2019 Essential Mathematics Subject Assessment Advice

Overview

Subject assessment advice, based on the previous year’s assessment cycle, gives an overview of how students performed in their school and external assessments in relation to the learning requirements, assessment design criteria, and performance standards set out in the relevant subject outline. They provide information and advice regarding the assessment types, the application of the performance standards in school and external assessments, and the quality of student performance.

Teachers should refer to the subject outline for specifications on content and learning requirements, and to the subject operational information for operational matters and key dates.

In 2019 the assessment specifications allowed teachers flexibility in the School Assessment component to undertake either:

* *four* skills and applications tasks and *three* folio tasks (each folio task with a maximum page limit of 8 A4 pages)
* *five* skills and applications tasks and *two* folio tasks (each folio task with a maximum page limit of 12 A4 pages).

This flexibility was utilised successfully by a number of schools. However, it is important to note the amendment to the page limits for the option of two folio tasks. Where two folio tasks are used for assessment the tasks *must* be updated to allow the students the increased maximum page limit.

Teachers are to refer to the 2020 subject outline for more information on the specifications for assessment types.

Assessment Type 1: Skills and Applications

Students complete four or five skills and applications tasks, including at least one skills and applications task from each of the non-examined topics. Skills and applications tasks are completed under the direct supervision of the teacher. The equivalent of one skills and applications task must be undertaken without the use of either a calculator or notes. In the remaining skills and applications tasks, electronic technology and up to one A4 sheet of handwritten notes (on one side only) may be used at the discretion of the teacher. The school set of assessments as a whole should provide students the opportunity to demonstrate evidence for assessment for each of the specific features at least once.

Teachers are encouraged to access the support material document [‘*Complexity Guide Essential Mathematics’*](https://www.sace.sa.edu.au/web/essential-mathematics/stage-2/support-materials/subject-advice-and-strategies) which is available on the website. The complexity guide has been produced to support teachers to identify key questions and key concepts that provide the opportunity for complexity in questions.

To support student learning, teachers should ensure SATs are marked to clearly indicate how much of each mathematical problem a student has been successful in attempting. This includes identifying where errors have been made to support student learning and checking/marking following parts of a question where the incorrect value may have follow-on implications.

The more successful responses commonly:

* included SATs which had a good balance between routine calculations/analysis (approximately 65%), complex calculations (approximately 30%) and complex interpretive questions (approximately 5%)
* included questions in the Measurement SAT that required a range of simple, compound and irregular shapes to be used in solving problems set within appropriate contexts (specific feature CT2)
* provided students the opportunity to answer ‘What if’ and ‘reasonableness’ questions in all SAT assessments allowing students to develop their skills in analysing their results and considering assumptions made to find solutions, and the reasonableness of the solutions. (specific feature RC1 and RC2)
* included routine questions that were broken into distinct parts (scaffolding) and often (but not always) used prompts as starters such as “show…” and “calculate”. Students can be prompted on the method required for solutions sometimes (e.g. “use the Sine rule to”, however this removes complexity and should not be common in a task (specific feature CT3)
* provided opportunity for students to use technology, particularly in Statistics and Investments and Loans (specific feature CT4)
* clearly indicated which assessment(s) provided evidence addressing the specification of at least one SAT without technology and notes
* provided clear feedback about errors in SATs and guidance on what needed improvement in following assessments
* displayed clear communication of the steps in solving problems (specific feature RC4), with correctly labelled calculations and correct units of measurement (specific feature RC3).

The less successful responses commonly:

* did not provide the students with enough complex problems to enable them to provide evidence of their ability to solve questions of a complex nature. This was particularly evident in Topic 1: Scales, Models and Plans, reducing opportunities for responses to show evidence at the ‘A’ level (specific feature CT2). It should also be noted that excessive scaffolding can reduce a complex calculation to one that is more routine in nature.
* were seen when tasks were short, limiting students ability to demonstrate comprehensive knowledge and understanding of concepts and relationships (specific feature CT1)
* lacked opportunities for students to provide evidence of good interpretation in the context of the question, rather providing opportunities for students to simply state results (specific feature RC1)
* provided limited opportunities to interpret, explain or justify (specific feature RC4)
* provided no, or limited evidence of calculations. In multiple mark questions where only final solutions are provided and the result is incorrect, marks for appropriate steps cannot be allocated. Teachers should encourage students to show appropriate steps in their mathematical calculations (specific feature RC4)
* did not include at least one skills and applications task from each of the non-examined topics as specified in the subject outline
* assessed performance standards within a task that did not provide students with the opportunity to provide evidence of that particular specific feature
* included tests straight off of the SACE website. These provide teachers with exemplars of the standard, however as they are available in the public domain they should not be directly used as summative assessment.

Assessment Type 2: Folio

Students complete 2 or 3 folio tasks, where they investigate a mathematical problem based in an everyday or workplace context. Where the option of 4 SATs for the school assessment is used, the topic not assessed in skills and applications should be assessed within a folio task. The subject of the mathematical problem may be derived from one or more topics. Each folio task, excluding bibliography and appendices if used, must be a maximum of 8 A4 pages (OR 12 A4 pages for two folio tasks) if written (minimum font size 10), or the equivalent in multimodal form. The folio tasks should provide ample evidence of specific feature CT3.

It is important to note the amendment to the page limits when the option of two folio tasks is selected. Where two folio tasks are used for assessment the tasks *must* be updated to allow the students the increased maximum page limit of 12 A4 pages per task.

Teachers are requested to ensure that all mathematical solutions produced by the student in the investigations are marked for accuracy and errors are identified. This supports both student understanding and the moderation process.

The more successful responses commonly:

* provided students with 12 A4 pages as their maximum per task when the option of two investigations was adopted
* addressed predictions in the Statistics topic (specific feature RC5)
* displayed evidence that teachers supported students in understanding where complexity could be found in the mathematical investigations that were undertaken (correlation — removal of outliers, using equation of best fit, loans and investments — explicit use of technology, multiple changes at once, comparisons of investments or loan costs)
* were seen when open-ended tasks were used which allowed students to choose the path of their investigation and select their own ideas/figures/contexts to follow — providing individuality in responses and hence allowing for differentiation in the responses seen (specific feature CT3)
* had responses with clear communication of the steps undertaken in the investigations — providing connections between the mathematical investigations which were easy to follow, and clearly identifiable (specific feature CT4)
* provided in-depth discussion of reasonableness and limitations that clearly linked to the context of the investigations, not just stating generic reasons (specific feature RC2)
* were intuitive, and did not repetitively change variables unless it made sense to investigate that particular part of the problem further
* included repetitive calculations in the appendices, with an initial calculation providing evidence of the skill in the main body, and then the results of the additional calculations placed in the appendices included in a table (or other concise manner of presenting multiple results) in the main body for comparison and discussion.

The less successful responses commonly:

* limited opportunities to provide alternative investigations or changes to scenarios, limiting the opportunities for variations in the analysis (specific feature CT2)
* were evident when teachers did not provide feedback to the students assisting them to identify areas that they needed to develop further (e.g. communication of the mathematics, including interpretation and analysis), or supporting students to identify which areas of the mathematical calculations had errors
* provided brief discussions with little or no reference to calculations (specific feature RC4) or provided a description of the mathematical process used rather than a discussion of the assumptions of the mathematical model and its impact on the reasonableness of solutions (specific feature RC2)
* were too short, limiting students ability to demonstrate comprehensive knowledge and understanding of concepts and relationships (specific feature CT1)
* did not provide evidence of using technology when it was identified for assessment in the task. Using technology does not include typing up the folio task response or continually using an “online calculator” (specific feature CT4)
* were seen when tasks had scaffolding throughout all parts of the task. This limited the complexity of the overall set of tasks and therefore the student’s ability to ‘develop’ a model. (specific feature CT3)
* provided evidence of students creating and using unreliable models, particularly in Statistics where correlations investigations with a very weak relationship between the variables were used to make predictions. As a guide, an r2<0.7 is not sufficiently large to proceed with. Where students have not got the time to investigate new variables, they need to show a very clear understanding of the limitations of using a least squares regression line to make predictions when the relationship is so weak
* were evident when tasks had very limited scope for further investigations, or included mathematical content that did not get beyond basic or routine levels. This was often evident in the Topic 2: Measurement folio tasks where only basic shapes were often used.

External Assessment

Assessment Type 3: Examination

Students undertake one 2-hour examination in which they answer questions on three specified topics from the Subject Outline. The topics that are specified for examination are:

* Topic 2: Measurement
* Topic 4: Statistics
* Topic 5: Investments and loans

Examination markers aim to award marks for evidence of student understanding in responding to examination questions wherever possible, however, students should be advised not to cross out their responses or attempted responses to questions in the examination booklet, unless they are confident that no part of their response should be considered by the marker.

If a student crosses out a response and then decides that it was the correct (or the most correct) answer, then the student should indicate clearly to the marker which part of their response should be considered. This could be done by circling or highlighting all or part of the response that the student wants to be considered and write “please mark this work”. Students do not need to rewrite their answers in this case, unless the crossing out has rendered the response unreadable.

Generally, students completed more questions successfully in the Measurement and Statistics topics. Students generally found the Investments and Loans topic more challenging. It is important that a graphics calculator be utilised to complete the Investments and Loans calculations to maximise student success in this topic.

Many students could identify assumptions but could not discuss the impact of the assumption or reasonableness of the answer found when using the simplifying assumption. When a question has the word ‘state’ students must simply state an answer to the question. This is allocated one mark. Additional explanation cannot be awarded any further marks. When a question has the word ‘explain’ then a description and further explanation of the answer is required. The allocation for a question like this is usually two marks. Writing multiple examples without an explanation or justification does not earn the students a second mark when an explanation is required.

Evidence in the exam showed that students were engaging with parts of questions even when previous answers were not achieved which was pleasing.

Although many students recognised when it was appropriate to answer with a whole number, further focus on whether the rounding should be up or down is recommended.

Measurement

In Question 1, Pythagoras Theorem was used accurately for right-angled triangles; however, several students also tried to apply this formula to non-right-angled triangles. Some students recognised that the cosine or sine rule was required for non-right-angled triangles but made errors with the substitution. When finding the length of the semi-circular path, students confused area and circumference formulae and/or did not halve their answers.

Finding the perimeter of the paddock in Question 2 was a common error. Many students were able to show that the grain stored would feed more than 1200 hens and used a variety of calculations which displayed well-considered thought processes that showed great understanding of this question.

In Question 3 students did recognise that the mathematical shapes chosen did represent the area appropriately, but students did not discuss the balance of the area outside the shapes was approximately equal to the area which did not fill the shape. Simpson’s Rule was generally applied well with some errors such as not dividing the width or multiplying lengths by the wrong coefficient. Many students did not attempt or successfully complete the calculation of volume and of those that did often the conversion to litres was not completed.

Statistics

In Question 4, students found it challenging to correctly identify the sampling method, but the majority made an attempt. When completing the stratified sample of Year 12 students a common mistake was for students to divide by 5 (due to there being 5 year levels).

Box plots and calculations of the statistical values were done well and students recognised that daily water consumption was reduced in Question 5. Standard deviation was the statistical value that students had the most difficulty recording, perhaps suggesting issues calculating it. This may once again have given an indication that students did not have access to an approved graphics calculator. When comparing and discussing the consistency of the results students did not always focus on standard deviation, IQR and range. It is important for students to specifically identify and refer to the correct measures to answer this question to earn maximum marks. Comparing the claim of 15% reduction challenged students and many made a statement but did not justify their answer with a mathematical calculation.

Question 6 was completed well by the majority of students. Common errors with the scatter plot included the scale applied or reversing the axes. When a sketch is required an indication of the maximum and minimum for each axis is sufficient and the data values can then be plotted within that scale. The general ‘shape’ of the data points should be identifiable. The coefficient of determination, r2, was calculated successfully but was not always described as weak or very weak. Students’ understanding of the reliability of interpolated values was limited. They often did not recognise that because the relationship was so weak any predictions made would be unreliable. Calculating predictions using the least squares regression line was challenging for many students, especially when the response time (y) was given.

Investments and Loans

Students often did not apply the simple and compound interest formulae correctly in Question 7.

A common error in Question 8 was for students to put the yearly income in Pv when calculating the superannuation balance. Students need some further focus on the appropriate entries of negative signs when completing Investments and Loans calculations on the graphic calculator. Negatives are significant when finding n or i in a standard Compound Interest (pmt = 0), Present (Fv = 0) or Future Value (Pv = 0) calculation and for the more complex questions where there are no zeros required (Pv, Fv and pmt all have values). For example: in Question 8 (c)(i) Pv and Fv must be opposite signs — one negative and one positive. Some students applied 24 fortnights for a year.

The interest calculation in Question 9 was challenging for the majority of students. Common errors included not accounting for the first 5 years or not subtracting the inheritance. When calculating the time taken to repay the loan after the inheritance some students added the inheritance instead of using it to reduce the loan.

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