2020 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 2020 the assessment specifications had temporary changes introduced to reduce assessment demands due to COVID-19. The flexibilities in the School Assessment component were approved by the COVID-19 response governance. These flexibilities required a total of seven or eight assessments, to be undertaken across the year, including the external examination. The school assessment component included:

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

This flexibility was utilised successfully by a number of schools to allow for the course content to be successfully completed. The specification that the non-examined topics had to assessed through a skills and applications task was maintained.

Teachers are to refer to the 2021 subject outline for more information on the specifications for assessment types for teaching in 2021.

School Assessment

Assessment Type 1: Skills and Applications Tasks

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 student’s 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 two or three folio tasks, where they investigate a mathematical problem based in an everyday or workplace context. Where the option of four 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.

Flexibilities that were made available for teachers in 2020 to support them to complete teaching the subject, given the COVID impact on teaching and learning time, some schools had one task with a maximum of 8 A4 pages and a second one with a maximum of 12 A4 pages as they amended their assessment from requiring three folio tasks to two folio tasks. 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 student’s 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 r 2<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.

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 explanations cannot be awarded any further marks. When a question has the word ‘explain’ or ‘discuss’ 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.

Rounding of numbers appropriately to a given number of decimals and recognising when it was appropriate to answer with a whole number requires further focus especially with respect to whether the rounding to a whole number should be up or down.

Measurement

Routine Measurement calculations were often completed successfully.

Some students applied Pythagoras’ Theorem to the non-right-angle triangle. While both the Sine and Cosine Rules provided possible ways to solve this question many students chose to apply the Sine Rule. Although many students chose these formulae correctly, a significant number of them made errors with respect to substitution and rearrangement of the formulae.

Conversion between units was challenging for students, especially when converting areas and volumes. Students often applied a linear measure conversion incorrectly to areas and volumes.

Despite often substituting the correct values in the correct formula for the volume of a cylinder, students found rearranging the volume formula to calculate the height of water in the tank challenging. Some students used proportions and ratios to solve the questions successfully which was pleasing. Some students used the formulae for surface area rather than volume.

Statistics

Some students incorrectly used r to determine the strength of the correlation relationship and despite drawing the graph correctly identified the relationship as positive. When a question requires a justification with a calculation, students must understand that a calculation and an explanation are required to earn full marks.

A suggested table for the determination of the strength of the correlation is:

|  |  |
| --- | --- |
| VALUE | STRENGTH OF ASSOCIATION |
| r2 = 0 | No Correlation |
| 0 < r 2 < .25 | Very Weak Correlation |
| .25 ≤ r 2 < .50 | Weak Correlation |
| .50 ≤ r 2 < .75 | Moderate Correlation |
| .75 ≤ r 2 < .90 | Strong Correlation |
| .90 ≤ r 2 < 1 | Very Strong Correlation |
| r 2 =1 | Perfect Correlation |

It is suggested that this table be used to increase consistency of responses as some students identified the strength incorrectly.

Students were generally able to calculate the statistical values correctly and accurately complete the box and whisker plots. Students should be encouraged to label the box and whisker plots as exampled by the values given. They were challenged by the question that required them to ‘circle the health advice’. It was unclear as to whether they missed the instruction or failed to connect the maximum value to the appropriate health advice. It may, however, be attributed to the challenging nature of interpretation of data for this cohort of students. Students generally were successful relating standard deviation, interquartile range and range to the consistency of the results but were not successful identifying the mean and median as evidence to support the claim that ‘the air quality in Sydney is getting worse every year’. Students must reference a statistical value when required in a question to earn full marks. Students were challenged by the question requiring them to discuss the reasonableness of the claim which could have included comments about the data only being related to one part of a month, for only two years or that the second date for data collection was during the bushfires. Students should be encouraged to question the validity of statistics to enhance their ability to respond to these types of questions.

Investments and Loans

When calculating the interest on the loan some students incorrectly applied the simple interest formula rather than determining the interest from the difference between the payments paid over the time of the loan and the amount borrowed.

Some students failed to identify a term deposit as a simple interest calculation and proceeded to calculate it as a compounded problem. It was pleasing to see that many students who did complete the question using simple interest mostly also converted the months to years.

Some students did not identify the $9500 given in the question as the annual employer contribution. Students calculated 9.5% of this value rather than just dividing the value by 4 to get the quarterly deposit. Students did, however, use the answer given in the question to successfully complete the remainder of the question. When calculating Barrie’s age at retirement, students generally converted the time successfully to years but did not add on the 25 years prior to his superannuation beginning.

Some students did not enter a negative into their calculator correctly. While there is no expectation for students to record them in their answers in the examination booklet some answers are incorrect (for example when finding n or i) when the negative is not entered in the calculator.