Mathematical Methods

2012 Chief Assessor's Report

Government of South Australia

SACE Board of SA

MATHEMATICAL METHODS

2012 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 Application Tasks

It is important when designing a task that it provides a range of questions, including problems that are both routine and complex in nature. 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 set at a complex level. When multiple questions were set at a complex level, it allowed discrimination in the A-grade band and gave students the opportunity to perform at the A+ level. Overall, there has been a distinct improvement in the design and quality of the skills and applications tasks this year. It is noted that the use of past exam questions without amendments to contexts and figures is not encouraged, as students may have ready access to solutions through revision guides.

During the moderation process, when multiple classes had undertaken the same assessment task, it was important that there was evidence of consistent marking. This was particularly important when classes were enrolled in the same assessment group. When classes are combined into one assessment group, the moderation team has to assume that a consistent understanding of the performance standards exists, and that it has been applied consistently throughout the assessment of the student work in the assessment group.

It was also very useful to see the mark allocations for each question in each assessment. This supported the students by indicating their areas of strength and weakness, and also provided evidence to the moderation team of how the students' grades were achieved by indicating how much of each question the students had responded to appropriately.

Assessment Type 2: Folio

There was a very evident improvement in the standard and nature of the folio tasks this year. The moderation process requires the mathematical investigations and analysis to be marked for accuracy, and generally the samples provided were appropriately marked. Once again, clear marking and feedback to students supports them in their learning, and provides them with directions on areas of this assessment type where they need to place further effort in subsequent tasks.

To enhance student opportunities to achieve at the highest level in investigations, the 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 and appropriate application of mathematical models, concise interpretation of mathematical results, and discussion of any limitations of the task and the reasonableness of the solutions found.

Tasks may need to provide support and clear directions, particularly in the first investigation of the year. Subsequent investigations should be less directed than the first. However, there should be an open-ended context in each investigation, providing students with the opportunity to make decisions about the path that they wish to undertake to further investigate the mathematical relationship, concept, or problem.

It is important that students 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 investigation should include evidence of appropriate application of the mathematical model or strategy; collection and/or generation of data; the mathematical calculations carried out; and analysis and interpretation of the results (including an understanding of the reasonableness of the results and discussion of any limitations of the model or strategy used). The conclusion should be in the context of the original problem and provide an evaluation of the results of the investigation. Appendices and a bibliography should be included where appropriate. More detailed information can be found on pages 32 and 33 of the 2013 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.

EXTERNAL ASSESSMENT

Assessment Type 3: Examination

The examination design is based on the key questions and key ideas outlined in the four topics within the Mathematical Methods subject outline. The examination consisted of a range of questions, some focusing on knowledge and routine skills and applications, and others on analysis and interpretation. The skills and understandings developed through investigations were also assessed in the examination.

There were many impressive papers clearly demonstrating the attention paid throughout the year to giving responses within the context of the question. The importance of paying attention to detail and carefully responding to each question cannot be underestimated, and should be reinforced throughout the year.

It was pleasing to see the vast majority of students attempting and achieving some success in most questions. There were very few instances of students making no attempt to work through questions. Routine skills and applications were generally well handled.

The majority of students displayed more than competent knowledge of the course content and understanding of concepts and relationships. Greatest concern continues to be students' ability to deal with the interpretation of mathematical results and the appreciation of the reasonableness and possible limitations of interpreted results.

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.

Students' 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. It was surprising to see the number of students who did not appear to use their graphics calculators to solve the simultaneous equations in Question 4. Too many students appear to be reluctant users of their graphics calculators.

Approximately 1130 students sat the examination and the overall results were sound, with the average score of 99.6 marks out of a possible 153 marks (65%).
As you read the comments provided for each question below, please keep in mind that the majority of student performed very well in this examination.

Question 1

For this question, 857 students scored 7 or more (out of a possible 9 marks). It proved to be a nice lead-in to the examination. There was the occasional transcription error and the product rule proved challenging for a few students. Some students neglected to place brackets around the $4 + x$ in part (d).

Question 2

This question was successfully completed by the vast majority of the students.
Part (a) continues to be a trap for students, with too many of them not placing all of the required values on the normal curve. All parts of this question are routine, and students should have been able to score the maximum possible mark of 6. An answer of 0.159 often occurred in part (c)(ii) as did $k = 52.3$ in part (d).

Question 3

Some students wrote $x \geq 1$ instead of $x = 1$ in part (a)(i). Writing equations in the form $Ax + By = C$ was a challenge for many students. Some students gave the coordinates of the vertices rather than inequalities in part (b). Many students understood the idea behind the question in part (c); however, very few were able to link $-\frac{3}{k}$ with $-\frac{4}{3}$.

Question 4

Around five hundred students gained full marks for this question. Parts (a)(i) and (a)(ii) were completed successfully by all students. A few students showed difficulty in multiplying the two matrices (A and B) because of the algebraic content. In part (b), where there were two simultaneous equations to solve, students often presented evidence of solving the problem without using their electronic technology. Problems like this should be posed in the students' formative learning, and the use of their graphics calculators to solve such questions should be strongly encouraged.

Question 5

This question was well done by most students. There were a small number of responses in part (b) of $\frac{1}{16}$ and $\frac{2}{8}$. Some students displayed difficulty in clearly

describing the meaning of the binomial probability distribution function with respect to the die in part (c)(ii). Students seemed confused as to what to put into their calculator when handling a range in a binomial situation. There were many answers of 0.969 in part (d)(i), and in part (d)(ii) there were many answers such as $P(X \leq 6) - P(X \leq 2)$.

Question 6

The mathematics of this question was well handled by the students; however, they struggled with the interpretive responses required. 'The slope of the tangent is increasing at a rate of 5.25 locusts per day' was typical of the incorrect responses found in the marking of this question. In part (a), students did not realise that the number of locusts was in thousands, as stated in the introduction to the question, and so answers of 0 were common. In part (b), students often found the two negative zeros of $P(\mathrm{n})$ and talked about days prior to the spraying, and in part (d), 'the tangent at $n = 8$ is zero' was not the required response. In part (e), the graph from the y-intercept to the turning point was often drawn as a straight line, and some of the positionings of A and B were unusual**.**

Question 7

Part (a) of this question was the most poorly attempted question in the paper, with the majority of students trying to compare two samples. The remaining parts of the question were quite well done. In part (c), some students did not realise that the question was concerned with the average weight of the nectarines on a tray. In part (d)(i), markers were looking for the notion of independent events, and in part (d)(iii), students often neglected the correction factor.

Question 8

This question was well done. Students displayed good ability to input data into their graphics calculator and were clearly able to extract the appropriate information. It was appropriate in this question to give answers correct to 3 significant figures. In part (c)(ii), many students neglected to discuss the reasonableness of the prediction made in part (c)(i) based on the high r value and the t value being just outside the given data range.

Question 9

Many students had little difficulty with this question. Shading of the incorrect feasible region was the most common error, while just giving the correct vertices in part (c)(ii) was not sufficient for a student to be awarded full marks.

Question 10

Using p = 0.5 in part (d) was inappropriate, as students had a p value of 0.81 to work with, based on the information provided at the start of the question. In part (d), some students did not use the formula given on the 'List of Mathematical Formulae for Use in Stage 2 Mathematical Methods' provided at the back of the examination booklet. Students should be encouraged throughout the year to use this formulae sheet where appropriate, to ensure that they are confident and able to easily access and find the information provided on it. Part (c) proved to be quite difficult for students who did not realise that, based on the 95% confidence interval, the true proportion of local residents supporting the placing of speed humps on the road could have been as low as 75.6%

Question 11

The majority of students had a good understanding of most of the parts of this question, but lack of attention to detail and accuracy proved the main reason for marks being lost. In part (a)(i), 'to the nearest cent' was often ignored; in part (b)(i), 5.8 was given without appropriate units being provided (that is, is this number in dollars or cents?). The idea in part (b)(ii) that $(0.92)^t$ was causing the Blaed shares to decrease by 8% each month was misunderstood, and many students were unable to get started with the use of the laws of logarithms in part (c)(i). The graphs in part (c)(ii) were poorly drawn, with the labelling of the two graphs being poor, and the point P not clearly identified.

Question 12

This question was quite well done by the majority of students. In part (b)(iii), markers were looking for 'the average rate of increase'. In part (c)(ii), 139.99 was not accepted. In part (d)(iii), students often wrote 'at t = 2.4', rather than 'after 2.4 hours', and students often mentioned the number of students who attended the party rather than those who had *heard about* the party!

Question 13

The matrix multiplications were responded to well by the many students. However, interpretations were often vague.

OPERATIONAL ADVICE

When teachers package materials for the nominated sample that is submitted to the SACE Board for final moderation, each sample must include all tasks from Assessment Type 1 and Assessment Type 2. 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 significantly 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 there are special provisions implemented.

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 (formerly the Variations in Materials for the Sample for Final Moderation form) was also used successfully to provide the moderation team with information about special provisions, breaches of rules, and student materials marked but not available for submission. A completed mark sheet or spreadsheet for the class also assisted the moderation process when included.

A teacher folder with a complete set of task sheets and the approved learning and assessment plan (with addendum when applicable) should be included in the materials submitted. Where assessment work completed deviated from the approved learning and assessment plan, particularly for the whole class, this needs to be clearly indicated on the *addendum* at the end of the learning and assessment plan submitted in the teacher folder.

It is essential that the student materials are clearly identified, and that all of the materials are packaged according to the guidelines provided in the Mathematical Methods subject operational information, with each individual student's materials packaged in separate clear plastic bags. Teachers should ensure that materials presented for moderation do not include hard folders.

GENERAL COMMENTS

All teachers are strongly encouraged to attend a clarifying forum in 2013, as this is an important opportunity for teachers to clarify and align their assessment decisions with those determined by the subject experts.

Teachers need to update tasks and performance standards to address the current curriculum and assessment requirements. In 2013, specific feature MMP6, 'Contribution to group work', has been removed from the subject outline. The learning requirements of the course still require that students be provided with opportunities to 'work both individually and cooperatively in planning, organising, and carrying out mathematical activities'; however, there will no longer be the need to explicitly assess the group work in folio assessments.

Learning and assessment plans for Stage 2 Mathematical Methods (except for those approved in 2012 for use through to December 2014) require approval in 2013. MMP6 should no longer appear in the assessment overview, but may still appear in the task description if the task incorporates group work.

Chief Assessor
Mathematical Methods