2023 NCEA Assessment Report

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Subject: Mathematics and Statistics (Statistics)
Level: Level 3
Achievement standard(s): 91584, 91585, 91586

General commentary

The format of all three examination papers remains consistent from year to year. Regardless of their target grade, candidates need to ensure that they complete as many question parts as they can, across all three questions in each paper. Most Merit and Excellence level questions will offer Achieved-level opportunities for partial solutions. Note that the question parts will not necessarily be arranged in order of difficulty. Most questions continue to have two main parts, parts (a) and (b), and candidates should be prepared to restart a question in part (b) even if they have encountered challenges in part (a). Even though the context of a question or a graphical display may be novel to the candidate, sufficient information will be given in the question for students to make a full response.

Candidates should be encouraged to read questions thoroughly to determine the evidence that they need to provide in each part. Correct answers only, for example calculating a probability with a graphical calculator, will gain only Achievement level credit. Written responses should be supported with statistical calculations, and sufficient working should be shown to indicate the candidate's thinking and reasoning. For some question parts, the inclusion of sketches or diagrams may improve explanations. Final responses need to be linked back to the question or statement that has been given, and should include reference to the context of the question as appropriate.

Report on individual achievement standard(s)

Achievement standard 91584: Evaluate statistically based reports

Assessment

The examination included three questions, each in 4–6 parts, of which candidates were required to respond to all three questions. Candidates were provided with a resource booklet and a question-and-answer booklet. The resource booklet contained three reports, one for each question. The reports were set in real-life contexts, two of which were New Zealand-based.

The questions covered the requirements of the 2023 assessment specifications, which were to answer questions about statistically based reports. The questions required the candidate to evaluate claims or conclusions made in the report, including identifying and discussing potential sources of error associated with statistical studies, calculating and interpreting margins of error, and considering study design and the type of sampling method.

Commentary

Candidates are required to assess the quality of reports using statistical methods indicated by the question, whether it is to do with the design of the study, or to identify potential issues with aspects reported in the study. Candidates need to read the report and the questions carefully, and then consider what is being asked of them, perhaps by highlighting or underlining key words, which allows them to focus better on their responses. In many cases, candidates provided a great answer that did

not answer the specific question at hand, but rather another question elsewhere.

Candidates should avoid using generic, learned answers – for example, “Only younger people have access to the internet”, without considering the context of the report or providing necessary explanation to relate their observations back to the statistical reports.

Candidates should not say that there is a need to ‘eliminate bias’. Where bias is being discussed, the term to use is ‘reduce’ or words to that effect.

Candidates need to ensure that any response is made in context to the report.

After calculating comparison confidence intervals, candidates need to interpret the confidence interval in context and appropriately discuss the underlying population. For example, if the confidence interval was [–1%, 17%], then candidates needed to interpret this correctly by saying something like “I am pretty sure that for **New Zealanders** who want all-year daylight saving, the proportion who gave the reason “**more time to enjoy daylight hours during summer**” is somewhere between 1% less and 17% more than for **New Zealanders who want to keep daylight saving as it is**”. Then the candidate should write the claim SEPARATELY from the interpretation. The claim must also be in context. For example, “Because this interval is both negative and positive, there is not sufficient evidence to support the claim that the proportion of **New Zealanders** who want all-year daylight saving because it gives them “more time to enjoy daylight hours during summer” is larger than the proportion of New Zealanders who want to keep **daylight saving as it is** for the same reason.”

Candidates should be able to identify, describe, and discuss both experimental and observational studies, and apply that knowledge. In particular, the need to understand concepts such as extending the results appropriately, advantages and disadvantages of different survey types, and a wide range of different sampling methods.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- commented on key features by referring to statistical evidence provided in the reports without including specific details
- calculated a confidence interval correctly
- identified and described a confounding variable
- described the concept of blinding in context
- identified a potential issue with extending the results of an experiment
- identified advantages and disadvantages of surveys conducted by interviews.

Candidates who were awarded **Achievement with Merit** commonly:

- calculated a confidence interval, but could only either correctly interpret it within the context, or justify why a claim was true in context
- identified advantages and disadvantages of survey interviews in context
- identified and described the importance of blinding and associated impacts on a study
- described the effect of post-weighting on survey results
- explained how random allocation will balance effects of confounding variables in context
- described the effect of independence on survey results.

Candidates who were awarded **Achievement with Excellence** commonly:

- demonstrated understanding of what regional sample stratification meant with contextual reasoning
- calculated a comparison confidence interval and interpreted it in context, justifying a statistical claim using correct statistical language, including identifying the population
- used and correctly applied statistical language
- demonstrated understanding of relevant reasoning for extending results and could discuss this in context
- identified and described the importance of blinding and associated impacts on a study, including how this affects the response variable.

Candidates who were awarded **Not Achieved** commonly:

- did not refer to the statistical nature of the reports
- did not use the appropriate MOE to calculate the relevant confidence interval for a comparison confidence interval
- did not define or correctly use statistical terms and statistical terminology
- incorrectly focused on the size of samples to discredit studies
- prefaced discussions with “Eliminating bias”.

Achievement standard 91585: Apply probability concepts in solving problems

Assessment

The examination included three questions, each in 5 or 7 parts, of which candidates were required to respond to all three. Candidates were provided with a question-and-answer booklet.

The questions covered the requirements of the 2023 assessment specifications, which were to calculate probabilities from formulae, a probability distribution table or graph, tables of counts or proportions, simulation results, or from written information.

Familiarity with the use of Venn diagrams, probability trees, and two-way tables of counts (including graphical display using an Eikosogram) was required. It was necessary for candidates to clearly show the method they had used to calculate probabilities, and state any assumptions made.

Commentary

Good grades were achieved by candidates who spread their effort well across all three questions, rather than focusing on only one or two. Candidates should read questions carefully to identify the necessary response, then write their responses in context, supporting these with necessary calculations.

Candidates continue to misinterpret the relative risk, confusing “times as likely” and “times more likely”, thinking that 50% more means a ratio of 0.5, not 1.5.

Again in 2023, candidates struggled with identifying situations involving conditional probability. Students need to learn to analyse situations that may or may not involve conditional probabilities, and apply tests for independence when required.

It is useful for students to be able to quickly recall tests for complementary, mutually exclusive, and independent events. There was confusion between the tests for mutually exclusive and independent events from many candidates.

Graphical display of a two-way table of counts using an Eikosogram was unfamiliar to most candidates. Candidates often didn’t realise that the figures given on the graph were conditional probabilities.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- chose which probability tool was best suited to solve a problem for each part and then used it to find the correct probability
- identified relevant probability concepts and contextual information
- processed information provided in a two-way table
- calculated and compared conditional probabilities
- constructed and used a probability tree to make a decision
- processed statistical information to find a proportion.

Candidates who were awarded **Achievement with Merit** commonly:

- related probability concepts to the context of the situation being modelled

- selected and used an appropriate test for independent events
- justified a claim using calculations and / or statistical statements
- completed a Venn Diagram and found the required probability.

Candidates who were awarded **Achievement with Excellence** commonly:

- demonstrated a good level of statistical literacy and were able to answer the question being asked
- processed large quantities of information and chose the correct method to solve a complex problem
- interpreted their solutions
- used appropriate rounding at all levels
- showed an understanding of the context when stating their answers
- devised a strategy to solve a problem, e.g. discussing a simulation
- calculated and explained relative risk in context
- clearly articulated their thoughts and backed up their statements with relevant probabilities.

Candidates who were awarded **Not Achieved** commonly:

- did not use calculations anywhere to support statements
- did not recognise that probabilities have to be between 0 and 1
- often gave proportions greater than one or numerical answers only
- used incorrect tests for independence and mutually exclusive events
- demonstrated diificulty in relating to or understanding the context of the question
- did not calculate conditional probabilities
- did not complete a Venn Diagram
- did not extract and use information from an Eikosogram

Achievement standard 91586: Apply probability distributions in solving problems

Assessment

Candidates need to be familiar with the uniform, normal, triangular, binomial, and Poisson Distributions and their features, and questions involving distributions of discrete random variables.

Understanding and identifying the random variable or event being discussed in a question is key to success in this assessment. Many candidates struggled with this.

Candidates should get into the habit of writing the name of the distribution they are using and listing its parameters when writing their responses. Frequently using an inappropriate distribution gives a similar answer to the correct one. A failure to identify the distribution, its parameters, and show working in these cases will result in no credit being given for the answer.

Merit and Excellence questions usually require responses to be linked to the context of the question. Instructions that require candidates to “support their answer with statistical calculations and reasoning” always require contextual references, statistical calculations with sufficient working to indicate the candidate’s thinking, and reasoning. Where a graph is given, discussion of the features of the graph in context is expected.

Commentary

Candidates with strong calculation skills performed well in this assessment, but those with the ability to calculate probabilities and describe / compare distributions and discuss the appropriateness of these to the context of the question gained higher grades.

Candidates often wrote responses that were not clearly linked to the context of the question, so failed to achieve higher grades.

A common issue was premature rounding which resulted in inaccurate / incorrect answers. Candidates should ensure that they do not round their work to less than 4 decimal places, until their final answer.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- identified which distribution to apply and calculated a probability for that distribution
- identified the correct parameters needed to solve a probability distribution problem
- calculated the mean and standard deviation for the distribution of a discrete random variable in table form
- gave an assumption in context relating to one of the distributions

Candidates who were awarded **Achievement with Merit** commonly:

- completed multi-step problems across a range of distributions
- calculated and compared means and standard deviations for two distributions
- calculated a straightforward inverse Poisson problem
- supported their responses with appropriate statistical calculations, contextual references, and features of a graph
- discussed the conditions of a distribution in context
- estimated parameters for a normal distribution from a graph
- demonstrated understanding of assumptions made when using probability distribution models and were discussed whether these assumptions were likely to be valid in the context of a problem
- communicated their thinking using appropriate statements and calculations.

Candidates who were awarded **Achievement with Excellence** commonly:

- showed a depth of understanding across a range of distributions, appropriately linking statistical and contextual information
- discussed the appropriateness (or inappropriateness) of a probability distribution model by considering features of the probability distribution, statistical evidence and the context of the situation
- made comparisons between two distributions in context, with evidence, and gave an explanation of what the comparisons meant in context
- showed an understanding of sampling variance and standard deviation in context.

Candidates who were awarded **Not Achieved** commonly:

- did not identify which distribution to apply
- did not calculate a given probability for a uniform, poisson, binomial or triangular distribution
- did not calculate the mean or standard deviation from a table showing the probability distribution of a random variable
- made calculation errors or rounded prematurely.