

The following report gives feedback to assist assessors with general issues and trends that have been identified during external moderation of the internal Mathematics and Statistics standards in 2018.

It does not clarify specific standards but provides further insights from moderation material viewed throughout the year.

Volume of Evidence Produced

Some students produce an excessive volume of evidence. Students are not required to submit evidence beyond the criteria of the standard. It is appropriate for teachers to guide students to produce succinct evidence in response to the achievement criteria of the standard.

This was not an issue in the material submitted for the Mathematics standards in 2018.

The volume of evidence in Statistics standards is satisfactory at all levels. This is mostly due to assessors providing the students with clear guidelines regarding expected volume of evidence to be produced.

Teachers who managed this successfully used the following strategies:

- Providing students with the opportunity to familiarise themselves with the context and variable(s) they were investigating. This resulted in more cohesive and coherent student responses.
- Giving the students a clear outline of the investigation process they were required to follow. For example, in 91582 the statistical enquiry cycle used to make a formal inference was described. In 91580 the statistical enquiry cycle needed to investigate time series data was clearly evident.

Excellence at Level 3

There is some inconsistency in awarding Excellence. When making assessor decisions regarding Excellence, consideration needs to be given to the overall quality of the evidence. This is critical when making a judgement at the Merit/Excellence boundary.

Students who reached Excellence in Mathematics standards produced evidence of insightful thinking in the solution of the problem.

Excellence, in the Statistics standards, occurred when students integrated statistical and contextual knowledge throughout the entire process. Acceptable evidence of statistical knowledge was free of statistical misunderstandings and inaccuracies. Appropriate contextual knowledge was evident in relevant research.

For example, in 91580, '*Investigate time series data*', students at Excellence integrated statistical and contextual knowledge throughout the statistical enquiry cycle. This was often

evident in the depth of discussion about the selected variable and the time series model, and in the investigation of other relevant variables.

In 91583, *'Conduct an experiment to investigate a situation using experimental design principles'*, students who reached Excellence integrated statistical and contextual knowledge throughout using experimental design principles. The integration of statistical knowledge was evident in clearly communicated explanations about the tail proportion after carrying out a re-randomisation.

The Clarifications document for each standard provides information about Excellence expectations.

Group Work

Group work is an acceptable form of assessment, if appropriate to the standard. When submitting group work for moderation, the teacher needs to ensure there is evidence that each student has met the standard.

The contribution of each student can be tracked and presented in a variety of ways, such as a written record of teacher observation, the division of workload into clearly defined tasks, a student worklog or video diary, recordings of teacher/student conferences, etc.

Students in the Mathematics and Statistics Standards could engage in group work for the collection, measurement and recording of data. 91032 and 91036, are particular examples of when this can occur.

In 91036, *'Investigate bivariate numerical data using the statistical enquiry cycle'*, students could work in groups to plan the investigation and when gathering data. In 91032, *'Apply right-angled triangles in solving measurement problems'*, the measurements needed for solving the problem could be done in a small group situation.

The authenticity of student evidence can be assured when the contribution of each student is successfully managed through such means as recorded teacher observations verifying student participation. Further information is available in the Conditions of Assessment document.

Integrated Assessment of Standards

This refers to assessing multiple standards via one submission of student evidence. The assessment of standards may be integrated either within a subject or across subjects.

For external moderation, if the assessment is across subjects and the student evidence is physical, it can be sent on to the next subject moderator/s if required. If it is an online submission, the student evidence can be uploaded for each standard being moderated.

Currently, integration of internal Mathematics and Statistics standards within the subject or with other subjects is rarely seen. Where integrated, successful student outcomes occur when the problem being solved, or the context being investigated, allows for all levels of achievement in the standard being assessed.

Sample to Population Inference

Successful student outcomes for the standards 91035, '*Investigate a given multivariate data set using the statistical enquiry cycle*', 91264, '*Use statistical methods to make an inference*' and 91582, '*Use statistical methods to make a formal inference*', all involved students using sample data to make a conclusion about the population.

When students are provided with a clear description of the population, they are more likely to achieve. In the case of 91035 and 91582, students use sample data provided from a multivariate data set. In 91264, students need to take a sample from a provided population. In all cases, an understanding of the population that the sample comes from needs to be evident in the student response.

When there is a link between the posed question about the population being investigated and the specific analysis occurring at each level, students achieve successful outcomes. For example, at Level 3, where the analysis involves bootstrapping for the difference in the means or medians, the posed question would be about the difference in the population means or medians.

Students demonstrate understanding when their comments analysing the sample distributions are linked to the posed questions and are used to make a conclusion about the population.

For 91035, for example, the conclusion is a comparative statement about the groups in the population for the selected variable. An understanding of the inferential nature of the conclusion is an essential part of the understanding.

A useful reference document for sample to population inference is 'inference-progressions-teaching' available at <http://new.censusatschool.org.nz/resource/sample-to-population-inference-the-path-to-3-10/>.

Guidance

For all the Mathematics standards, students provide sufficient evidence when they make their own decisions about the method of solution. This allows them to demonstrate the required thinking to reach each level of achievement.

For example, for 91032 '*Apply right-angled triangles in solving measurement problems*', students who used measurements they had taken in the solution of the problem were able to achieve the standard successfully. Students should not be guided through a sequence of steps about what to measure and what to do.

Context

To ensure successful student outcomes, the context of the assessment needs to be one that is accessible to all students. It is acceptable for students to know the context prior to the assessment.

For the Statistics standards, familiarity with the context provides students with the opportunity to demonstrate the required thinking to reach each grade.

In 91583, for example, students were able to achieve at all grades when their research was linked to the intervention that they selected and identified in their investigative question. Without appropriate and relevant research, students' ability to integrate statistical and contextual knowledge throughout the investigative process and when making the causal inference would be compromised.