Mathematical Methods

2013 Chief Assessor's Report

Government
of South Australia

SACE
Board of SA

MATHEMATICAL METHODS

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

Assessment Type 1: Skills and Applications Tasks

It is heartening to see that the majority of tasks presented had an appropriate balance of routine and complex questions. This provides students with the opportunity to perform at all levels of the performance standards, including the highest level. About 30% of questions should be complex to allow discrimination within the A grade level of achievement.

The use of past exam and textbook questions without amendment to context and figures is discouraged, as students may have ready access to solutions through revision guides. It is also not advisable to use test generators for all skills and applications tasks as the questions generated are too similar to the review questions in the textbook and do not provide the opportunity for discrimination between students.

It is important that the assessment tasks are marked and the marks scheme is clear. This provides evidence to the moderation team of how the students' grades were achieved and clear feedback to the students about their strengths and weaknesses.

Assessment Type 2: Folio

Once again there was an improvement in the standard and nature of the folio tasks this year. The tasks that are available on the SACE website have been updated over the last two years to provide students further opportunity to achieve at all grade levels; in particular, the A grade level. If you use these tasks, please ensure you have the most up-to-date version.

The first investigation task of the year may require teacher support and direction. However, students should work independently on subsequent investigations. Each task should have an open-ended, contextual question that provides students with the opportunity to decide how to investigate the mathematical relationship, concept, or problem.

To maximise the chance of students achieving at the highest level in investigations, tasks need to provide clear opportunities for students to address the specific features in the mathematical modelling and problem-solving assessment design criteria; in particular, the development of solutions and appropriate application of mathematical

models, interpretation of mathematical results, and discussion of any limitations of the task and the reasonableness of the solutions found.

One of the crucial elements of a folio task is students' ability to communicate their understanding of their investigation topics. It is important for students to use a report format for their folio tasks, beginning with an introduction that outlines the purpose and context of the investigation. The main body of the report should include evidence of appropriate application of the mathematical model or strategy, including the collection or generation of data, mathematical calculations and analysis, and interpretation of the results, including assumptions and limitations of the model or strategy used. The conclusion should be in the context of the original problem and include an evaluation of the result of the investigation. Detailed information can be found on pages 32 and 33 of the 2014 subject outline and teachers and students should refer to this and to the description of the specific features at each grade in the performance standards on pages 35 and 36.

It is important for moderation that these mathematical investigations and analyses be marked for accuracy; generally the samples provided were appropriately marked. Clear marking and feedback to students also supports students in their learning and provides them with direction for subsequent tasks of this assessment type.

EXTERNAL ASSESSMENT

Assessment Type 3: Examination

The examination was designed to assess the student's ability to:
- demonstrate mathematical skills and understanding without electronic technology
- demonstrate mathematical skills and understanding with electronic technology
- analyse and interpret results and information
- communicate mathematical information.

There were quite a few, very impressive papers, clearly demonstrating the attention paid throughout the year to giving responses within the context of the question.

The paper was handled very well by many students. It was pleasing to see the vast majority of students attempting and achieving some success in all questions. Routine skills and applications were generally well handled.

As in previous years, the rules for differentiation were examined in quite a few questions. There were an alarming number of students who could not differentiate correctly. The derivative of the product of two functions continued to confuse some students and the derivative of the logarithmic function also caused some confusion.

The sensible rounding of numbers was attended to by the majority of students. It was noticeable that some students do have difficulty rounding numbers. Marks were deducted from students if they persisted in not giving sensibly rounded responses.

There is a list of approved calculators on the SACE Board website. Teachers are advised that students need to use a calculator from the list of calculators approved for use in the examination. Use of a non-approved calculator is considered to be a Breach of Rules and action may be taken by the SACE Board where evidence suggests that a non-approved calculator has been used in the examination. Students are required to complete the section on the front cover of the examination booklet

indicating the brand of calculator used, and the examination invigilator is required to check calculators as students enter the examination room.

The discerning use of electronic technology in the examination is encouraged. Students may use their calculator whenever they see an opportunity to do so. There is no need to indicate to the examiners when they have used their calculator. Too many students appear reluctant to use their graphics calculators. A surprising number of students seem to be unaware of where there are suitable opportunities to use their graphics calculator, and instead use more lengthy methods to determine answers. This affects their ability to complete the paper and review their responses in the time available.

The ability of many students to analyse and interpret results within the context of the question was pleasing. The intent of the examination was to enable students to give their personal mathematical responses to some of the contextual questions. Students should be aware that a 'stock standard' result taken from their reference sheet might not provide the appropriate interpretation of a particular contextual question.

There were 1070 students who sat the 2013 examination and the average score was approximately 64%, with a median score of 104 out of 154.

Question 1

The derivatives in this question were handled well. In part (b) quite a few students omitted the 3. The most significant problem for students was the correct use of the product rule in part (c). Six hundred and seven students scored full marks for Question 1.

Question 2

This question was very well done by most students. The one issue was that in part (b) some students neglected to check that their solution was the same for all the entries in the matrix AB that contained x.

Question 3

In 2012, students had difficulty in finding the equation of a straight line and in 2013 the responses showed limited improvement. Students should take care when reading the questions as many missed the statement that A, B, and C were integers.

Question 4

Generally, this question was done well. However, markers deducted marks for inappropriate rounding of the answers to parts (a) and (b).

Question 5

A common error in this and previous papers has been the inability of students to recognise the difference between solving for x when $P(x) = 0$ and solving $P(0)$. Students could have used a variety of calculator approaches to solve the equation in part (a). This proved to be quite a challenge for many students. Students often did not recognise the possibility of more than one solution.

In part (b)(iii) only a few students recognised that the value of x when $P'(x) = 0$ gave the minimum perimeter for this rectangular plot.

Question 6

Parts (a), (b), and (c) were done well. In part (d), the lines drawn are equations and students lost easy marks by omitting to label these lines. In part (f), the question asks for the profit function; $70x + 60y$ is an expression. In part (g)(ii), markers were looking for a clear indication from students that there were more than two solutions.

Question 7

A good response to part (a)(i) would state that the confidence interval calculated by the farmer indicates that the farmer can be 95% confident that the true mean weight of all the farmer's ducks lies between 2150 and 2186 grams. The remainder of the question was well done by most students.

Question 8

The derivative in part (a) was handled well by most students. Some problems arose when students chose to take out the common factor. As in Question 5, some students were confused over the difference between solving $C'(0)$ and solving for t when $C'(t) = 0$. The graph in part (c) was drawn accurately in most cases; however, some students did not clearly indicate the information that they had found in earlier parts of the question.

Question 9

Students found this one of the most difficult questions in the paper. In part (a) there was a restriction on the domain; that and the axes supplied should have given students a clear indication of how to set up their graphics calculators. Students struggled with the requirements of parts (b) and (c), showing that students need to revise Stage 1 and prior learning about functions. There are two solutions to part (d)(ii) and, again, discerning use of the calculator was the most efficient way to determine these. Only ten students gained full marks for this question.

Question 10

In part (a), markers were looking for 'random scatter' and a comment about the apparently small residuals. There were many 'near solutions' to part (c)(ii) as students rounded off in various ways. In part (e)(ii) some students missed the fact that T was not the independent variable. However, many students were alert to the unit of time (T) — $\times 10^{-2}$ seconds — provided in the table.

Question 11

Most students scored at least 6 out of the 8 marks allocated to this question. The only area of concern was that, in part (b)(ii), students did not discriminate between the weight of the box (1840 grams) and the mean weight of a packet in the box $\left(\dfrac{1840}{20} \text{ grams} \right)$.

Question 12

Students had the most difficulty with this question when, in part (e)(iii) they were asked for an interpretation of their findings. The confidence interval is determined so

that a statement about the true proportion of all people is possible rather than a statement about the sample.

Question 13

This proved to be one of the most difficult questions of the paper. To begin with some students were distracted by π; π is just a constant, and students should be familiar with questions presented in this manner. In part (b)(iii), students wrote about 'the balloon inflating' whereas it was the surface area of the balloon that was increasing. Part (c)(i) proved to be a challenge with many students unable to expand $(t + 3)^2$. In part (c)(ii) very few students mentioned anything about 'the average rate of change'.

Question 14

This question was completed well by most students. In part (e) weaker students were able to solve the system by trial and error. The most common mistake in this question came in part (d)(ii) when students failed to recognise that the matrix F_2 represents the distribution of female Tasmanian Devils.

OPERATIONAL ADVICE

When teachers package materials for the nominated sample that is submitted to the SACE Board for final moderation, each sample folio 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 assisted the moderation team in identifying reasons for missing materials.

The Variations — Moderation Materials form was also used successfully to provide the moderation team with information about special provisions, breaches of rules, and student materials that had been marked but were not available for submission.

To assist the moderation process, all student materials should be presented with a task sheet. An appropriate performance standard sheet indicating the assessment of the work greatly assisted the moderation team in the moderation process, particularly for the folio tasks. For a particular task, all students should be assessed against the same specific features unless special provisions are implemented.

A completed mark sheet or spreadsheet for the class also assisted the moderation process.

Teachers are asked to submit a folder containing a complete set of task sheets and the approved learning and assessment plan (with addendum when applicable) with student materials. Where the assessment work that is completed by students deviates from the approved learning and assessment plan, particularly for the whole class, the deviation needs to be clearly indicated on the *addendum* at the end of the learning and assessment plan and included in the folder that the teacher submits.

Mathematical Methods
Chief Assessor