Review of the causes of errors in the 2016 NCEA and Scholarship Mathematics and Statistics examinations

21 February 2017

Executive summary and Recommendations

In response to concerns about errors in five of the 2016 external examination papers, the New Zealand Qualifications Authority (NZQA) convened an independent panel of experts (Dr Sharleen Forbes - Convener, Dr Marion Steel and Linda Tame) to review the causes of the errors and to provide advice and make recommendations to NZQA on how such errors can be prevented in future external examinations.

The panel considered, from their dealings with NZQA assessment and editorial staff, that there is a strong ethos within the secondary examinations section of NZQA aiming to give students credit for all their work and to ensure that individual candidates are not disadvantaged.

Almost all of the people contracted to NZQA in the examination setting and marking processes are doing this on top of their other work commitments. The five papers with errors involved three different examiners and five groups of setters and markers. It is the Panel's opinion that no one person was responsible for any of the errors. It is also the Panel's view that internal NZQA policies and processes could be strengthened to minimise the possibility of such errors occurring again and ensure early detection of errors. Critical decision-making about errors or late changes to examination papers should be escalated to the senior levels of the organisation.

Recommendations

Policy for the Appointment of Setters of External Assessment

Recommendation 1: The "Policy for the Appointment of Setters of External Assessment", contracts for examination setters and checklists used by them be strengthened by:

a) Clearly defining roles and accountabilities, in particular that the overall accountability for the development of a valid, fair, technically correct and error free examination paper lies with the Examiner as the leader of the examination paper development team.

b) Stating that all examination setting personnel, with the exception of the Independent Checker (who sits the paper as a student would), have a specific role in ensuring examination papers are both technically correct and error free.

Process for examination paper and assessment schedule development

An obvious inclusion in the examination setting process to ensure all errors are detected prior to the examination being printed would be to have the final step in the process (after all changes, in particular late changes, have been made) before printing being another check by the Independent Checker and the Subject Matter Checker[1]. It is recommended that:

Recommendation 2: NZQA review and extend its end-to-end process for setting and revising examination papers and assessment schedules, including the use of a dating and version control system in relation to examination assessment schedules.

Recommendation 3: Changes to examination papers not be approved for printing without a final and formal independent check.

Recommendation 4: In relation to requests from examiners for late changes in examination papers, it is recommended that:

a) There be a defined deadline for such requests.

[1] See pages 8 and 9 for information on the various roles in the examination paper setting process.

b) If such a request is received from an examiner after that date, the decision to approve or not be escalated to NZQA senior management.

Guidelines and training

The Panel considered the current "Guide Notes for Setting External Examinations" did not contribute significantly to the errors in the 2016 papers, but that:

Recommendation 5: There be a holistic review of the "Guide Notes for Setting External Examinations" including:

a) The creation of separate sections on the paper setting process, other important protocols (such as confidentiality), and administration matters.

b) An additional section on Data and Graphics Guidelines that would relate to the use of, and standards for, data, graphs and tables and provide advice on ensuring their correctness.

It is recommended that:

Recommendation 6: Training sessions for new appointees to examination setting teams for data rich subjects include both a component on how to ensure that content including data, graphs and tables is technically correct and error free, and access to expert advisors in their own subject.

The Panel considered NZQA would benefit from developing a register of past errors. The register should include commentary on the nature of the error and how the error was handled and the lessons learned, and be used to inform subsequent examination paper setting teams and in the training of new appointees to examination setting roles. It should also be shared within and beyond the subjects in which the error occurred and with management and governance groups within NZQA. It is recommended that:

Recommendation 7: NZQA develop and maintain a formal register consisting of all errors detected over time in examinations and responses to those errors.

Response to Detected Errors

In the event of an error in an examination paper being detected, candidates' answers to a flawed question should always be marked to ensure that all of a candidate's work is taken into account in consideration of their final grade. It is recommended that:

Recommendation 8: Markers consider and report all candidates' responses to questions.

Because both examination papers and assessment schedules are used as resources by teachers, it is recommended that:

Recommendation 9: NZQA implement a system of appropriately annotating on published examination papers and assessment schedules any questions that contain errors.

2016 errors and responses

The five errors in papers were as follows:

Level 1 Mathematics 91037:
In the Q2(a)(iii) box, the plot position did not match data in the table for value of the upper quartile. The upper quartile and sample sizes were incorrect. 100 points on the graphs occurred as 94 and 99.

Level 2 Mathematics 91262:
Q2(b) referred to a point on a function, but the point's coordinates did not touch the graph line, making the tangent at the point undefined.

Level 2 Mathematics 91267:
In Q3(b) the vertical axis label 'Probability' was technically incorrect.

Level 3 Statistics 91585:
In Q3(b)(i) the probability distribution table had incorrect values which added to greater than 1. This meant candidates could not answer the question that was asked. Part (b)(ii) could still be answered.

New Zealand Scholarship Statistics 93201:
In Q1(a) the table of values and Figure 2 did not match. The last data value in State Y data table did not match the point plotted on the graph in Figure 2.

The errors could be categorised into:

- technical inaccuracies
- those occurring because of very late changes to papers
- numerical errors such as transposition of digits (e.g. (3,2) instead of (2,3))
- inconsistencies between tables and graphs or within graphs.

However, it was the Panel's opinion that in only one case was the error likely to cause disadvantage for individual candidates.

In the four National Certificates of Educational Achievement (NCEA) papers, the distribution of candidates across the four grades: Not Achieved, Achieved, Merit and Excellence was similar to previous years, leading the Panel to the view that overall the 2016 cohort of students had not been disadvantaged. Similarly, a review of Scholarship results led the Panel to believe that the 2016 cohort of candidates was not disadvantaged compared to previous years.

It is the Panel's opinion that NZQA's response to the error in the Level 3 Mathematics with Statistics paper was pragmatic. Although the error was in the second part (b) of the third and last question in the paper, a few students may have attempted it, and some could even have successfully achieved the last part that was not necessarily dependent on the material containing the error. In the original assessment schedule, this part of the question was at Excellence level. NZQA's strategy was to mark only the first two questions and part (a) of question 3, re-weighting these questions to ensure that students still had enough Merit and Excellence opportunities. While this would certainly have advantaged some students, it could also have disadvantaged the few who had attempted 3(b) and demonstrated knowledge and understanding in this question. In New Zealand candidates receive back their marked examination papers so will be aware of unmarked sections. It is recommended that:

Recommendation 10: NZQA take all practical steps to ensure candidates were not disadvantaged in Standard 91585, including possibly extending the deadline for reconsideration applications and investigating the feasibility of using the derived grade process.

Introduction

In November and December 2016, teachers of Mathematics expressed concerns about errors in five of the 2016 external examination papers, in particular a significant undetected error in a Level 3 Statistics examination paper that prevented candidates from being able to answer part of a question. The papers concerned were:

Mathematics and Statistics Standard 91037 (Level 1),
Mathematics and Statistics Standards 91262 and 91267 (Level 2)
Statistics Standard 91585 (Level 3)
New Zealand Scholarship Statistics 93201.

As a result of these concerns, NZQA convened an independent panel of experts to review the causes of the errors and to provide advice and make recommendations to NZQA on how such errors can be prevented in future external examinations in Mathematics and Statistics. The Panel only considered the specific examination questions identified in the terms of reference.

The Review Panel comprised:

Dr Sharleen Forbes (Convenor): Former Adjunct Professor of Official Statistics, School of Government, Victoria University and has held a number of senior research and policy positions within the public sector. Dr Forbes is a current member of NZQA's external Technical Overview Group Assessment (TOGA) that advises NZQA on the assessment process for NCEA and New Zealand Scholarship.

Dr Marion Steel (Panel member): Current Head of Department Statistics and acting Head of the Mathematics learning area at Epsom Girls Grammar School. Dr Steel is a member of the New Zealand Association of Mathematics Teachers and the Education Sub-Committee of the New Zealand Statistical Association.

Linda Tame, QSM (Panel member): Former Principal of Lincoln High School and current Pro-Chancellor of the Lincoln University Council.

Prior to the Review Panel meeting, NZQA provided policy and other information related to the appointment and training of examination personnel, the process for developing examination papers and specific information on the errors in the five 2016 papers, including how the marking of candidates' answers was managed. In addition to seeking further documents from NZQA, the Panel also interviewed NZQA management and assessment staff.

Background

NZQA is responsible under the Education Act 1989 for managing the external assessment of secondary school students. The external assessment comprises the National Certificates of Educational Achievement (NCEA), Levels 1-3, and New Zealand Scholarship (Scholarship). Mathematics and Statistics is assessed at NCEA Levels 1 and 2; for NCEA Level 3 and Scholarship, Statistics and Calculus are assessed separately.

In 2016, Question 3(b)(i) in the Level 3 Statistics examination paper Standard 91585 contained a critical, undetected error that made part of the question unworkable.

Mathematics teachers expressed concerns about this error and also questioned the adequacy of quality checks on the examination papers for Standards 91037 (Level 1), 91262 and 91267 (Level 2) and New Zealand Scholarship Statistics (93201), which did not detect discrepancies in, or relating to, a number of tables and graphs.

Given the significance of the error in the examination paper for Standard 91585 and its impact on candidates, and the concerns relating to the quality checks on the four other Mathematics papers, NZQA convened an independent expert panel to review the respective causes. The Panel was asked to make appropriate recommendations to NZQA on how such situations can be prevented in future external examinations in Mathematics and Statistics.

The Terms of Reference for the review are included as an appendix to this report.

Review Process

The Panel convened at NZQA's offices in the last week of January and first week of February 2017. Policy and Guideline papers and information concerning the five mathematics papers were provided to the Panel prior to its meeting.

The Panel aligned its considerations with the cycle NZQA follows for setting external examination papers: from the policy for making appointments to an examination setting team and training of those personnel to the development of, and quality assurance arrangements for, examination papers and assessment schedules.

With respect to the specific papers in which the errors occurred, summarised information from the markers' Panel Leader reports was also considered. Examiners' Reports have not yet been received by NZQA. The Panel also examined NZQA's response after the errors were detected and looked at the distribution of candidates' results compared to previous years.

NZQA management and assessment and editorial staff were appropriately involved in the Panel's discussions and provided all supplementary information requested.

Policy on appointments for external examination setters

NZQA's "Policy for the Appointment of Setters of External Assessment" contains the rationale for this policy and the general selection criteria on which appointments to the various roles in examination setting teams are based. The "Application for Exam Setting Role" and "Selection Summary" documents and the contract templates for the various roles were also examined by the Panel and discussed with NZQA management and assessment staff. NZQA advised that, despite there being a shortage of mathematics teachers, there had not been any significant recent difficulty in appointing appropriately qualified people to the various roles in developing Mathematics examination papers. There were references to other attributes of examination setters such as subject matter expertise, length of time spent teaching the specific examination subject, and an appropriate length of time for being involved in the examination setting. Comment was also made on "succession planning", whereby, for example, a Materials Developer might in due course be appointed to the role of Examiner.

It should be noted that almost all of the people contracted to NZQA in the examination setting and marking processes are current secondary or tertiary teachers, doing these tasks on top of their normal work load with reasonably low remuneration. There are currently three separate examiners involved in setting the five examinations containing errors: one for Level 1 and 2 Mathematics with Statistics papers, another for Level 3 Statistics and another for Scholarship Statistics. In the main, there are also different examination setting teams with 22 of the possible contract positions for these papers being filled by 19 different individuals.

The Panel concluded that the selection policy and criteria had no direct bearing on the occurrence of the errors in the five 2016 examination papers. The document could be strengthened to include explicit statements on additional criteria, for example, very strong subject knowledge and years of teaching. There could be an indication of the expected length of the terms of appointment and role

definitions and accountabilities should be clarified. All examination setting personnel, with the exception of the Independent Checker[2], should have a clearly identified responsibility for ensuring examination papers are both technically correct (in terms of the subject matter) and error free (from a student's perspective). The overall accountability for the development of an examination paper lies with the Examiner as the leader of examination paper development team. The Panel also queried whether the workload (a total of eight examinations) for the Examiner setting the Level 1 and 2 papers, as well as the MCAT papers, was excessive.

The Panel noted that there were a number of people in the examination setting process (see Fig 1 and Fig. 2) with joint responsibilities and considered that both the "Policy for the Appointment of Setters of External Assessment" and individual contracts and checklists could be strengthened by inclusion of the specific words "*valid, fair, technically correct and error free examination*" for all those involved in the setting process (with the exception of the Independent Checker who sits the paper as a candidate would).

Recommendation 1: The "Policy for the Appointment of Setters of External Assessment", contracts for examination setters and checklists used by them be strengthened by:

a) Clearly defining roles and accountabilities, in particular that the overall accountability for the development of a valid, fair, technically correct and error free examination paper lies with the Examiner as the leader of examination paper development team.

b) Stating that all examination setting personnel, with the exception of the Independent Checker (who sits the paper as a student would), have a specific role in ensuring examination papers are both technically correct and error free.

Process for examination paper development

The Panel examined the process NZQA uses for developing examination papers and the roles of the various people in the examination paper setting team (see Fig.1 and Fig.2) as well as the "Guide Notes for Setting External Examination Papers 2016" (see the following section of this report). The Panel considered that there appeared to be multiple rather than a single point of accountability for ensuring that an examination paper was technically correct and error free. As recommended above, it should be clear that the Examiner is the single point of accountability for producing a valid, fair, technically correct and error free examination. It is the Examiner who signs off the examination paper at the "approve to print" stage. The examination development process and the Guide Notes discussed below should clearly identify the precise role and contribution of each member of the paper development team, their reporting lines and their sign-offs.

[2] Information on the various roles in the examination setting team is provided in the following section of this report.

Fig.1 Examination Development Process

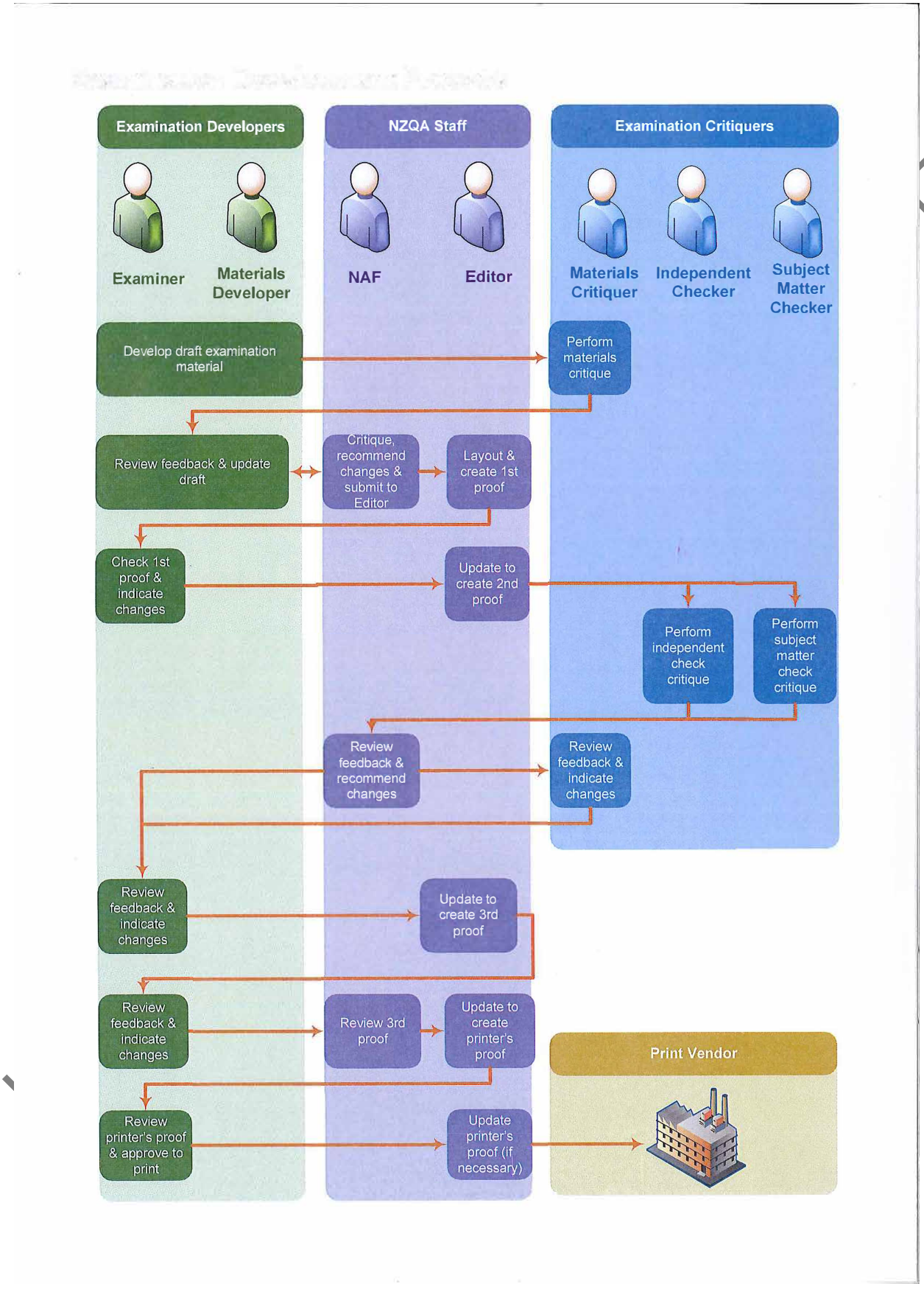
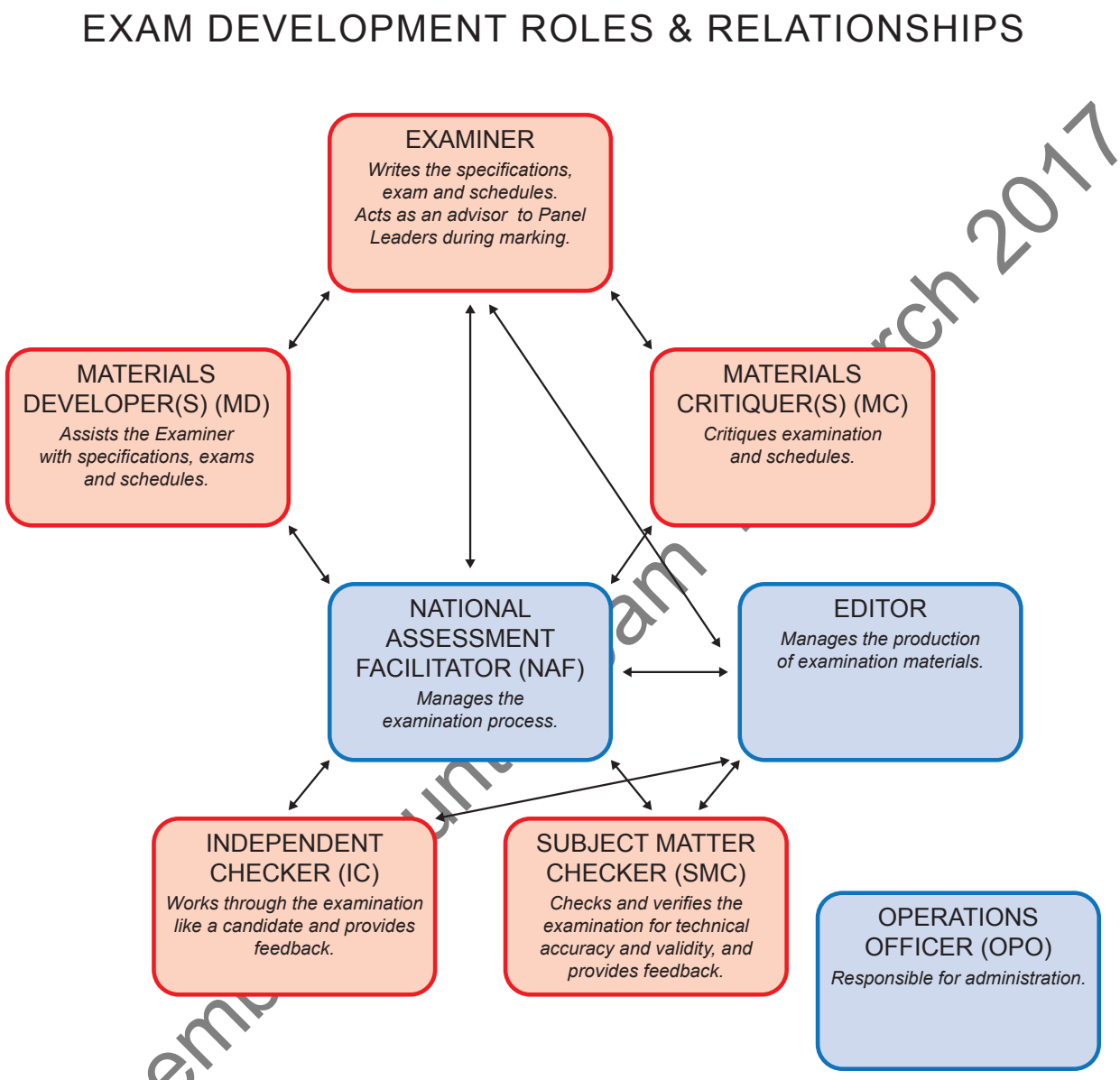


Fig. 2



NZQA uses the following acronyms for personnel involved in developing examination papers:

- IC = Independent Checker
- SMC = Subject Matter Checker
- MC = Materials Critiquer
- MD = Materials Developer
- NAF = the NZQA National Assessment Facilitator.

Analysis of the "Examination Development Process" diagram (Fig.1) indicated that the Examiner could make changes to papers after the Independent Check (sitting of the paper as a student would) and Subject Matter Check had taken place. This is one cause of errors being undetected before examinations were printed in 2016 and could be avoided by all changes being independently checked before the paper was signed off for printing. It is recommended that:

Recommendation 2: NZQA review and extend its end-to-end process for setting and revising examination papers and assessment schedules, including the use of a dating and version control system in relation to examination assessment schedules.

Recommendation 3: Changes to examination papers not be approved for printing without a final and formal independent check.

Recommendation 4: In relation to requests from examiners for late changes in examination papers, it is recommended that:

a) There be a defined deadline for such requests.

b) If such a request is received from an examiner after that date, the decision to approve or not be escalated to NZQA senior management.

Guide Notes and training

NZQA provides all examination setting teams with "Guide Notes for Setting External Examinations" that focus on the assessment system, the examination paper development system, the imperative of confidentiality, and administration requirements. These notes are similar for both NCEA and Scholarship papers. NZQA also uses the Guide Notes in the training process for new Examiners, Materials Developers and Materials Critiquers.

It is not usual for a new appointee to have contact with the retiring person (because of confidentiality constraints), although a Materials Developer who is subsequently appointed to the Examiner role would be aware of the identity of the retiring Examiner. As a result, previous learning, experiences and advice are not formally passed on to new appointees, but covered through a generic (across all subjects) 'voice of experience' session, where an experienced person is available during new appointee training days.

The Panel considered the current Guide Notes did not contribute significantly to the errors in the 2016 papers, but that the structure of the Guide Notes could be improved by separating the document into distinct sections. In addition, the Panel noted that while there was appropriate specific guidance on the use of language including being culturally sensitive and free of gender bias etc., there was none about the use of data or graphics in examinations papers or about the use of questions with component parts. Examination setters in all data rich subjects would benefit from learning about common numerical errors, graphical standards and the need to ensure consistency between tables and graphs. The Panel recommended that:

Recommendation 5: There be a holistic review of the "Guide Notes for Setting External Examinations" including:

a) The creation of separate sections on the paper setting process, other important protocols (such as confidentiality), and administration matters.

b) An additional section on Data and Graphics Guidelines that would relate to the use of, and standards for, data, graphs and tables and provide advice on ensuring their correctness.

Examples of material that could be included in this section are:

- Common numerical errors and how to check for them
- Graphical standards that should be adhered to, such as titles, axes and technically correct labels
- That tables and graphs must be consistent and kept together in the checking process
- How to minimise ambiguity in graphs, especially when used for data comparisons
- A checklist to assist the methodical checking of data.

There should be an emphasis throughout this section on the distinction between checking for correctness in terms of candidates' ability to answer a question and actively searching for other possible sources of error such as technical inaccuracies and alternative interpretations or methods of solution.

It is recommended that:

Recommendation 6: Training sessions for new appointees to examination setting teams for data rich subjects include both a component on how to ensure that content including data, graphs and tables is technically correct and error free, and access to expert advisors in their own subject.

It would be helpful to new appointees if there was a specific training session that focused on how and why errors can occur in papers using real examples from previous years with comments on how the errors occurred and how they were handled in the marking process. A subject-specific voice of experience may be especially helpful for a new Examiner in curriculum areas where there have been recent errors, such as statistics.

In this context of errors in previous examination papers, NZQA does not formally record over time the background and nature of all errors, how they were handled or comments on the impact of the errors. However, it was noted that NZQA does inform the examination setting teams with the details of marking, results, known errors and their impact from the previous year's examination.

The Panel considered that, in order to minimise the risk of future errors, NZQA would benefit from developing a register of past errors. The register should include commentary on the nature of the error, how the error was handled particularly during marking, the lessons learned, and be used to inform subsequent examination paper setting teams and in the training of new appointees to examination setting roles. It should also be shared within and beyond the subjects in which the error occurred and with management and governance groups within NZQA. It is recommended that:

Recommendation 7: NZQA develop and maintain a formal register consisting of all errors detected over time in examinations and responses to those errors in order to minimise the risk of future errors.

2016 examinations: errors and responses

Level 1 Mathematics Standard 91037: Demonstrate understanding of chance and data

Issue

In the Q2(a)(iii) box, the plot position did not match data in the table for value of the upper quartile. The upper quartile and sample sizes were incorrect. 100 points on the graphs occurred as 94 and 99.

Response provided by NZQA

The question was likely to be answered as intended. While most candidates would not have noticed the error, some might have commented. The error did not prevent candidates from answering the question.

Review panel comments and recommendations

Examination papers containing data / graphs / tables need to be thoroughly checked for technical accuracy, possible errors, consequential ambiguity etc., throughout the quality assurance processes. Panel members commented on the importance of clarity in questions involving graphs and the imperative of avoiding ambiguity in questions unless this is integral to the question. *(Recommendations 1, 5 and 6).*

The Panel noted that while the question could be answered, the error introduced ambiguity. It is not known what impact the error had on individual candidates. If there is an error in a paper, markers should keep records on individual candidates. This information would inform the marking Panel Leader's report to NZQA *(Recommendation 8).*

Impact on candidates

The distribution of candidates across the four grades: Not Achieved, Achieved, Merit and Excellence was similar to previous years leading the Panel to the view that overall the 2016 cohort of students had not been disadvantaged in this paper.

Level 2 Mathematics Standard 91262: Apply calculus methods in solving problems

Issue

Q2(b) refers to a point on a function, but the point's coordinates do not touch the graph line, making the tangent at the point undefined.

Response provided by NZQA

Candidates were able to answer the question as intended. Some students might have noticed that the point was not on the line and might have commented. These candidates would have gained full credit for that part of the question. There was no consequent impact on other parts of the question.

Panel's comments and recommendations

While candidates who commented on the error were given credit, there is little data available on the impact of this on their grades. Implementation of *Recommendation 8* would have enriched the marking Panel Leader's report. The error is a specific example of a transposition error (3, 2)

instead of (2,3) and is an instance where specific training in commonly occurring data errors and a record of past errors (*Recommendations 6 and 7*) may have prevented the error occurring.

Impact on candidates

The distribution of candidates across the four grades: Not Achieved, Achieved, Merit and Excellence was similar to previous years leading the Panel to the view that overall the 2016 cohort of students had not been disadvantaged in this paper.

Level 2 Mathematics Standard 91267: Apply probability methods in solving problems

Issue

In Q3(b) the vertical axis label 'Probability' was technically incorrect.

Response provided by NZQA

The error in the question was such that there was no impact on the candidates' ability to answer the question. No change was required to the assessment schedule.

Panel's comments and recommendations

While NZQA advised that no markers commented to the Panel Leader on any candidate being impaired by the error, it was noted that some students did interpret the graph incorrectly. All terms used in an examination should be technically correct. (*Recommendation 1 (b)*)

Impact on candidates

The distribution of candidates across the four grades: Not Achieved, Achieved, Merit and Excellence was similar to previous years leading the Panel to the view that overall the 2016 cohort of students had not been disadvantaged in this paper.

Level 3 Statistics 91585: Apply probability concepts in solving problems

Issue

In Q3(b)(i) the probability distribution table had incorrect values which added to greater than 1. This meant candidates could not answer the question that was asked.

Part (b)(ii) could still be answered.

Response provided by NZQA

Marking was based on Q1, Q2, and 3(a), with a consequent maximum grade score total of 21 (instead of 24). The impact of this decision was that Question 3 was marked out of 5 rather than 8. As a result, Question 3 was marked at Merit level and Question 2 at Excellence level in order that candidates seeking to achieve Excellence were not disadvantaged by the error.

Comment and recommendations

The Panel noted that a very late change in the form of a new replacement question was requested for the examination paper. Because of time pressure, the new question did not go through further independent checks that it was technically correct and error-free.

The Panel noted that while NZQA has well-established procedures for handling situations where an error is detected after papers have been printed and distributed to examination centres but before it is sat by students, this was not the case in this paper as the error was not discovered until the examination was underway.

The Panel considered that there should be a defined point in the examination development timeline at which the Examiner no longer has the authority to make a significant change or withdraw a question. Such a late request should invoke special procedures whereby senior NZQA managers would consider it in light of the potential risk to the integrity of the paper, printing schedules and any other factors. If NZQA management decides to accept the request, the change should still go through a formal independent check for technical accuracy and any errors. *Recommendation 4,* that there be a defined deadline date for requests for late changes and that requests after this date be escalated to NZQA senior management, together with *Recommendation 3* that changes to examination papers not be approved for printing without a final and formal independent check, will help prevent such an error occurring again.

The decision to adjust the assessment schedule was based on the marking Panel Leader's review of a number of candidate scripts in which there was no evidence of candidates attempting to answer Part 3(b)(ii) and the difficulty of having two approaches to marking (that is, discounting Question 3 in its entirety, and marking 3(b)(ii).) However, there were instances of students pointing out the error to examination supervisors who then instructed them to do whatever they could in the question.

It is the Panel's opinion that NZQA's response to the error in the Level 3 Mathematics with Statistics paper, once the organisation became aware of it, was pragmatic. Although the error was in the second part (b) of the third and last question in the paper, a few students may have attempted it, and some could even have successfully achieved the last part which was not necessarily dependent on the material containing the error. In the original assessment schedule, this part of the question was at Excellence level. NZQA's strategy to mark only the first two questions and part (a) of question 3, re-weighting these questions to ensure that students still had enough Merit and Excellence opportunities, would certainly have advantaged some students. It could also have disadvantaged the few who had attempted 3(b) and demonstrated knowledge and understanding in this question.

For this reason the Panel recommends (*Recommendation 10)* that NZQA takes all practical steps to ensure candidates were not disadvantaged in Standard 91585, including possibly extending the deadline for reconsideration applications and investigating the feasibility of using the derived grade process.

This is especially important as Standard 91585 is a Level 3 examination and the result may impact on University Entrance and students' future pathways.

In general, and in particular whenever there is an error in a paper, candidates' work on a question should not be completely disregarded by markers, as this may disadvantage individuals. Markers should consider and report all candidates' responses to questions containing errors so that NZQA is aware of the overall impact of the error on the marking process and the impact on individual candidates is minimised In the event of changing assessment schedules after an error, markers should keep records of candidates who submitted work and report on this to the marking Panel Leader for their report. It is recommended that:

Recommendation 8: Markers consider and report all candidates' responses to questions.

Impact on candidates

The distribution of candidates across the four grades: Not Achieved, Achieved, Merit and Excellence was similar to previous years leading the Panel to the view that overall the 2016 cohort of students had not been disadvantaged in this paper.

There was limited information relating to the impact on any individual candidates. NZQA has not collected information on how many candidates had attempted 3(b)(ii), and this has led to *Recommendation 8* above.

New Zealand Scholarship Statistics 93201

Issue

In Q1(a) the table of values and Figure 2 did not match: The last data value in State Y data table did not match the point plotted on the graph in Figure 2.

Response provided by NZQA

The error had no impact on candidate response. Candidate answers that referred to the data mismatch were accepted.

Comment and recommendations

In addition to the error, a late change resulted in a single graph containing three separate sets of data being replaced by four graphs, one for each set of data and a combined graph. The axes were also swapped leading to some ambiguity in responses to the question. The Panel considers that all graphs used in examinations for comparison purposes should clearly indicate differences. It is important that data used in both graphs and tables be the same so that inconsistencies do not distract candidates. Data, graphs and tables need to be checked at every quality assurance stage of examination paper development (*Recommendations 5(b) and 6).*

The Panel noted that the assessment schedule had been adjusted after the change, and that there was no evidence that candidates had been disadvantaged by different interpretations of the graphs

Impact on candidates

Provisional results from the examination indicated that there was no impact on overall candidate performance for this cohort, especially at the “Outstanding” level of achievement. The Panel Leader reported that it appeared that only a small number of candidates had noticed the error.

Overall comment on the marking of the five papers

Whenever there is a change in an examination question there needs to be a consequential change in the marking schedule. Particular care needs to be taken whenever there are late changes and when an Examiner is also the Marking Panel Leader.

Because both examination papers and assessment schedules are used as resources by teachers, it is recommended that:

Recommendation 9: NZQA implement a system of appropriately annotating on published examination papers and assessment schedules any questions that contain errors.

The Panel had confidence with the way NZQA handled the errors in four of the five papers. However, it considered that a few individual candidates could have been disadvantaged by NZQA's response to the error in the Level 3 Statistics paper Standard 91585. It was recommended that:

Recommendation 10: NZQA take all practical steps to ensure candidates were not disadvantaged in Standard 91585, including possibly extending the deadline for reconsideration applications and investigating the feasibility of using the derived grade process.

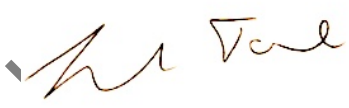
Acknowledgements

The Panel wishes to acknowledge the support provided by NZQA for the conduct of the review. Policy papers and special briefing documentation were provided to the Panel prior to its meeting. The Panel especially appreciated the way in which NZQA management and assessment and editorial staff engaged with the Panel and willingly provided advice and extra information to assist the Panel in its work.

It is evident that NZQA has a very strong commitment to ensuring that candidates are not disadvantaged as a result of errors in examination papers. The staff demonstrated this ethos throughout the review and the Panel wishes to express its appreciation for NZQA's approach to this review of its external examination system.

Dr Sharleen Forbes
(Convener)

Dr Marion Steel



Linda Tame

Appendix: Terms of Reference

20 December 2016

Review of the causes of the error in the 2016 NCEA Level 3 Statistics examination (standard 91585) and of the quality assurance processes for this examination and the examinations for the Mathematics and Statistics standards 91037 (Level 1), 91262 and 91267 (Level 2), and 93201 (NZ Scholarship Statistics)

TERMS OF REFERENCE

Background

The New Zealand Qualifications Authority (NZQA) is responsible under the Education Act 1989 for managing the external assessment of secondary school students. The external assessment comprises the National Certificates of Educational Achievement (NCEA), Levels 1-3, and New Zealand Scholarship (Scholarship). Mathematics and Statistics is assessed at NCEA Levels 1 and 2; for NCEA Level 3 and Scholarship, Statistics and Calculus are assessed separately.

In 2016, Question 3(b) in Level 3 Statistics examination paper standard 91585 contained a critical, undetected error that made the initial question and the following parts of the question unworkable. Consequently, candidates were unable to answer the question.

Mathematics teachers have also expressed concerns about the adequacy of quality checks on examination papers for standards 91037 (Level 1), 91262 and 91267 (Level 2) and New Zealand Scholarship Statistics (93201), which did not detect discrepancies in, or relating to, a number of tables and graphs.

Given the significance of the error in the examination paper for standard 91585 and its impact on candidates, and the concerns relating to the quality checks on the four other Mathematics papers, NZQA has determined to convene an independent expert panel to review the respective causes. The Panel is asked to make appropriate recommendations to NZQA on how such situations can be prevented in future external examinations in Mathematics and Statistics.

Objectives

The Review Panel has been established to:

- **consider** the established procedure for developing external examination papers from initial contractor appointments, development of examination papers, through to approval to print and the current arrangements for quality assuring draft papers;
- **determine** whether the examination papers for standard 91585, in particular, and standards 91037, 91262, 91267 and NZ Scholarship statistics 93201 complied with the established procedures, timelines and quality assurance arrangements;
- **determine**, if they did not, why they did not follow the established procedures, and determine the causes of the problems and why they were not identified; and

- **recommend** to NZQA, in light of the 2016 issues in Mathematics and Statistics, improvements to the procedures for the development of future external examination papers and their quality assurance.

Scope

The scope of the Review includes all stages in the system NZQA uses for the development of external examination papers from the appointment of contractors, the initial draft through to the approval to print and the roles played by the various Examination Critiquers. The Review Panel will ascertain through documentation and discussions with appropriate NZQA staff whether the examination papers for standards 91585, 91037, 91262, 91267, and NZ Scholarship Statistics 93201 went through all the established stages for examination paper development and quality assurance by the Critiquers. The Panel will determine if there were issues relating to development, timelines and quality assurance that led to the error and concerns with the quality checks in the other Mathematics examination papers.

Having ascertained what factors led to the problems with these papers, the Panel will consider and make recommendations to NZQA on how such problems might be prevented in future years and whether changes or improvements in the current quality assurance processes are required.

The following are out of scope for this review:

- Any matters relating to Standards other than the Mathematics Standards specified in the Scope of the Review[3]
- Changes to the fundamentals of the external examination system, such as the NCEA and NZ Scholarship assessment structure, supervision, marking and results procedures, and certification.

Timeframes and Reporting

The Panel will meet in late January / early February 2017 and its final report should be submitted to NZQA by 28 February 2017.

The report will be published in early March 2017.

Panel Members

1. Dr Sharleen Forbes (Convenor): Former Adjunct Professor of Official Statistics, School of Government, Victoria University and has held a number of senior research and policy positions within the public sector. Dr Forbes is a current member of NZQA's external Technical Overview Group Assessment (TOGA) which advises NZQA on the assessment process for NCEA and New Zealand Scholarship.
2. Marion Steel (Panel member): Current Head of Department Statistics and acting Head of the Mathematics learning area at Epsom Girls Grammar School. Ms Steel is a member of the New Zealand Association of Mathematics Teachers and the New Zealand Statistical Association.
3. Linda Tame, QSM (Panel member): Former Principal of Lincoln High School and current Pro-Chancellor of the Lincoln University Council.

Support for Panel

An advisor and secretariat will be provided to the Panel.

[3] NCEA Level 3 Statistics Standard 91585; NCEA Level 1 Mathematics Standard 91037; NCEA Level 2 Mathematics Standards 91262 and 91267; and New Zealand Scholarship Statistics 93201