HELPING MAKE GOVERNMENT POLICY ANALYSTS STATISTICALLY LITERATE

Sharleen Forbes[1,2], Paul Bucknall[2] and Nathaniel Pihama[2]
[1]Victoria University of Wellington, New Zealand
[2]Statistics New Zealand, Wellington, New Zealand
sharleen.forbes@vuw.ac.nz

Evidence-based decision making increased the demand for government policy makers to have basic numeracy and statistics skills. Statistics New Zealand's response was to create a Certificate in Official Statistics specifically for policy analysts that aims to give them the skills to critically evaluate statistical releases, research reports and published policy or media documents for their appropriateness and quality (of data, survey design, analysis and conclusions made) for some given policy question (e.g. how to reduce unemployment). Both statistical and non-statistical aspects are covered. Four of the units in the Certificate have learning done in traditional classrooms using small group workshops. Both the learning and competency based assessment are focused around real case study publications. In the final (major) unit students undertake and present an analytical report relevant to their own workplace. This paper reports on evaluations of the success of the certificate using the first three cohorts of students.

INTRODUCTION

Governments make a significant investment into the public sector and part of this investment is for the provision of sound advice. The Secretary of the New Zealand Treasury stated in 2006 that *'the public sector is a large part of our economy. Government expenditure and taxation excluding transfers is equivalent to one-third of GDP in New Zealand.'* (Whitehead, 2006). There is an expectation that the advice given to government will be based on accurate quantitative evidence and robust analysis. However, ensuring that people have the skills to understand the growing avalanche of data that they face is an ongoing challenge. In most countries, the structure of the education system has led to graduates in either literacy-based or numeracy-based disciplines, but very few with both sets of skills. In many cases, government policy makers have high literacy, but only limited numeracy skills. The New Zealand Government Statistician commented that policymakers need data at four stages of the policy cycle (Bascand, 2009). First, they need data at a fairly high level of aggregation (e.g., nationally) to help identify, or define, particular problems. Second, they need data to help identify causes (e.g. disaggregated socioeconomic data to identify educational, ethnic, or family factors). Third, they need data to monitor and manage the implementation of policy (e.g., What is delivered and to whom?) and finally they need data to evaluate the impact (outcomes) of their policies. For government employees to provide good advice to their managers, or directly to Government through its Ministers, they need to collect, interpret and present a base of evidence. At a minimum, they require basic numerical and statistical literacy skills and an understanding of official data should be regarded as an essential skill.

Within the national statistics office, Statistics New Zealand, managers were concerned that staff did not have as high a level of statistical skill as in the past, and that it was becoming more difficult to retain those staff that did have statistical skills. The lack of quantitative skills in the rest of the state sector was reinforced in New Zealand by a pilot study (Macky & Saffron, 2004) and Statistics New Zealand's own consultation with statisticians and policy managers in 18 state sector agencies. This identified basic numeracy skills, basic statistical skills and literacy, and general statistical knowledge as areas that staff needed to improve. These studies also indicated that gaining a formal qualification was an incentive for staff to study statistics.

To help address this problem, Statistics New Zealand developed a basic qualification for staff both from within the national statistics office and from across the state sector generally. The goal of the qualification is to give policy analysts the skills to critically evaluate statistics releases, research reports and published policy and media documents for their appropriateness and the quality of: the data used; the survey design; the analysis undertaken; and the conclusions made. The ability to do so is fundamental to providing good information about a given policy question (such as, how to reduce unemployment). It was intended that the qualification would:

- meet, at a basic level, the requirements of each individual learner's workplace and be undertaken with minimal disruption to their ongoing work;

- have open entry with only a basic level of numeracy being assumed;
- have small student cohorts (between 15 to 25 students) to allow for class interaction; and
- be based on current statistical literacy theory (Wild & Pfannkuch, 1999) but focused on official statistics as well as general statistics methods.

'What does statistically literacy mean with respect to official statistics?' The interpretation used in the content development for this qualification was having an understanding of: the metadata about the statistics (why, when, where, how and what data was collected); the analysis used; and the statistical meaning and 'real world' interpretation of the statistics.

THE CERTIFICATE OF OFFICIAL STATISTICS

The resulting qualification, the Certificate of Official Statistics, was developed and piloted in 2007 then registered on the New Zealand Qualifications Framework, hereafter called the framework (National Qualifications Framework Project Team, 2005). There were several innovative aspects in its development. First, it was jointly developed in a 3-way partnership between Statistics New Zealand, the agency responsible for cross-departmental state sector issues (State Services Commission) and the Industry Training Organisation responsible for state sector training (Learning State). Second, from its conception a group of academics from university statistics departments (at least one from each of in the seven main New Zealand universities) advised on the number of modules or units (called Unit Standards in the New Zealand context) that the qualification would contain and the content of each unit. They also agreed to work collectively with Statistics New Zealand to deliver and assess these units. Third, the assessment is competency based. That is, students are required to demonstrate that they have a certain level of understanding and skill and, within a given timeframe, can re-sit units until the required level is attained. Students are not awarded grades.

The certificate is comprised of five units covering both statistical and non-statistical aspects. Four *core* units cover basic statistics, official statistics and the constraints in their production, for example, the ten United Nations Fundamental Principles of Official Statistics (United National Statistics Commission, 1994) and, in New Zealand, the Statistics Act 1975. The titles of these units are, in the current order of delivery:

- Resolve ethical and legal issues in the collection and use of data in a public sector context.
- Interpret statistical information to form conclusions for projects in a public sector context.
- Assess a sample survey and evaluate inferences in a public sector context.
- Evaluate and use statistical information to make policy recommendations in a public sector context.

The second and third of these units are registered at level four (vocational or pre-university) of the framework but the first and last are at level five (first year university). Overall the certificate is registered at level four. Students can demonstrate competency in a variety of ways to achieve units registered on the framework. The following teaching and assessment methods are used to deliver this certificate.

Learning for the core units is done using full-day courses in traditional classroom settings with small group workshops. Each course is delivered by an academic from a different New Zealand university (the unit provider). The use of short-courses is based on evidence that this was what employees and managers preferred (Macky & Saffron, 2004). A case study approach is used. Two main publications are chosen for use across all four units for teaching purposes and two different publications are chosen for assessment purposes. The four case studies are selected annually from:

- Statistics New Zealand's official statistics releases, e.g., Household Labour Force Survey media releases (2008) and reports, e.g., Innovation in New Zealand (2005);
- other government agency releases, e.g., an evaluation report commissioned by the Ministry of Social Development (Ferguson et al., 2005) and the 2006 Maori Language Survey (Te Puni Kokiri, 2007);
- research reports, e.g., benefits of insulating houses (Howden-Chapman et al., 2007); and
- media articles such as 'Gore the least gay town in New Zealand' (Gault & Chapple, 2007).

Assessment questions are written by the unit providers, but assessed by an independent person (the assessor). Students can request these questions as soon as they have attended the

relevant seminar and are required to give their answers in the context of the two supplied publications. Answers are completed in the student's own time (supposedly over a three week period) then submitted to the assessor either in writing or orally (but most chose in writing). Originally the final component of the certificate was selected by students from a set of level four or five units registered on the framework that were deemed to be appropriate for the public sector context, such as management and communication skills or knowledge of public sector processes. As a result of the pilot evaluation discussed below, this was changed to a compulsory 'umbrella' unit consisting of a workplace-based statistics project that is partly assessed by the learner's manager. This unit is registered at level five of the framework. More information on the certificate can be obtained from http://www.statisphere.govt.nz/certificate-of-official-statistics.aspx.

EVALUATIONS OF THE CERTIFICATE

Including the pilot, there have been four cohorts (of between 13-16 students in each). A total of 58 students, some of whom are still progressing through the units, have enrolled in the certificate to date. The certificate is run on a cost-recovery basis, with candidates being charged an enrolment fee that covers the unit provider and assessor costs. There are, however, additional administrative and tutoring costs that are met by Statistics New Zealand, so it is important that initiatives such as this are evaluated and monitored by the agency to determine whether or not they remain a worthwhile investment. In the case of this certificate, two evaluations have taken place. One while the first cohort of students was participating in the certificate (the pilot evaluation in November 2008) and the second mid-way through the fourth cohort (October, 2009).

The first cohort of 13 candidates (all but one from Statistics New Zealand) started the certificate in 2007. These students (and their managers) were aware that, although their work was being formally evaluated for credit, they were also being regarded as a pilot. Both the candidates and their managers were surveyed part way through the certificate using a structured questionnaire with open-ended responses. The feedback obtained, together with concerns expressed by the then assessor, resulted in a number of changes being made to the certificate including:

- the order of delivery of the core units was changed (in the pilot the units were delivered in the order 3, 2, 4, 1 using the above numbering);
- one unit provider made substantial changes to their teaching style in response to student feedback;
- the number of assessment questions was reduced and ordered by difficulty;
- overlaps in questions between units were removed and linkage provided across units;
- worked examples were fine-tuned to show students what was required for a pass; and
- tutoring and mentoring systems were extended.

The level of complexity of the assessment questions in each core unit was also analysed using a method designed by Black and described in detail in Forbes et al. (2008) where each question received a score according to the following increasing level of complexity: 1=Idiosyncratic; 2=Verbal; 3=Transitional; 4=Procedural; 5=Integrated Process. The two units registered at level four on the framework had considerably more questions at the lowest two levels of complexity, and lower mean complexity scores (2.3 and 2.5 compared to 3.6 and 3.2), than the two units registered at level five providing reassurance that there was a real difference between the units registered at each level of the framework.

A similar survey to that used with the pilot candidates was delivered to candidates (and their managers) who had enrolled in the certificate by mid 2009. The major difference was that the pilot candidates were interviewed whereas later cohorts self-completed written questionnaires. The results of both surveys were then combined to give comparable results for all 58 students. The overall response rates to the evaluations were 62% for both students (36 out of 58) and managers (21 out of a total of 34 managers responding for 27 learners). Reasons for enrolling in the certificate were obtained from students and used to determine, in part, their level of motivation. The most common reasons given by students for enrolment were to improve their statistical knowledge and promotion prospects, or as a refresher course. For the pilot, those that enrolled to increase their statistics knowledge or assist with career advancement were classed as 'high' motivation, and those who wanted either a refresher or to '*contribute to the pilot*' were classed as 'low' motivation. For the later cohorts, recorded involvement in the Certificate (such as, participation in tutorials) was also taken into account. Almost two-thirds of students (65%) were

classified as having high motivation. It appeared that students with high motivation were more likely to respond than those with low motivation.

In the pilot, managers were asked to give their perception of the statistical skills of learners prior to enrolment as either '*none*' or '*low*'. In the latter evaluation prior statistical skill was classified solely on the student's self report from the questionnaire. Of those that responded, 61% were classified as having basic prior statistics knowledge. Although statistics knowledge is part of the definition for classifying motivation there was no obvious relationship between the student's motivation and their prior statistics knowledge as shown in table 1 ($\chi 2_{(df = 1)} = 1.02$, p-value = 0.31). That is, the low motivation candidates were not necessarily those with some (low) statistical background.

Table 1. Frequency of Prior knowledge by Motivation

Prior Knowledge	Motivation level		
	Low	High	Overall
None	3	13	16
Low	8	16	24
Not specified	7	11	18
Overall	22	36	58

Completion rate of students and time taken to complete individual units

It was initially expected that students would take a year to complete the certificate, but only about half have done so, with many being granted time extensions. To date, 26 students have completed the certificate. This is, just over 60% of the 43 that could have done so. All units need to be completed for the certificate to be attained, so delays in the completion of individual units may decrease the overall likelihood of certificate completion. As of the date of the evaluation, about 60% of students have completed all core units that were due.

As grades are not awarded in this certificate, the only measures of student performance available are the length of time taken to complete units and the number of re-sits required. Despite minor refinements, the four core units have remained substantially the same for all the cohorts so these were used to investigate factors related to the completion time and number of re-sits. Overall, two-thirds (103 out of 155) of all assessments required a re-sit of at least one question. Only one student was able to complete the certificate without any re-sits.

The time taken to complete from the seminar date was highly variable with a range over the four core units of between 11 to 401 days. The mean (median) time taken to complete a unit from the date of the seminar was 164 (127) days (standard deviation = 123 days). Not all students request the assessment questions as soon as they have attended the relevant seminar and, as figure 1 shows, there is no strong relationship between time taken to request the assessment and the time taken to complete it after reception (Spearman's $\rho = -0.034$, $p = 0.52$).

Relationships between motivation, prior learning and time taken to completion

There was a statistically significant relationship between motivation level and completion rate with 92% of high motivation and 34% of low motivation students completing units ($z = 8.48$, p < 0.0001). However, there was no significant difference between completion rates for low (86%) and no (92%) prior knowledge groups ($z = 0.77$, $p = 0.44$). It also appears that, for both groups, there are two groups of learners, those that request assessments soon after a seminar (within 7 days say, which 46% of students do) and those who wait for some time before doing so.

There was also a significant difference between the time to complete the assessment from the seminar date for high motivation (mean = 137 days, median = 115 days) and low motivation (mean = 237 days, median = 220 days) students (Wilcoxon Two-Sample Test: $z = 4.61$, p < 0.0001). No significant difference was evident for low prior knowledge (mean = 147 days, median = 118 days) and no prior knowledge (mean = 134 days, median = 125 days) students (Wilcoxon Two-Sample Test: $z = -0.94$, p = 0.17). Using the time taken from the date of the seminar to completing the unit as the survival time, survival functions for the two motivation and the two prior knowledge groups can be calculated (figure 2). Survival analysis also suggests slower rates of completion for students with low motivation compared to those with high motivation (Log-rank test for equality: $\chi 2_{(df = 1)} = 40.15$, p < 0.0001). No significant difference between survival functions was found for prior knowledge (Log-rank test for equality: $\chi 2_{(df = 1)} = 0.75$, p = 0.39).

Days to complete assessment from its reception
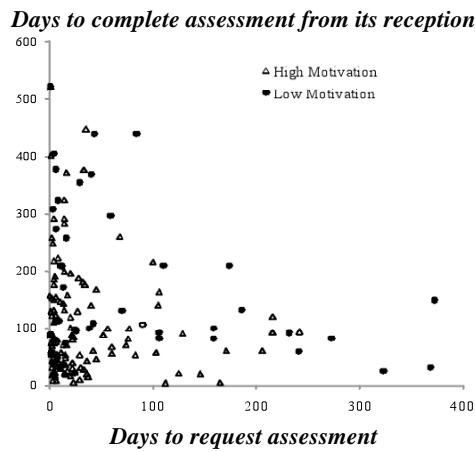

Days to request assessment

Figure 1. Relationship between completion time since receiving assessment and time to request assessment following the seminar date
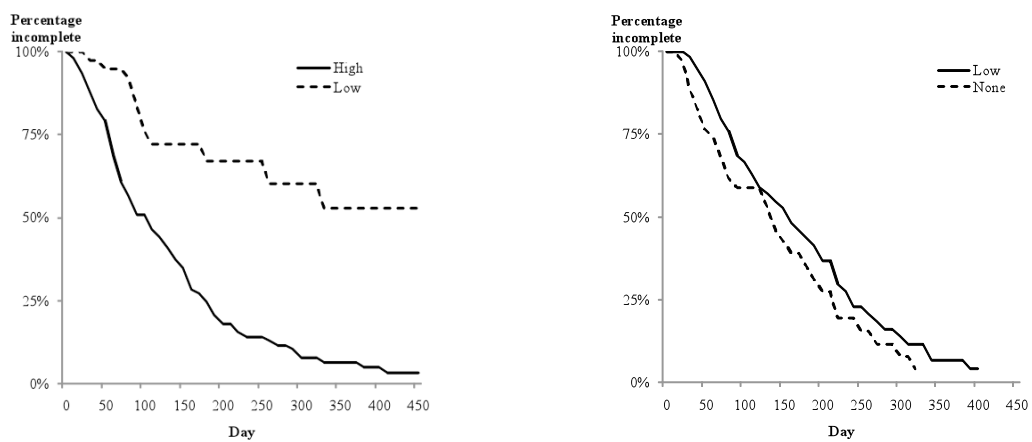

Figure 2. Survival functions for incomplete assessments, following the seminar date, by Motivation (left) and Prior Knowledge (right)

Perceived barriers to completion

About half (52%) of the students reported that there was a tension between completing assessments and work and personal life. Eight students mentioned that fixed deadlines would have given them more incentive to complete sooner. Lack of support from their manager was given as a barrier to completion by only two students however 31% of the responding managers indicated that they were not involved in the progress of their staff. One manager in the pilot stated *"I relied on the Certificate process to help her (tutoring, study groups, etc)."* Although a number of modifications were made to the assessment questions following the pilot, some later students also suggested that questions were either unclear or too broad, suggesting that there is more work to do in this area.

Seven people moved during or after the Certificate into a new role or organisation. Only one was explicit that the Certificate contributed to their move stating: *"Changed job after completing certificate. Knowledge from certificate is very useful in new job, and encouraged me to apply for new job."* All seven of those who changed workplaces midway through the certificate completed it (contrary to the findings of Curson (2004) that this is a barrier to course completion).

Overall success of the Certificate

All but one student stated that they would recommend the certificate to others. Most managers indicated that it was too soon to determine if the certificate had met their expectations but all those responding said they would recommend the certificate. Fourteen managers also stated that there was a noticeable increase in the confidence of staff enrolled in the certificate. Although the certificate has been largely promoted by word-of-mouth interest is still being expressed by potential candidates. Candidates have come from a range of government agencies (Archives New Zealand, Cancer Control Council, Department of Building and Housing, Department of Labour, Human Rights Commission, Inland Revenue Department, Ministries of Economic Development,

Education, Justice, Social Development, Women's Affairs, Youth Development and Health, New Zealand Qualifications Authority, Defence Force, Police, Transport Accident Investigation Commission, The Treasury) as well as Statistics New Zealand and one local council.

CONCLUSION

The number of students succeeding in the certificate has been limited to some extent by Statistics New Zealand's capacity to promote and deliver it. Our evaluations indicate that there is further refinement work needed to the assessment questions, to finding ways of increasing the level of manager involvement and possibly to extending the timeframe to have a better fit with the other demands on students' time (especially given that they are all also in full-time employment). The importance of formal evaluation of this type of qualification is highlighted by the subsequent and ongoing refinements to the certificate.

There is feedback, however, that the certificate is meeting some of the statistical literacy needs of staff and their managers in the state sector. This is partly demonstrated by the continued interest shown in participating in the certificate. In many countries, having a statistically literate state sector would help ensure that the advice governments are presented with has a sound evidence base. The Certificate of Official Statistics is presented as a possible model to consider for other national statistics offices interested in raising the statistical skills of policy advisors.

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