**The effects of the September 2010 earthquakes on NCEA results – a statistical analysis**

**Purpose**

1. This note reports on the results of three statistical analyses of the 2010 NCEA results to see if there is evidence that the September 2010 earthquakes and its aftershocks affected the performance of students in Christchurch/Canterbury.

**Background**

1. Some secondary schools in Christchurch have expressed concerns about the effects of the September 2010 earthquakes on the performance of NCEA candidates.
2. Given the changes in the Government’s management of tertiary education in 2008, entry into some tertiary education qualifications has become more competitive and this means that more notice is taken of NCEA results by tertiary education organisations when they make admission decisions.
3. During 2010, NZQA agreed to a process to reduce any adverse effects of the earthquakes, through allowing a school to apply for a ‘derived result’ where they considered a student’s performance was below what might have been expected.
4. The analyses summarised in this paper take different views of the data to explore the issue. One of the analyses was done by NZQA and two by the Ministry of Education.

**NZQA analysis of results in 2008, 2009 and 2010**

1. NZQA looked at all schools in the three local authorities Christchurch, Waimakariri and Selwyn. The analysis compared indicators of NCEA performance in the three local authorities at all NCEA levels in each of the years 2008-2010 with national performance on the same indicators.
2. The indicators were:

* the proportion of students attempting NCEA at each level in each year
* the proportion of candidates gaining NCEA at each level
* the proportion meeting the university entrance standard
* the proportion of candidates at each level gaining excellence, merit and achieved grades at each of the levels.

1. On each of the measures, the relationship between Canterbury schools and New Zealand schools was roughly the same in 2010 as it had been in 2008 and 2009, suggesting that there was no measurable disadvantage as a consequence of the earthquakes. Key findings were:

* pass rates in standards at all NCEA levels for Canterbury schools were higher in 2010 than in the previous two years
* the percentage of excellence results in achievement standards at all levels for Canterbury schools was higher in 2010 than in the previous two years
* rates of qualification attainment in NCEA in 2010 of Canterbury schools were higher than attainment rates in the previous years
* the difference between Canterbury schools and other schools in pass rates and NCEA qualifications attainment rates was roughly the same in 2010 as in 2008 and 2009.

1. The full data is in Appendix 1.

**Ministry of Education statistical analysis**

1. The Ministry looked at the achievement scores in NCEA over three years for two cohorts of students. The NCEA achievement score – sometimes called the ‘expected percentile’ – maps each student’s NCEA results in each year to a number between 0 and 100 that reflects both the level of performance (excellence, merit, achieved) and also the relative difficulty of the achievement standards in which those grades were obtained[[1]](#footnote-1). The NCEA achievement score is the best overall summary of the level of a student’s achievement; it is the best predictor of transitions to tertiary education and of success in tertiary education[[2]](#footnote-2).
2. In order to avoid submerging the results of students in a few severely affected schools in the results of lesser affected schools, we divided schools into three groups:

* a small group of plausibly earthquake-affected schools – Kaiapoi High School, Darfield High Schools (two schools that might claim they were adversely affected) plus Lincoln High School and Hagley Community College (two schools that have discussed the impacts of the earthquake)[[3]](#footnote-3)
* the other schools in Christchurch, Selwyn and Waimakariri
* schools in the rest of New Zealand.

1. We used mixed model regression. We used a cohort approach, looking at the 2010 level 3 group in relation to the performance of the same group at other levels and in previous years – rather than comparing one group’s results with the results of another cohort in a previous year – thereby eliminating variations that could be due to differences between years.
2. Figure 1 shows the (actual) mean NCEA achievement scores for students completing NCEA level 3 in 2010. It shows that:

* The four earthquake-affected schools performed at a slightly lower level than the rest of New Zealand, but that the performance in level 3 in 2010 was roughly on a par with the performance of those schools in previous years, when compared with the performance of the rest of New Zealand
* The ‘rest of Canterbury’ schools performed better than the rest of New Zealand in each of the years and the relationship in 2010 between their performance and that of the rest of New Zealand was roughly the same as the relationship in earlier years.

**Figure 1: Change in actual mean achievement score for students completing NCEA level 3 in 2010, by location of school**



1. The results were modelled using mixed model regression analysis. Figure 2 shows the modelled results and also includes the results for the previous cohort as a comparison.
2. The difference in the slope of the line between the four earthquake affected schools and the rest of New Zealand schools was not statistically significant.

**Figure 2: Change in modelled mean achievement score for students completing NCEA level 3 in 2010, by location of school**

**a – 2010 b – 2009**

|  |  |
| --- | --- |
| **A** | **b** |

1. While there is no significant difference between the gradient of the four earthquake affected schools and the rest of New Zealand in 2010, there was a statistically significant difference between performance on those four schools and performance in the rest of New Zealand in 2009, when there were no earthquakes.
2. There is a statistically significant[[4]](#footnote-4) difference between the gradients of the rest of New Zealand line and the rest of Canterbury line, with the latter steeper by 0.4 (-4.7 as opposed to -4.3). But there is a similar statistically significant difference for those who took NCEA level 3 in 2009. Again, the difference cannot be plausibly attributed to the earthquakes.
3. When the same model is applied to NCEA results in 2010 for Wellington schools, the gradient of the slope is the same as the gradient in the four earthquake-affected schools.
4. Full data is attached at Appendix 2.

**Individual school trends**

1. As students progress through NCEA levels and as academic work gets more difficult, there is a drop in the mean achievement score – from level 1 to level 2 and a further drop between level 2 and level 3. At a national level, the relationship between the mean achievement scores at the three levels of each cohort is approximately linear – ie the difference in the mean between levels 1 and 2 is roughly equal to the difference in the means between levels 2 and 3, so that the graph is essentially a straight line.
2. But the national data may be masking the situation in individual schools whose results may have deteriorated between level 2 and level 3 at a faster rate than expected. If there is an earthquake effect, we would expect a larger difference between Level 2 and Level 3, compared with the difference between Level 1 and Level 2. If the Christchurch schools were overrepresented in the list, we might have reason to suspect an earthquake effect.
3. Nationally, there were 84 schools[[5]](#footnote-5) whose change in their 2010 level 2 to level 3 results were greater than the difference in their level 1 to level 2 results. Of the 84, two[[6]](#footnote-6) were from the earthquake-affected group described in paragraph 11 above, while ten were in the ‘rest of Canterbury’ group.
4. This means that 24% of the rest of New Zealand schools are in the list, and 39% of Canterbury schools. A chi square test of independence is not significant at the 5% level (p=0.087). That means that the differences seen are not dependent on where the school is. Looking at the same analysis in 2009, the same figures were 17% for the rest of New Zealand, and 26% for Canterbury schools. These results are also independent of location (p=0.219).
5. Given the distribution of results and given the fact that the Canterbury schools were not among those with the highest differences, this analysis doesn’t provide grounds to suggest that these schools were negatively impacted by the 2010 earthquake.
6. The full data for 2010 is attached at Appendix 3.

**What can we conclude?**

1. The three analyses reported in this note all suggest that there are differences between the NCEA performance of students at Canterbury schools and schools elsewhere. However, there are no statistically sound reasons to assign the differences in 2010 to earthquake effects.
2. This analysis will be repeated in 2012 to look at the effects of the 2011 earthquakes.

1. For an explanation of the calculation of NCEA achievement scores and an account of their meaning, refer to Ussher S (2008) *Post-school choices* <http://www.educationcounts.govt.nz/publications/tertiary_education/23103> [↑](#footnote-ref-1)
2. Engler R (2010a) *School leavers’ progression to bachelors-level study*; Engler R (2011) *School’s out – what next*; and Engler R (2010b) *Academic performance of first year bachelors students at university.* All are available at: <http://www.educationcounts.govt.nz/publications/tertiary_education> [↑](#footnote-ref-2)
3. It would be possible to repeat the analysis for a different subgroup of Canterbury schools. But it needs a reasonably large number of NCEA Level 3 candidates to produce a statistically robust analysis. [↑](#footnote-ref-3)
4. At the 1% level. [↑](#footnote-ref-4)
5. Only schools with 20 or more level 3 candidates are included in this analysis. [↑](#footnote-ref-5)
6. Kaiapoi and Darfield [↑](#footnote-ref-6)