Scholarship

2013 Assessment Report

Statistics

COMMENTARY

Overall the standard of the candidates' answers was satisfactory given the change and emphasis of the content being examined. The best-answered questions were the written interpretive style Questions One and Four covering the bi-variate and time series topics respectively. The hardest questions were Questions Two and Five involving experimental design factors and statistical literacy respectively. Many candidates were able to start these two questions however their ability to complete them by providing a full answer was a deciding factor for them in order to achieve high marks.

SCHOLARSHIP WITH OUTSTANDING PERFORMANCE

Candidates who were awarded Scholarship with Outstanding Performance typically:

- interpreted their statistical calculations correctly and in context. They checked that their calculations made sense with the context and information supplied
- communicated their thinking clearly and without "sitting on the fence" or being repetitive. Their choices were justified fully and clearly using correct statistical vocabulary
- considered the representativeness of a sample when making inferences about a population
- demonstrated an understanding of the difference between "sample to population" inference and "causal relationship" inference
- compared and contrasted information gleaned from graphical information and included good numeric detail (values, dates, range units) and context in their description i.e. Q1 (a) and Q4 (a)
- interpreted the randomisation test graphs in Q2 (a) correctly by discussing the experiment that tested the effectiveness of a new anti-parasite product compared to a currently used product, and were able to identify and discuss the relevant experimental design factors
- knew the meaning of statistical terms such as "strength of relationship" and "precision" and were able to apply them to practical situations like Q2 (b) (ii)
- used a confidence interval to successfully argue that the two groups were different in Q2 (b)
- solved complex probability questions and understood the implication of the calculated answer i.e. the number of operators required in Q3 (c) coupled with justification to the Poisson model
- understood concepts around the Consumer Price Index (CPI) with relevant working of deflation processes in Q4(c) and indexed time series. They were able to discuss the changes to milk fat prices and dairy land sales in terms of "real dollars" for a comparison
- selected and justified the use of the appropriate probability distributions in Q3
- took into account sampling variation when making comparisons between populations
- used models for bivariate data to make predictions and discussed the precision of these predictions using the visible variation of response variables (y) at the relevant explanatory variable (x) values
- predicted the amount of milk protein for cows and were able to discuss the accuracy of their prediction as well as considered factors that need to be considered before their predictions could be applied to the whole of New Zealand.

SCHOLARSHIP

Candidates who were awarded Scholarship but not Scholarship with Outstanding Performance typically:

- read and described information fully in graphical form and included some numeric detail in support of their descriptions i.e. for Q1(a) in comparing and contrasting milk production for Jersey and Ayrshire cows and/or Q4(a) in describing the milk production from 2003 to 2011
- described at least two points about a relationship between two variables but often left out details such as the range of each variable
- made correct predictions from bivariate and time series data (using an appropriate estimate for the trend and an appropriate estimate for the seasonality) but struggled to discuss the precision of their estimates
- commented on the validity of time series forecasts in terms of the stability of the trend, seasonality and also how far into the future the forecast is being made, with specific comment related to the data and context
- calculated accurately and justified their statements, i.e. the confidence intervals of difference of two means by using supplied bootstrapped confidence intervals for each population mean with an appropriate validity answer provided in context for Q2(b)(i)
- used point estimates to argue that two groups were different in Q2 (a)
- used probability distributions to solve problems i.e. they were able to use the binomial distribution with justification in Q3 (a) to provide an appropriate conclusion with the correct evidence that the new yoghurt was distinguishable
- provided good evidence for their conclusions i.e. Q4 (a)
- found the correct number of operators required for Q3 (c) by being able to use the Poisson distribution correctly
- partially answered the report in Q5 but not enough to get an “O”
- used evidence from the situation, context, graphs, statistics or output provided to support key statements made i.e. bootstrapped confidence intervals or randomisation test
- combined time series data presented in different units i.e. years and quarters
- were able to locate the distinct features with the appropriate evidence in Q5.

OTHER CANDIDATES

Candidates who were not awarded Scholarship or Scholarship with Outstanding Performance typically:

- did not attempt all parts of questions. Confused terminology and lacked context
- used predominantly descriptive statements without any relevant figures i.e. Q1 (a)
- made arithmetical errors and did not check them against graph or other relevant information
- used statistical terms incorrectly or did not use them at all
- did not understand the meaning of “strength” of a relationship or the “degree of scatter”
- were vague with their answers, i.e. they stated that “production peaked in Year 6” but didn’t give the value of peak production
- were repetitive in their answers. i.e. they stated the same point several times in answering Q5
- did not use values or other evidence when answering questions i.e. in Q1 (a) and Q1 (b). They were unable to quote the actual statistical values and describe features from

a time series from a graph in Q4 (a). They described changes in time series data at specific points rather than identifying key short term trends

- did not understand re-randomisation and bootstrapping. They confused randomisation tests with bootstrapped confidence intervals
- did not know the difference between experimental design factors and the kind of factors that were required in Q1 (b) (ii)
- were unable to describe a correct forecast with an appropriate corresponding validity comment about it, i.e. Q4 (b)
- used generic statements and did not relate their answers to the question. For instance features of the bivariate data were described without referring to the context, population, statistical values or the nature of the variables. The description “moderately strong relationship” was used for Q2 (a) but this meaning was contradictory
- were usually very good with the mechanical work but were unable to make sensible conclusions or comments related to their answers
- failed to “index” the milk fat prices and dairy land sale values in Q4(c)
- demonstrated misunderstanding of appropriate sample sizes (e.g. incorrectly stating that not enough data had been provided to make an inference or to perform a probability calculation)
- over-simplified situations involving chance. They failed to demonstrate adequately any knowledge of the various probability distributions required in Q3
- presented the conditions for a probability distribution without linking these to a specific context
- disregarded sampling variability as an explanation for differences
- confused “randomisation variation” with “sampling variation”
- were not able to identify the features relating to lameness in Q5 and they also gave vague comments in answering this question.

OTHER COMMENTS

- Many candidates had apparently not studied the “experiment design” topic.
- The words “valid”, “accurate”, “precise” and “reliable” were often used as if interchangeable.
- The number of candidates who suggested that “a representative sample of milking cows was one having a range of ages and/or genders” was surprising.
- There was evidence that some candidates failed to use their basic statistical knowledge and were not familiar with levels 1 and 2 Statistics work especially when working with graphs, tables and probability distributions.
- There was a general lack of rigour in candidates’ writing.
- Candidates used the word “outlier” too freely despite the fact that there were no actual outliers in the paper.
- Interquartile range was confused in meaning in comparison to the “middle fifty percent of values”.