# Government of South Australia LogoSACE Board Logo2024 Essential Mathematics Subject Assessment Advice

Overview

This subject assessment advice, based on the 2024 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. It provides information and advice regarding the assessment types, the application of the performance standards in school and external assessments, and the quality of student performance.

The Subject Renewal program has introduced changes for many subjects in 2025; these changes are detailed in the change log at the front of each subject outline. When reviewing the 2024 subject assessment advice, it is important to consider any updates to this subject to ensure the feedback in this document remains accurate.

It is expected that teachers use their professional judgement in the design of the suite of assessments to suit their cohort, ensuring any specific requirements of the subject outline are met (for example, covering the non-examined topics).

Any adjustment(s) to the learning and assessment plan (LAP) in a teaching year must be indicated as an addendum, which is submitted electronically for moderation in the teachers’ materials. Any subject adjustment adopted in the LAP must apply to all students in the assessment group. Individual student adjustments are made through a special provisions process.

*It is a requirement for moderation that student work is marked for both school assessment types*. This means clearly indicating the accuracy of mathematical calculations for SATs and folio tasks. Insightful comments about the written sections for investigations identifying aspects that supported assessment also support the moderation process. Where unmarked samples were identified in moderation samples, schools were contacted and required to upload appropriately marked materials for moderation to proceed.

Before uploading materials, teachers should check the file(s) for reasonable scan quality and that the work has the correct orientation. Scanning all SATs for a student sample as a single PDF file and all folios for a student sample as a single PDF file is both quicker and easier for the teacher and makes the moderation of materials much more efficient.

Some samples did not contain complete sets of materials and did not have any information to explain the variation in the sample. Any samples with missing assessments (i.e. for either assessment type) risks disadvantaging the student. Teachers are asked to provide an explanation in a Variations to Moderation Materials (VMM) form, to be uploaded for moderation. Schools were contacted and asked to upload the missing materials or to provide an explanation for the missing materials (via the electronic VMM form) before moderation could continue. This includes lost tasks and tasks not attempted by students.

# 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. In 2024 the equivalent of one skills and applications task was undertaken without the use of either a calculator or notes and had to be clearly identified on the LAP. 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.

*Implemented changes to the subject outline for 2025 for this assessment type provide varied specifications to what is described in this introduction. Please ensure you consider the new opportunities presented by the implemented changes.*

Teachers are strongly encouraged to access the support material document [Complexity Guide Essential Mathematics](https://www.sace.sa.edu.au/documents/652891/3592910/Complexity+Guide+Essential+Mathematics.docx/43125aa9-6c3c-4be9-abc1-b13f6ec7479f?version=1.0), 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. The Performance Standards rubric indicates the requirement of students to demonstrate success with both routine and complex problems to achieve grades in the A and B bands. A lack of complexity in assessment tasks disadvantages more capable students by preventing them from demonstrating evidence at the A and B grade bands.

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. Clear marking of mathematics for accuracy supports students in identifying where they have made errors in applying algorithms and manipulating formulae. Students are disadvantaged moving forward when marking does not clearly and accurately identify errors in their mathematics or in the language of their discussions and explanations.

There was little evidence of students not having access to approved graphics calculators. Students are required to show effective use of technology. Evidence at moderation has shown that lack of access to an approved graphics calculator disadvantages the students.

Teachers can elicit more successful responses by:

* including SATs which have an appropriate balance between routine calculations/analysis (approximately 65%), complex calculations (approximately 30%), and complex interpretive questions (approximately 5%)
* including some routine questions that are broken into distinct parts (scaffolded) and at times (but not always) use prompts such as ‘show’ and ‘calculate’ to support students to engage initially with questions. 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 (CT2)
* providing 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. The complexity guide does outline several opportunities for complexity in Topic 1, and teachers should ensure that they have an appropriate range of questions that are considered complex in nature within this SAT. It should also be noted that excessive scaffolding, breaking too many problems down to 1 or 2 mark sections, in any topic, can reduce a complex calculation to one that is more routine in nature
* including questions in the Measurement SAT that requires a range of simple, compound, and irregular shapes to be used in solving problems set within appropriate contexts (CT2)
* providing students with the opportunity to answer ‘What if’ and ‘reasonableness’ questions in all SAT assessments. This enables students to demonstrate the development of their skills in analysing their results and to consider assumptions made to find solutions, and how the assumptions impact the reasonableness of the solutions (specific features RC1 and RC2). Such questions are most successful when applied to clear and reasonable contexts
* expanding questions to include the development of an initial scenario, particularly in Loans and Investments. This increases the complexity, particularly where the signs of input values need to be considered (CT2, CT3, and CT4)
* providing diagrams which support student understanding of contextual information or requires students to identify values or add values to the diagram. These support the students to understand the requirements of the question and/or to identify and/or interpret all known information. Any diagrams provided should be appropriate to the problem being solved, e.g. if Simpson’s Rule is to be used to estimate the area of an irregular shape, it needs to be divided into an *even* number of sections
* providing opportunities for students to demonstrate the effective use of technology, particularly in Statistics and in Investments and Loans (CT4)
* providing clear feedback about errors in SATs and guidance on what needs improvement in future assessments
* making use of ‘show’ questions, which enables students to progress through subsequent sections of a question even if they are unsuccessful with the initial calculations
* providing opportunities for students to demonstrate the different approaches required for ‘state’, ‘explain’, and ‘describe’ questions, supported by appropriate marking schemes.

Teachers limited opportunities of students by:

* using tasks that cover narrow aspects of topic content, limiting student’s ability to demonstrate comprehensive knowledge and understanding of concepts and relationships (CT1). Alternatively, asking questions about concepts beyond the scope of the subject, e.g. residual plots or non-linear regressions, may also disadvantage students
* providing limited opportunities for students to display evidence of good interpretation in the context of the question (RC1)
* providing limited opportunities to effectively communicate mathematical ideas and reasoning to develop logical mathematical arguments (RC4)
* requiring 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 (RC4)
* assessing performance standards within a task that did not provide students with multiple opportunities to provide evidence of that particular feature. Where only one opportunity was provided, students were often disadvantaged
* including tests in the set of assessments straight from 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. Similarly, questions copied from the textbook, also available to students, do not allow students to demonstrate mathematical techniques in a variety of contexts (CT2).

The more successful responses commonly:

* displayed clear communication of the steps in solving problems (RC4), with correctly labelled calculations, correct units of measurement, and appropriate rounding (RC3)
* provided detailed, concise calculations when responding to questions (CT2)
* stated any formulas used, identified values that had been given in the question stem or provided in diagrams required for the solution, and provided a clear answer for the variable that was required to be found
* displayed an understanding of the impact of assumptions on the answers they calculate, and the ability to explain these in the context of the problem being solved
* attempted the majority of the questions
* demonstrated discerning and efficient use of technology as required
* presented their solutions in a clear, logical, and legible manner.

The less successful responses commonly:

* did not attempt to answer questions, particularly the questions requiring more complex processes and understanding
* included many arithmetic and algebraic mistakes
* did not use the prompts given in ‘show’ questions to identify when they have made an error or use that value in following calculations to allow them to continue on through the question successfully
* used incorrect notation and did not communicate a good knowledge of the mathematical techniques and algorithms covered in the course
* attempted to use the compound interest formula in place of the graphics calculator, making financial models calculations much more difficult and in some cases impossible
* stated rather than explained or discussed assumptions, limitation, and reasonableness
* did not demonstrate the rearrangement of equations to find an independent variable when rearrangement of a known formula was required
* applied given formulae incorrectly
* gave general statements rather than interpretations in context with the question
* did not round appropriately
* supplied an answer only, with no evidence of working or steps taken in the calculation.

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. In 2024 each folio task, excluding cover page, bibliography, and appendices if used, was to 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.

*Implemented changes to the subject outline for 2025 for this assessment type provides varied specifications to what is described in this introduction. Please ensure you implement the change to the number of folio tasks required, and the specified maximum page limit for folio tasks in 2025.*

Again, teachers are encouraged to access the support material document [Complexity Guide Essential Mathematics](https://www.sace.sa.edu.au/documents/652891/3592910/Complexity+Guide+Essential+Mathematics.docx/43125aa9-6c3c-4be9-abc1-b13f6ec7479f?version=1.0), which is available on the website. Teachers need to ensure each folio task provides an opportunity for students to clearly demonstrate complexity in their mathematical calculations.

Teachers are required to ensure that all mathematical solutions produced by the student in the investigations are marked for accuracy and errors are identified. This supports both students’ understanding and the moderation process. Where samples were provided for moderation without a clear indication of the level of correctness of the mathematical calculations, schools were required to upload appropriately marked materials before the moderation process could commence.

Teachers can elicit more successful responses by:

* referring explicitly to the complexity guide when providing feedback and guidance to students
* providing students with clear opportunities to format predictions. Predictions should not be arbitrary, but rather students should be encouraged to communicate their reasoning behind their predictions (RC4) and to go on to test those predictions mathematically and interpret the results of their testing in context of the predictions made (RC1 and RC5). It is important to note that to achieve beyond the C grade level for RC5, students must provide evidence of forming and testing *more than one* appropriate prediction, using sound mathematical evidence.
* supporting students to understand where complexity can be found in the mathematical investigations that are undertaken (CT1, 2, and 4) and how they can develop mathematical models to explore and interpret changes to the initial models (CT3 and RC1, 2, and 5). Opportunities for the development of mathematical models exist in all topics, for example:
  + Scales, Plans, and Models: development of bearings problems from unstructured information where changes to an initial scenario are posed and the impact of these changes examined and interpreted
  + Measurement: improving the estimate of the area of irregular shapes by refining and improving initial models
  + Business Applications: both mathematically and graphically exploring and interpreting the effect of multiple and combined changes to an initial break-even scenario
  + Statistics: the recalculation of correlation statistics after appropriate outliers are removed and using the equation of the line of best fit to examine the effect of their removal on the appropriateness of the model to predict within and beyond the given set of data
  + Investments and Loans: the creation and analysis of real-life timelines to reflect combinations of changes to loan conditions or superannuation funds over extended periods of time
* providing students with open-ended tasks that allow students to choose the path of their model development in their investigation and select their own ideas, figures, or contexts to follow. This ensures individuality in responses and supports differentiation in assessment of the responses seen (CT3)
* not expecting students to complete mathematics beyond the scope of the course
* not scaffolding excessively, e.g. providing fully structured excel sheets that limit students to the appropriate application of technology and prevents them from being able to demonstrate effective use of technology (CT4).

Teachers limited opportunities of students by:

* providing minimal, no, or incorrect feedback to the students, therefore, not assisting them to identify areas that they needed to develop further (e.g. communication of the mathematics, including interpretation and analysis), or not supporting students to identify which areas of the mathematical calculations had errors. Note: In this instance, teachers should provide students with the drafting feedback to check calculations on page ‘X’, not specifically highlight all calculations with errors
* designing assessment tasks that were too short by providing maximum page limits less than the subject outline allowed for the number of assessments undertaken in this assessment type. Providing students with a page maximum less than the subject outline specifies may limit the student’s ability to demonstrate comprehensive knowledge and understanding of concepts and relationships (CT1)
* limiting opportunities to provide alternative investigations or changes to scenarios by providing tasks that had obvious scaffolding throughout all parts of the task. This limited the complexity of the overall set of tasks and impeded the student’s ability to show that they could ‘develop’ a model (CT3)
* designing tasks with very limited scope for further investigation or included mathematical content that did not get beyond basic or routine levels. This was often evident in Topic 2: Measurement folio tasks where only basic shapes were often seen
* providing tasks that did not encourage students to develop their initial models (CT3).

The more successful responses commonly:

* demonstrated a high level of accuracy in their calculations
* provided clear and reasoned predictions, followed by mathematical testing where results were compared to the initial prediction and interpreted within the context of the study (RC1 and 5)
* had clear communication of the steps undertaken in the investigation — providing connections between the mathematical investigations which were easy to follow and clearly identifiable (specific feature RC4). Clear and accurate units and notation were also evident throughout the folios (RC3)
* developed a model that addressed ‘What if’ scenarios and/or opportunities that were of a complex nature (addressing multiple, simultaneous, or sequential changes) (CT3)
* made links between the results of different ’What if’ scenarios and were able to interpret differences within the context of each scenario and the mathematics used (RC1)
* provided in-depth discussion of reasonableness and limitations that clearly linked to the context of the investigations, not just stating generic reasons (RC2). The student discussions provided clear explanation of the likely effects of the assumptions/limitations on the model/answers
* showed intuitive modelling 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. The results of the additional calculations that were placed in the appendices were included in a table (or other concise manner of presenting multiple results) in the main body for comparison and discussion (RC4)
* provided clearly labelled and accurate diagrams and graphs as required (RC3)
* demonstrated discerning and highly effective use of technology (CT4).

The less successful responses commonly:

* provided no or limited introduction or summary
* provided limited evidence of mathematical calculations
* provided brief discussions with little or no reference to calculations (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 (RC2)
* only addressed the initial routine scenario set up by the task and did not go on to develop ‘What if’ questions in any depth
* 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’ or using a calculator for basic arithmetic, often seen in Business Applications – break-even investigations or measurement tasks (CT4). Use of technology is demonstrated through excel spreadsheeting (provided students can demonstrate their involvement in its construction, not just its application) and through the use of the graphics calculator, particularly in graphing, statistical analysis, and financial applications.
* provided evidence of students creating and using unreliable models, particularly in Statistics where correlation 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
* reworded statements from the task sheet slightly rather than discussing findings in their own words with links to their calculations and specifically in the context of their own investigation
* would state an arbitrary prediction, without justification
* tested predictions using incorrect mathematical processes or not at all
* provided limited, if any, interpretation of differences between predicted values and mathematically calculated solutions
* missed the opportunity of exploring the effect of rounding choices
* missed the opportunity to discuss the reasonableness of results or to improve the reasonableness, e.g. removal of outliers in correlation or improved techniques in estimation of irregular or compound areas
* missed the opportunity of developing and interpreting the impact of meaningful and reasonable changes to an initial scenario (e.g. the impact of making the same lump sum payment at alternative times during the term of a loan) or recognising the relationship between different interest minimisation strategies (e.g. a first home buyer’s grant as a lump sum payment made at the start of a loan term is effectively reducing the amount borrowed and not a complex calculation)
* were careless with notation, rounding, and labelling and oblivious to unreasonable results
* had not appeared to have taken advantage or acted upon drafting opportunities given.

# External Assessment

Assessment Type 3: Examination

Question 1:

Students were generally able to apply Pythagoras’ Theorem correctly to solve right-angled triangles but were generally more challenged when the question required use of trigonometric ratios. Some students applied right-angled trigonometric ratios to non-right-angled triangles.

In Part (b) students often used the Cosine Rule to solve for the angle but did not recognise the bisection of the triangle allowed them to solve it using the right-angle triangle created. Doubling the angle found allowed students to calculate the answer for the whole angle. It is important to note both answers are correct and achieved full marks. However, students who solved the question using the Cosine Rule often then did not recognise the relationship between the half angle and angle HGJ which was then a simple subtraction for complementary angles.

In Part (c) students needed to justify their selection of True or False; however, many failed to complete this part of the question.

Question 2:

Students generally completed this question successfully. They demonstrated a good understanding of finding the area of a composite shape. Some students misinterpreted the shape as a single trapezium, rather than a trapezium and rectangle. Some students did not differentiate that the diagram showed five flags, but the question asked them to consider the reasonableness of six flags on the same length of rope.

The correct calculations and sound reasoning supporting the calculations demonstrated by students in this question was positive.

Question 3:

When calculating the area of the cross-section of the scoop, the majority of students recognised the need to halve the diameter and halve the area of the circle and applied Simpson’s Rule appropriately. When students made errors in this question, it occurred when calculating the volume. Students did not show understanding of the connection between the area of a uniform cross-section and volume to calculate the volume of the scoop. Students generally correctly calculated the volume of the sand box and the number of scoops but rounding their answer to a whole number and in particular down correctly for the answer to make sense in the context was not always completed to answer the question successfully. Students did, however, generally provide well-explained assumptions. The mass calculation was regularly completed correctly, but some students did not convert the answer to kilograms successfully or perhaps did not recognise it as a requirement for the question.

Question 4:

This question was completed well by most students. They efficiently used their calculators to complete the table. However, some students struggled to identify the correct statistical measurement needed to justify their answers related to generalisations as compared with variability. Mean and median were more consistently identified as statistical measures related to general trend but range, standard deviation, and interquartile range being statistical values related to variability were less consistently identified and discussed by students. Students must be encouraged to clearly identify statistical measures to support their answer, as a general statement that all values are higher does not show understanding of what the measures specifically relate to. Box plots were generally well-drawn and labelled accurately. Interpretation of the box-and-whisker diagrams to complete the sentences was challenging for many students, perhaps suggesting their understanding of the percentages of the quartiles was not consolidated.

Question 5:

Students performed well in plotting the missing data value on the graph, calculating the coefficient of determination, and effectively commenting on the strength of the correlation. Outliers were generally correctly identified, although some students incorrectly selected milk as an outlier which was on the extreme end of the trend. Many students struggled with finding the equation of the least squares regression line (line of best fit). Alternatively, if they were able to record the equation of the least squares regression line (line of best fit), they were unable to use it to make predictions. For those students who were able to make predictions from the equation of least squares regression line (line of best fit), rearranging the equation to find the protein content was often not completed successfully. The reasoning question was poorly attempted, with many students leaving it unanswered. Some students were able to state factors that affected the reliability of predictions but did not include an explanation about how the factor would affect the answer, which would have allowed them to achieve the second mark for the question.

Question 6:

Many did not attempt this question and likely had not identified the calculation required was a stratified calculation to determine the number of participants surveyed from South Australia. Many students also had difficulties in identifying the advantages and disadvantages of using this survey method. If they did identify advantages and/or disadvantages, they were unable to provide reasons for their response.

Questions 7, 8, and 9

Overall, graphic calculation inputs were generally correct, and negatives correctly located in the required questions. When students did make errors, they were generally related to not entering appropriate values as negative when required, or confusion with whether a value was a present and future value entry.

Question 7:

Part b(i) was often incorrectly completed using a compound interest calculation rather than recognising that the payment needed to be divided by 3 to change from a quarterly to monthly payment. Students generally failed to successfully explain that a higher interest rate can be moderated by a lower compounding frequency, and at the same time, a lower interest rate can be compensated by a higher compounding frequency. When students calculated the interest earned, they either did not subtract the payment multiplied by the number of payments made and/or the deposit of $2000. The calculation for inflation was completed successfully by students and the compound interest formula equation was overwhelmingly used as compared with using the graphic calculator function. Either solution was acceptable.

Question 8:

Students who attempted the interest saved calculation completed it successfully. Students who calculated the outstanding debt correctly did not always carry this value through into the next question. Students did, however, achieve an answer for N and were then able to correctly convert this value to years. Explaining which scenario took more or less time was often not explained successfully. Students did not demonstrate understanding of the greater impact of making increased repayments early in the loan.

Question 9:

This question was completed well by the majority of students. When errors were made, students incorrectly applied the employer contribution rate (11%) as the superannuation fund rate or missed the step that required them to calculate the difference between the payments to determine the voluntary contribution. Pleasingly, most students could accurately state one way the retirement goal could be reached.

General Examination Comments:

Students need to be reminded of the importance of showing their working out for all questions, but in particular for ‘show’ questions. When the answer is given in the question stem, students must include their working out to achieve marks for the question.

It is important to draw students’ attention to the different expectations of questions that are ‘state’, ‘discuss’, ‘justify’, or ‘explain’. ‘State’ just needs a statement or observation related to the question. In the mark scheme each statement is assigned one mark. It is assumed that by making the statement, students understand the significance of the question or situation, so no further explanation is required. ‘Discuss’, ‘explain’, and ‘justify’ all require students to show their understanding of their answer and these questions are always assigned an additional mark(s) in the mark scheme. Students need to explain what it means in the context of the question, going beyond just a statement about the question or context. Students sometimes make two statements rather than explaining one answer. Students who make two statements do not earn the second mark. Finally, students should check the number of marks awarded for each question as they can give a clear cue to the depth of answer required.