

# **Mathematical Applications**

2013 Chief Assessor's Report



Government  
of South Australia

**SACE**  
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# MATHEMATICAL APPLICATIONS

## 2013 CHIEF ASSESSOR'S REPORT

### OVERVIEW

Chief Assessors' reports give 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, the quality of student performance, and any relevant statistical information.

### SCHOOL ASSESSMENT

Most teachers designed their assessment tasks well, and addressed all areas of the performance standards in a well-balanced fashion. This gave their students the scope to achieve at all grade levels.

In the past there has been strong evidence that attendance at clarifying forums benefited teachers in the area of good task design and the ability to apply the performance standards appropriately in both skills and applications tasks and folio work. Those new to teaching the subject, as well as teachers whose students' results underwent a significant change at moderation in 2013, are encouraged to attend one of the clarifying forums that will be offered by the SACE Board in early 2014.

### Assessment Type 1: Skills and Applications Tasks

Most teachers have now adjusted to the reduction in the number of skills and applications tasks (SATs) by including a single test for some topics, and recognise that it is no longer a requirement of the Mathematical Applications course that all key ideas in a topic are covered in the SATs.

In some cases the standard of SATs still led to a disparity between the marks awarded and the grade levels achieved against the performance standards. This was sometimes due to a lack of complexity in the questions which meant that students did not have the opportunity to demonstrate their ability to meet the criteria for the higher grade levels. An example of this is the scaffolding of answers in Investment and Loans tests by providing a table of TVM entries to be filled in by the student. This does not allow students to show that they know when this type of calculation is appropriate and when it is not, thereby removing complexity from the question.

In determining what is routine and what is complex in a topic, teachers are referred to the topic support sheets on the Mathematical Applications minisite.

In other cases SATs had a high level of complexity that made it difficult for the less able students to show that they could do the routine work. A well-designed SAT contains a good balance of routine and complex questions to allow for discrimination between students of different abilities.

Teachers are strongly encouraged to use the past examination papers available on the Mathematical Applications minisite as a guide to the standard required for SATs. *However, these must not be used for assessment unless they are altered so substantially that they are unrecognisable from the source material* as the solutions are in the public domain.

In the marking of SATs it was noted that some teachers were not penalising students for errors in mathematical communication, such as the omission of units (or using incorrect units) and incorrect rounding of answers. The specific features of the communication of mathematical information assessment design criterion are an important part of a student's demonstration of his or her understanding of the mathematics.

Harsh marking was still occasionally found when an initial error in a multistep problem was not followed through in the marking to see if subsequent calculations were accurate, or if subsequent reasoning was correct.

It is imperative that teachers work with the *current* (2014) subject outline on the Mathematical Applications minisite. Some SATs tested mathematical ideas that are no longer in the subject outline, for example:

- Topic 2: Investment and Loans — the treatment of bonds
- Topic 3: Mathematics and Small Business — calculation of the costs of fitting out a business premises
- Topic 4: Matrices; matrix algebra and  $2 \times 2$  transition matrices
- Topic 7: Statistics and Working with Data — the use of z-scores to find probabilities for the normal distribution, coefficients of skewness and variation, graphs of single data sets (i.e. no comparison of data sets), cumulative frequency tables, calculation of statistics such as standard deviation or coefficients of correlation using tables instead of electronic technology.

It is not appropriate to use these concepts to determine achievement against the performance standards in SATs and students need to be aware that they will not be covered in the examination.

## **Assessment Type 2: Folio**

Many teachers set good folio tasks and assessed them well against the performance standards. There was plenty of evidence of tasks that enabled students of all abilities to get started and gave them scope to demonstrate their ability at all grade levels.

Concerns raised at moderation about some teachers' folio tasks and their students' responses were similar to those documented in previous years. The main areas of concern are:

- 'overprescribed' or 'closed' tasks with so much scaffolding that the responses from a class look too similar for moderators to distinguish between students of different ability
- tasks where students may reach a 'dead end' and have no opportunity to demonstrate more complex work
- tasks that spread the students too 'thin', that is, tasks that require the student to do routine work in every aspect of the topic rather than pursuing one or two specific sections of the topic in depth
- tasks that are not related closely enough to the topic material in the subject outline; these can prevent students from providing enough evidence of

mathematical skills and knowledge in the topic (Ideas related to the topic *can* be included in a folio task if they are directly relevant and useful but this should not form the majority of the work in the student's response.)

- students who copy graphs and information without acknowledging their sources, and/or who do not discuss the relevance of such material to their conclusions; these students gain nothing in achievement against the performance standards.

A more detailed discussion of these concerns is in previous Chief Assessor's reports on the Mathematical Applications minisite.

Teachers are encouraged to look at and use the support materials for folio tasks in all topics on the minisite. These tasks may be used for assessment purposes as students will add their own scenarios and data, ensuring original responses.

Marking the mathematical investigations in the folio tasks for correctness is a necessity for the moderation of student materials and supports the process of confirming teachers' assessments. The annotation of these assessments for accuracy in the calculations is also very important in helping students to identify where they are applying skills correctly, and pointing out skills that they need to review. There is still concern about the number of folio task responses seen in moderation where very little or no feedback appeared to have been given to students about their performance on specific aspects of the task.

If more than one teacher is marking student work in a single assessment group, it is essential that these teachers use a benchmarking process and cross-marking to ensure consistency in the students' results. The moderation process is based on a sample of the class, and students not in the sample could have their results affected by inconsistent marking of their work.

## **EXTERNAL ASSESSMENT**

### **Assessment Type 4: Examination**

#### **Topic 1: Applied Geometry**

- It is an expectation of this topic that students use appropriate measuring equipment such as a ruler or a protractor. Students must be encouraged to bring this equipment to Applied Geometry examinations.
- Students should be aware that they may need to find angles and sides not specifically asked for in order to appropriately complete a question.
- Many students seemed unfamiliar with the section of the subject outline that requires them to know how to estimate an irregular area by modelling it appropriately, using a simple mathematical shape. In Question 4 a great many students drew a baseline with offsets and then proceeded to use the trapezoidal rule or Simpson's rule to estimate the area (often incorrectly, as stated in the 2011 report: 'When using Simpsons or the Trapezoidal rule students did not include zeros to apply the formulae correctly (e.g. for  $d_0$  and  $d_5$ )'). What was required was an approximation of the shape of the spill using a simple shape (a rectangle or an oval would have been most appropriate) that balances the amount of area lost on the outside of the shape with the extra area included inside it. Such a shape would then require only two measurements to be taken to allow an area to be calculated, unlike the multiple measurements required for Simpson's rule or the trapezoidal rule.

## **Topic 2: Investment and Loans**

- Effective rates continue to be done poorly. Students confused the process for loans and investments as well as simple and compound interest conversions.
- The interpretation of inflation as reducing the purchasing power or value of money over time was not described clearly.
- Students had difficulty completing present value questions that had a present value other than zero.
- Negative values were not always entered appropriately when using TVM solver.
- Students should be encouraged to relate analysis of options to the results of their calculations.
- Students should take care about time-frames, for example, 6 months was often interpreted and applied as 6 years.

## **Topic 3: Mathematics and Small Business**

- Students did not understand how to carry out calculations from the initial parameters to determine the number of servers required for a given queuing situation to be efficient.
- Students were challenged by the calculation of the cost price and a series discount.
- Many students did not factor in multiple variable costs for the break-even question.
- The profit-and-loss statements prepared by students often did not have the correct formatting. This led students to make errors or perform randomised operations with the numbers in order to eventually get to the required output.
- The most common error with taxation was applying the Medicare Levy to the tax instead of to the taxable income.

## **Topic 4: Matrices**

- Students found it difficult to interpret the steady state in context.

## **Topic 5: Optimisation**

- This topic was generally answered well. Students either demonstrated the required knowledge and answered the questions well or showed limited understanding but were usually able to obtain some marks for their answers.

## **Topic 6: Share Investments**

- When using the break-even price formula, some students did not differentiate between the formula used for a brokerage rate and a flat fee for brokerage.
- Although some students were challenged by the calculations of the percentage changes of share portfolios, the all ordinaries index, and the consumer price index, many students showed a lack of understanding of what the two indices actually were, and of their relationship to the performance of the shares.
- Students should be encouraged to relate analysis of options to the results of their calculations.

## Topic 7: Statistics and Working with Data

- For correlation, students were able to recognise extrapolation. They did not then link this to the reliability/reasonableness of the results in reference to the predictions being extrapolated, nor did they consider the strength of the relationship as another important determining factor. Students need to be aware of when it is appropriate to extrapolate and when it is not, and to consider whether the prediction would be reasonable in the given context (e.g. such as a case in which a negative answer is found, but would not be reasonable in the context of the question).
- Most difficulties with normal distribution questions occur when students are given the area. The tail seemed problematic for some students.
- Some students seemed unfamiliar either with how to handle the calculator overflow error or with scientific notation output.
- Students often did not link their comments and analysis to the actual statistics.
- Students often fail to label axes, despite statements in the questions instructing them to include labels.

Overall students are generally coping better with the examination process.

## OPERATIONAL ADVICE

- When teachers package materials for the nominated sample that is submitted to the SACE Board for final moderation, each folio of materials, separated into the two assessment types, must include all tasks from Assessment Type 1 and Assessment Type 2. Many teachers included a cover sheet with each set of student materials from the nominated sample for moderation, identifying all completed assessments and the grade level achieved. This helped the moderators to identify reasons for missing materials. The Variations — Moderation Materials form was also used successfully to provide information about special provisions, breaches of rules, and student materials marked but not available for submission.
- Consistency of marking is essential when more than one teacher is assessing groups within a school or when schools combine for assessment.
- A student who submits no work for an assessment type must be assigned an I, representing 'insufficient evidence', not an E.
- It is important to be aware that final results for the school assessment component are submitted only once (i.e. schools receive only one results sheet at the end of the year). This must be filled in with results that are consistent with those that will appear on the student materials submitted for moderation. In some cases schools gave 'provisional results' that were changed after the results sheet had been sent to the SACE Board (possibly because work was marked after the results had been submitted). Marking must be completed before the results sheet is submitted. If particular circumstances make this impossible, the SACE Officer — Curriculum must be contacted so that the matter can be dealt with before moderation.
- Equal consideration must be given to the four topics when the overall grade for Assessment Type 1: Skills and Applications Tasks is assigned. For example, a topic that has two SATs should be considered equal to a topic that is assessed with one SAT when the grade for the overall assessment type is determined.
- It is important to combine grades appropriately. The final grade given for a student must be consistent with the grades shown on individual assessment tasks (e.g. B, B+, C+, B cannot be awarded an A– overall).

- It is helpful to provide solutions for SATs so that moderators know the kind of response the teacher is expecting from the students. The total mark that a student achieves for SATs helps the moderators to gain an initial insight into the performance of the student, and therefore supports the moderation process.
- If there are multiple assessment groups in a school, each assessment group should include a copy of the LAP.

## **GENERAL COMMENTS**

Many teachers were involved in setting, vetting, and marking the examinations, and in the moderation process. The valuable input of these dedicated teachers at very busy times of the year contributed greatly to the efficiency and effectiveness of these processes. Interested people who would like to be involved in this professional development are encouraged to contact the SACE Board.

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