist Mathematics

The overall reaction to the Specialist Maths curriculum has been positive. It was generally agreed that the rationale, aims, general capabilities and achievement standards were seen to be suitable. The majority of the content was also well supported.
The issues of concern which were raised all related to the content. Many comments were made in the section of the survey relating to ‘relevant and appropriate content’. There was a widespread feeling that there was too much content and that it would be better to remove some and that the amount of material needed to be cut back to ensure that the subject is teachable and learnable within the time frame.

The main targets for criticism were the Statistics Unit and the Graph Theory Unit. With regard to the Statistics, there was a feeling that the material was uninteresting and would have an effect on teacher and student enthusiasm for the subject. It was also seen to take up time which could be spent more productively on other, more interesting topics. It was often stated that these do not fit with the major thrust of a subject.

**The comments on the Statistics Unit included**

- Get rid of the statistics. Students are exposed to enough in Methods. Replace statistics with second derivatives and implicit differentiation which have moved to Methods.
- Statistic should be omitted and replaced with Calculus 5 from Maths Methods 3/4.
- The course is appropriate except for Graph Theory and Statistics. Omit these topics and replace with Calculus 5 in Unit 4.
- The Statistical Inference in Unit 4 is dry and boring. This would wipe out student and teacher enthusiasm for the subject. There is a page of dot points but it was suggested that these would only take two weeks to teach. Few teachers would have the knowledge needed to teach this material at present.
- The new Unit 3/4 course will be hard to teach in 50 – 60 hours. It is suggested that the Statistics be removed from the course and nothing else added. This would make the 50 – 60 hour timeframe more realistic.
- Delete Statistical Inferences – it is irrelevant to the flow of the course.
- Delete Statistical Inferences – it is out of place, unnecessary, not relevant to the rest of the course and will make valuable time for deep learning of other topics.

There were no comments supporting the inclusion of Statistical Inference in the Specialist Maths curriculum.

The comments on the Graph Theory Unit included

- Graph Theory leads nowhere and should go.
- Graph theory is out of place in this course.
- Graph Theory in SM Unit 2 is out of sequence and goes nowhere; it could be omitted from the course for a good outcome.

While the vast majority of respondents expressed the view that Graph Theory was not appropriately placed in the Specialist Maths curriculum there was a dissenting view. A small number of people argued for its inclusion stating that “Graph Theory enables geometric definitions and theorems to be developed and leads to proof. It is a good way to enable ‘thinking mathematically’ and Unit 2 is a suitable place for it.”

The overwhelming majority of comments about the content pertained to the Statistics Unit and the Graph Theory Unit. There were several other comments including

- I like the inclusion of proof by induction and geometric proofs - this will bridge the gap between school and university.
- Why isn’t sequences extended out to series?
- I query the sequencing of trigonometry given that it is more conceptually difficult compared to Maths Methods and considering Trigonometry will be studied in Maths Methods.
- Glad that row reduction methods have been included.
• Matrices is an important topic. It is introduced in Unit 2 but not covered again in SM. Should it be revisited in Unit 3/4, or should it go into MM34? Transformations is a good application of Matrices in the current MM courses.

• The exponential form of Complex Numbers should be at least mentioned. This would be helpful in the explanation of De Moivre’s theorem and related concepts.
Appendix – About the MAV

MAV Core Statement

Valuing mathematics in society

MAV Mission

The Mathematical Association of Victoria (MAV) is a membership driven not-for-profit association, which provides a voice, leadership and professional support for mathematical education. Its mission is to advocate for the continual review and improvement of mathematics education and the profession of mathematics teaching.

The MAV will achieve this by:

• Being a leading voice in mathematics education,
• Supporting mathematics teachers and educators,
• Listening and responding to members and the broader mathematics community about their professional needs,
• Celebrating excellence in mathematics education,
• Defining the profession of the mathematics educator,
• Promoting best practice in mathematics education,
• Influencing policy and practice in mathematics education, and
• Promoting the importance of mathematics in careers and daily life.

Background

The Mathematical Association of Victoria (MAV) first met in July 1906.

The Association has since developed over time into a large professional teacher association with over 10,000 teachers in schools from all systems across Victoria entitled to membership benefits. 63% of members are based in Greater Melbourne, 37% in regional Victoria. 68% of members are based at State schools, 19% in the Catholic system and 13% from independent schools. 52% of members work at the primary school level, 46% at the secondary level with the remainder at TAFE and universities.

A Council of elected members governs the MAV. Councillors take responsibility for particular portfolio areas such as professional development, student activities, journals, publications and membership services.

The staff work together to plan and deliver specific services to members, such as:

- Professional learning programs
- Curriculum implementation support
- Publications
- Public lectures
- Student enrichment activities like VCE revision days, family maths nights, games days and project based quests
- An annual metropolitan conference attended by 2,000 teachers
- Regional conferences attended by over 300 teachers
- Policy development and advice to members, Government and the Victorian Curriculum and Assessment Authority
- Advocacy and information services.