# Staying the course

*School leavers completing their first*
*one-year non-degree qualification*

Secondary to tertiary transitions

This report forms part of a series called Secondary to tertiary transitions.

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# SUMMARY

KEY POINTS

Overall, young intramural students studying in one-year non-degree qualifications do not perform very well. Only about 36 students in every 100 who start on of these qualifications completes that same qualification, a little less than the number who drop out in their first year.

However, when the type of study is controlled for—separating students who study full-time versus part-time—full-time students perform considerably better, with moderately high likelihoods of completing these one-year non-degree qualifications in one year. As expected, part-time students take longer to complete, this being most likely to occur in year two. Full-time and part-time students have much the same likelihood of dropping out in year one and very few students progress past year two in these types of qualification. Importantly, the likelihood of completing in year two for part-time students is *lower* than the likelihood of full-time students to complete in year one.

If a student's prior school achievement (the highest NCEA level) and their ability (the average grade they gained in their NCEA Level 1 standards) are also controlled for, we find that students of average ability with higher school achievement are more likely to complete a one-year non-degree qualification than similar students with lower school achievement, and this is true for both full-time and part-time students. Students with higher school achievement are also less likely to drop out. But interestingly, full-time and part-time students of average ability with the same level of school achievement have about the *same* likelihood of completing these qualifications in their expected year of completion.

These apparently contradictory findings—part-time intramural students either do or don't have the same likelihood of completing as intramural full-time students, albeit a year later—can be explained by the fact that students with higher school achievement are more likely to start their tertiary study as full-time students. On average, these higher-achieving students have higher ability, and so are more likely to complete their qualification in one year. But this correlation of full-time study and better completion should not be misinterpreted as a cause and effect relationship. Because when comparing the ability of students of equal school achievement, full-time and part-time students have much the same average ability. These students, with the same level of achievement and the same ability, have about equal likelihoods of completing their qualification in their expected year of completion. Studying full-time or part-time intramurally therefore is not associated with the likelihood of completing when a student is expected to complete.

Nevertheless, proportionally fewer part-time students complete these one-year non-degree qualifications. This can be explained by the fact that part-time students, on average, take an extra year to complete, so there is more opportunity for these students to drop out of their studies.

These findings are important, because they shift the focus from the reasons why students aren't completing, to why they are dropping out. While there will always be students who won't complete a qualification, regardless of their ability to do so, more can be done to ensure students begin qualifications they will want to complete, and keep them sufficiently motivated to ensure they actually complete.

This study looks at the performance of young tertiary students studying in their first one-year non-degree qualification. Performance is measured as to how likely it is they complete that same qualification.

We have focussed on students whose highest school achievement was up to and including the National Certificate of Educational Achievement (NCEA) at Level 2. Many of these students enter the labour market after leaving school, so the government is developing strategies to help them continue in education and achieve worthwhile qualifications. There is also concern about the amount of money invested in student loans. Students who take longer than the minimum time to complete a qualification incur extra costs, while those who borrow but don't complete take on the costs of study without gaining the benefits. It is important to know therefore what conditions maximise the likelihood of completing a qualification, and minimise the time it takes to complete it.

The report considers the following questions.

- *How is school achievement associated with the likelihood of completing a one-year non-degree qualification?*

  For intramural students, increasing school achievement is generally associated with increasing likelihoods of completing. There is far less of an association for extramural students.

- *Do students with NCEA Level 2 complete in a shorter time than other students? In particular, do they complete the one-year qualification in one year?*

  Generally, students whose highest school achievement level is NCEA Level 2 have a median enrolled time to completion of one year,[1] which is a shorter time than for other students. Students with lower school achievement but who have higher ability[2] can also have shorter completion times. However, of those students who are ever going to finish, the majority of full-time students complete in one year, while the majority of part-time students do so in two years. Thus, of those students who do complete, the majority do so in the minimum time.

- *If students with lower school achievement take longer to complete, do the same proportions of these students complete over the long run?*

  No. If students take several years to complete, they have more opportunities to drop out, so a lower overall proportion eventually complete.

- *What influence does student ability have on completion, and does higher ability offset lower achievement?*

  It appears that higher ability can offset lower achievement to some extent. However, for students with the same level of ability, intramural students with higher school achievement are more likely to complete their non-degree qualification than similar students with lower school achievement. This indicates that, while *ability* is important, prior *achievement* is the more important factor. Successfully completing a higher-level programme of study at school, rather than doing well in just some standards, is the better indicator of tertiary performance in these one-year non-degree qualifications.

Other findings of the study include:

- Most young students attempt to complete these one-year qualifications in one year. Only a third start these qualifications studying part-time, and 95 per cent start out studying intramurally. It appears most students intend to complete the qualification in the shortest possible time.

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[1] The median enrolled time to completion is defined as how long it takes for 50 per cent of students to gain their qualification.

[2] Student ability measures how well students perform, on average, across individual achievement standards. School achievement is the highest NCEA certificate gained by the student by the time they leave school.

- Dropping out is the main reason why more students don't finish these one-year sub-degree qualifications. Overall, about 37 per cent of intramural students drop out in the first year of study, and most of these students do not go back to complete that qualification, although they may go on to study other qualifications in later years.

- Those who persist in their studies have a reasonable likelihood of completing. Full-time students of average ability who gained NCEA Level 2 as their highest school certificate have a better than 50 per cent chance of completing in year one.

- In these one-year non-degree qualifications, when controlling for school achievement and student ability, full-time intramural students in year one are about as likely to complete their qualification as intramural students studying part-time in year two. In addition, full-time and part-time intramural students have about the same overall likelihood of dropping out in year one. This suggests that the reason why fewer intramural part-time students complete these one-year non-degree qualifications is not because they are intrinsically less likely to complete, or more likely to drop out, but because part-time students have an extra year in which to drop out.[3]

- For extramural students, the likelihood of completing or dropping out is not that much different between school achievement categories. It would appear the factors that determine success while studying extramurally outweigh the benefits associated with higher school achievement.

- Overall, for these one-year non-degree qualifications, the results show that dropping out is mostly independent of how students study, and their track record of prior achievement. Research suggests that some students are enrolling in study at this level primarily to see if they can cope with tertiary study, and seeing if it provides them with any benefit. Clearly some of these students will decide to discontinue their studies, regardless of their ability to complete the qualification. Our data also suggests that prestige, or potential employment benefits, as indicated by the level of qualification attempted, could also play a role in the decision to drop out, with drop out more likely for students enrolled in lower-level qualifications.

- Students with higher school achievement are more likely to study full-time in year one. This has implications for understanding why students study full-time or part-time. It is generally thought that part-time students don't do as well as full-time students because of the reasons that impel them to study part-time in the first place—usually work, family or social commitments, or because they do not intend to actually complete a qualification. But neither of these hypotheses can explain why there might be a difference in achievement between these two groups of students at the start of their study. An alternative hypothesis might be that some students who don't do so well at school may not wish to continue their study with the same level of intensity as other students. They may be consciously choosing to study part-time, rather than it being a consequence of trying to undertake work and study at the same                                                                                                            time.

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[3] A student drops out of their studies when they don't continue their enrolment in the same qualification for at least one year. More details of dropping out, and the other events modelled in this report are discussed in Section 6.3.

# 1   INTRODUCTION

This report follows on from our earlier report "School's out – what's next" (Engler 2010a) which considered the post-school activities of young students with a level of school achievement that generally precludes them from going on to university study. In this current report, we consider students with lower school achievement who went on to study a one-year non-degree qualification, and we look at the likelihood of them completing this qualification.

How well students perform in non-degree qualifications, and how this is affected by school achievement, is currently of much interest to the government. This is for two reasons. Firstly, the government wants to see all young people achieve the National Certificate of Educational Achievement (NCEA) qualification at Level 2 or higher. This provides them with a greater opportunity to continue with their education after they leave school compared to achieving lower level school certificates. But unlike the path to university and bachelors degree study taken by students with NCEA Level 3, lower-achieving students have no clear educational pathway after secondary school, and a large proportion of them do no further study, at least by the time they reach 19 years of age (Engler 2010a). The government is developing 'vocational educational pathways', and establishing trades academies[4] and tertiary high schools[5], to improve the educational opportunities for these students. So it is important to know how well these students perform in tertiary study, and whether there is a minimum level of school achievement below which further educational success is less likely.

Secondly, there is concern about the amount of money students borrow for their studies, and the efficient and effective use of the government's investment in tertiary education (Ministry of Education 2012). Students in non-degree qualifications who have borrowed to fund their study make up 47 per cent of all borrowers, although they contribute only 36 per cent of the loan balance (*ibid*, Table 8). Students who take out a student loan to pay for their study, and then take longer than the minimum expected time to complete it, increase their loan and repayment obligations, and this requires the government to both fund the extra time it takes to complete the qualification and the extra student loan borrowings. It is important therefore to know *how long* students are taking to complete their qualifications, not just whether they are completing them or not.

Previous studies have looked at qualification completion in New Zealand. Prominent amongst these are the studies by our colleague David Scott (see for example Scott 2003, 2005, Scott and Smart 2005). These studies, and the qualification completion data published by the Ministry of Education, use completion rates calculated after a specified number of years for a cohort of students starting their studies in a particular year. For example, of the European domestic students studying full-time for a level 1 to 3 certificate, who started studying in 2001, 70 per cent complete after 5 years (Ministry of Education 2011). In our study, we have chosen to analyse and present the results in a different way, using a method called 'event history analysis'. This new method provides additional insights into the dynamics of qualification completion, and more importantly, allows us to analyse time-varying factors far more easily than other analysis methods. We describe event history analysis in detail in Section 6.3.

Our primary interest in this study is to see how school achievement and student ability affect the likelihood of qualification completion, but we also have to consider whether a student studies

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[4] Details on trade academies can be found at
http://www.minedu.govt.nz/NZEducation/EducationPolicies/Schools/Initiatives/TradesAcademies/TradesAcademies.aspx.

[5] Details on tertiary high schools can be found at
http://www.minedu.govt.nz/theMinistry/PublicationsAndResources/RIS/EducationAmendmentBillNo2/SecondaryTertiaryEducationInterface.aspx.

part-time or full-time, as clearly, part-time students will take longer to complete. The dataset which includes school achievement and student ability is only robust over two years of data. We therefore also use a much longer dataset, starting in 1997, which allows us to analyse four years of enrolment in these one-year qualifications.

We also consider the effect of attendance type, that is, whether a student studies intra- or extramurally. Extramural study has been shown to be associated with lower likelihoods of completing a degree qualification (Scott and Smart 2005). Like full-time or part-time study, intra- or extramural study can vary from year to year for the same student, but most students usually only attend either intra- or extramurally for these one-year qualifications. Proportionally few students study extramurally in year one, and while the proportion increases substantially in later years, student numbers in those years are small, making quantitative analysis problematic. We have dealt with this by considering extramural students separately, with the main body of the report focussed on intramural students.

We have used the highest qualification gained by a student at school as the measure of *school achievement*. This is most commonly the National Certificate of Educational Achievement, and it can be gained at level 1, 2 or 3. We also identify students who study towards but do not gain NCEA Level 1. We define s*tudent ability*, on the other hand, as how well a student performs across a range of individual achievement standards. Thus, a student may have gained an 'achieved' pass grade for each of the standards that contributed to a particular NCEA level. Another student may have gained 'excellence' grades for their standards. Even if both students gain the same NCEA level and therefore exhibit the same level of school achievement, the latter student has shown more ability.

Finally, we turn to the specific questions we address in this study:

- How is school achievement associated with the likelihood of completing a one-year non-degree qualification?

- Do students with NCEA Level 2 complete in a shorter time than other students? In particular, do they complete the one-year qualification in one year?

- And if other students take longer, do the same proportions of students complete over the long run?

- What influence does student ability have on completion, and does higher ability offset lower achievement?

This report is structured as follows. In section two we consider the pattern of full-time and part-time study over the first four years of study. We then outline the results for intramural students in section three, and extramural students in section four. We complete the substantive part of the report in section five with a discussion of the results. Because the methods we use in this analysis are new to education research in New Zealand, we have a detailed explanation of the data and methods in section six, and a technical description of the mathematical models used in the analysis in section seven.

# 2 TEMPORAL PATTERNS OF STUDY AND ATTENDANCE TYPES

Most students who undertake one-year non-degree qualifications either complete or drop out of their studies within the one year. So it is not surprising that there is little variation in how students study over time—there simply isn't time to change. Most students study full-time, and intramurally in their first year of study, and if they don't complete, some then switch to part-time study. Switches between intra- and extramural study are less common. The fact that most students start studying full-time suggests they intend to complete the one-year qualification in one year. There is also a sizeable proportion, about a third, who start studying part-time, who clearly expect to take more than one year to complete the qualification.

Table 1 shows the pattern of study and attendance types for all students 15 to 24 years of age in one-year non-degree qualifications. Figure 1 shows this data as a percentage of students enrolled each year.

**Table 1**
Patterns of full-time and part-time study for young students in their first one-year non-degree qualification

| Sequence of study and attendance types* | Number of students | Per cent of 1997-2011 study population |
|---|---|---|
| $F_i$ | 86,454 | 62% |
| $P_i$ | 22,419 | 16% |
| $P_iP_i$ | 15,326 | 11% |
| $P_iF_i$ | 3,198 | 2.3% |
| $P_eP_e$ | 2,795 | 2.0% |
| $F_iP_i$ | 2,686 | 1.9% |
| $P_e$ | 2,558 | 1.8% |
| $F_iF_i$ | 1,652 | 1.2% |
| $F_e$ | 726 | 0.52% |
| $P_iP_iP_i$ | 328 | 0.23% |
| $P_eP_eP_e$ | 313 | 0.22% |
| $P_eF_e$ | 210 | 0.15% |
| $F_eP_e$ | 135 | 0.10% |
| $P_iP_iP_iP_i$ | 115 | 0.08% |
| $F_iP_iP_i$ | 84 | 0.06% |
| $P_iF_iP_i$ | 80 | 0.06% |
| $P_iP_e$ | 78 | 0.06% |
| $P_eP_eP_eP_e$ | 74 | 0.05% |
| $F_iF_iF_i$ | 51 | 0.04% |
| $P_iP_iF_i$ | 51 | 0.04% |
| Total | 139,781 | 100% |

* F=full-time, P=part-time; i=intramural, e=extramural.
Study combinations are only shown where student numbers are greater than 50. The total includes all combinations.

**Figure 1**

Distribution of study type and method of study by years of enrolment (LHS), and total number of enrolled students (RHS) in the 1997-2011 study population
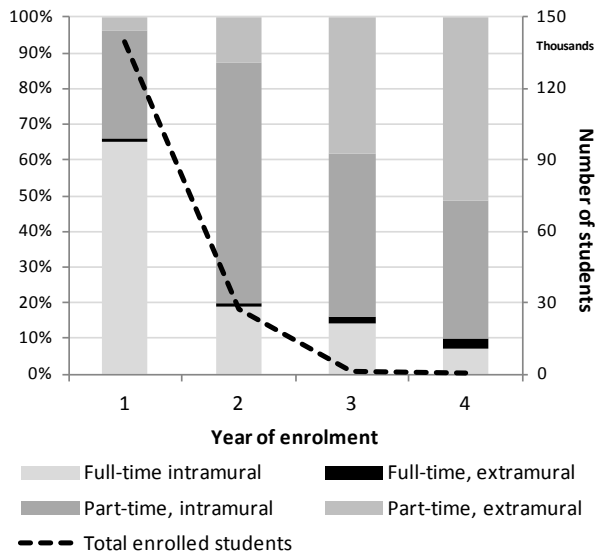


The pattern is quite clear. For a one-year qualification, the majority of students start out as intramural full-time students. In that first year, 66 per cent study full-time, and 95 per cent study intramurally. In the second year of study, 20 per cent of students study full-time, and 87 per cent study intramurally. By year four, 10 per cent of students study full-time, and 46 per cent are intramural students.

What is also clear is that the number of students declines dramatically after year one (see also Table 3, page 36). We should reiterate that this result is for students in their first qualification, and their continuing enrolment in that exact same qualification. When a student completes, drops out or changes to another qualification, they are removed from the study population. The next section describes the likelihood of these events for intramural students.

# 3 INTRAMURAL STUDENTS

In this section we focus on intramural students. All results are for students 15 to 24 years of age, averaged across all one-year non-degree qualifications. Extramural students are considered in section 4. All results are derived from event history analyses using the mathematical models described in section 7.

## 3.1 Overall pattern of completing and dropping out

Figure 2 shows the results of completing a qualification, changing qualifications or dropping out for young intramural students studying a one-year non-degree qualification, this being their first-ever qualification. The data used is the time series from 1997 to 2011.

**Figure 2**

Likelihoods (and 90 per cent confidence limits[6]) of completing, changing qualifications or dropping out, for young intramural students enrolled in one-year non-degree qualifications[7]
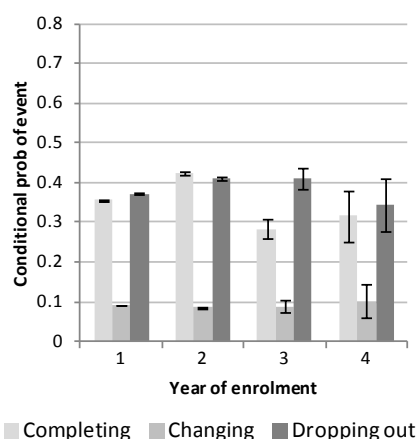


The likelihoods of the events occurring in any one year are for students who are able to experience the events in that year—that is, the probabilities are conditional on the student still being enrolled in that year.[8] Thus, any students who complete a qualification, change qualifications, or drop out in a particular year are excluded from later years. This means student numbers fall as time progresses (see Figure 1), and so the precision with which we can estimate our likelihoods declines. This is evident in the size of the error bars in later years. We truncate the results at four years because while there are still some students studying after this length of time, there are too few of them to model accurately.

The results in Figure 2 also show that the likelihood of completing these one-year qualifications is highest in the first two years of study, and then declines. In contrast, the likelihood of

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[6] Most of the results are presented in graphical form as means with 90 per cent confidence intervals. Ninety per cent confidence intervals are used so that readers comparing the difference between two means using the confidence intervals can be at least 95 per cent certain those means are significantly different. The reasons why this apparently counter-intuitive approach is necessary can be found in Schenker and Gentleman (2001) and Paton *et. al.* (2003).

[7] We present the hazard functions in our figures as bar graphs deliberately. Normally, hazard functions, and results through time more generally, might be expected to be presented as line graphs, and indeed, for Figure 2, this would not have been inappropriate. But when we present the results for full-time and part-time study separately, using line graphs becomes problematic. In our discussion in the methods section we explain how to interpret the results for time-varying variables. Linking the data points across years suggested too strongly, at least to us, that the results are for a person studying, say, full-time continuously across time. The results of course can be interpreted like that, but we believe line graphs make it more difficult to also view the results as discrete events, where students can change from one study type to another in different years.

[8] See Section 6.3, subsection *Conditional probabilities* for more details.

dropping out is high across all four years. In years three and four the likelihood of dropping out is much higher than the likelihood of completing. Finally, the likelihood of changing to another qualification is quite low, and is fairly steady over these four years of enrolment.

In all of the results in this report, the likelihood of changing qualifications is low in each year. While few students in our study populations change qualifications, this event remains in our models because it is a legitimate event which competes with completion. Excluding it would inflate the likelihood of completing.

## 3.2  Full-time versus part-time study

Previous studies have found that one of the major factors influencing completion is study type—whether a student studies full-time or part-time (Scott 2009). In our analysis, this is *a priori* an important factor, because we are considering qualifications of one year's length. Without somehow fulfilling the requirements of the qualification in previous years, it ought not to be possible for a part-time student to complete a one-year qualification in one year.[9] To properly gauge how these intramural students are performing, we have to consider full-time and part-time students separately. The results are shown in Figure 3.

Figure 3 shows the likelihoods of the three events of interest for students who are studying full-time, or part-time, in a particular year. If they have not completed, or dropped out, or changed to another qualification, a part-time student completing in year two, shown in the left hand panel of Figure 3, may have been either a full-time or part-time student in year one. But as Table 1 shows, only about 4 per cent of students change their study type.

**Figure 3**

Likelihoods (and 90 per cent confidence limits) of completing, changing qualifications or dropping out, for young intramural students enrolled in one-year non-degree qualifications, by study type
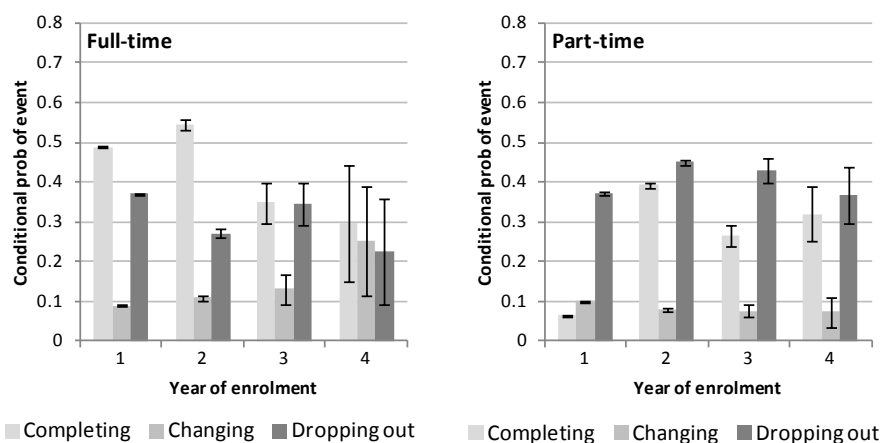


The benefits of full-time study are immediately apparent. In years one and two, the likelihood of completing the qualification for intramural students studying full-time is significantly higher than the likelihood of dropping out. In years three and four, the likelihood of completing is not significantly different from the likelihood of dropping out. In comparison, students studying part-time are always more likely to drop out than complete, significantly so in the first three years of study.

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[9] As the results show, some part-time students *do* complete their qualification in one year, even though we have deliberately chosen students in their *first-ever* qualification. Still, the likelihoods of this happening are always very low, and can arise for a number of reasons. The most likely reason is that the student previously fulfilled some of the requirements for the qualification, but this is not captured in the data.

The likelihood of completing a one-year qualification when studying part-time in year two is not as high as completing it in one year of full-time study, although when we control for school achievement and student ability, the rates become very similar (see section 3.3). We defer the discussion of why this is the case to the later section.

Figure 3 gives the likelihoods of completing or dropping out in any one year. An alternative representation of the data is to look at the cumulative proportions of students experiencing the events of interest (Figure 4). The curves of Figure 4 are analogous to what are known as survivor curves, but rather than showing the proportion of students who have *not* completed a qualification—who have survived the hazard—we show the proportions who do complete, or do drop out. They are the additive-inverse of survivor curves.

Unlike the hazard functions depicted in Figure 3, for survivor curves, we have to use the same state of a time-varying factor for each year of the plot. For example, in Figure 4 we could have plotted the survivor curve for students who studied full-time in year one, then part-time for the remaining years, or indeed any combination of full-time and part-time study over the four years of interest. Clearly there are many potential graphs that could be plotted, most of which would be for combinations of study taken by very few students. In this study we only plot survivor curves for students who study the same way—either full-time or part-time—in each year, up to the point they complete, change qualifications, or drop out.

**Figure 4**
Cumulative proportion of students completing or dropping out for young intramural students enrolled in one-year non-degree qualifications, by study type
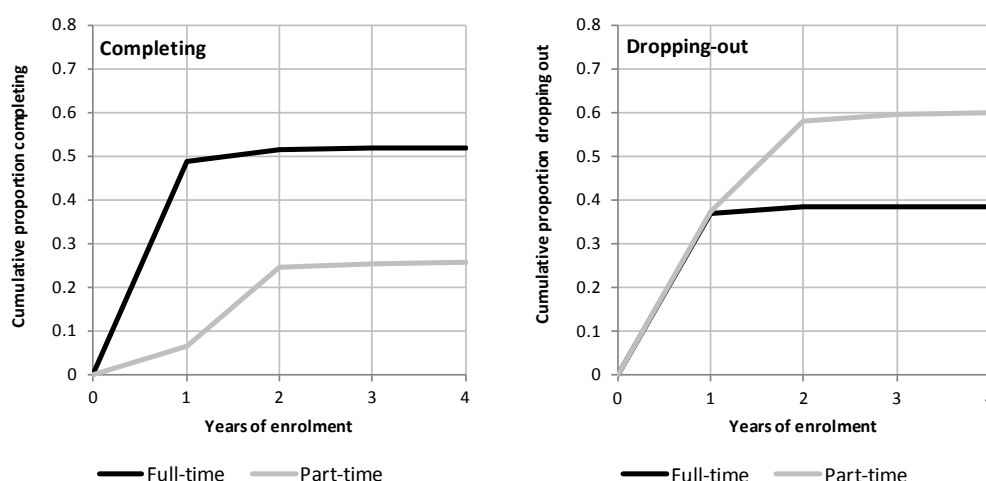


The left-hand panel of Figure 4 shows that just less than 50 per cent of continuous full-time students complete their one-year non-degree qualification in one year, and this figure reaches 52 per cent in the second year. This compares to 25 per cent of continuous part-time students completing their qualification in *two* years. As the graph shows, proportionally very few extra students complete, or drop out, after year two. This is because compared to the number of students who start in year one, there are very few students in year three onward (see Figure 1).

These survivor curves also allow us to calculate the median enrolled years to complete.[10] This statistic is analogous to the average completion rate in situations where time is measured continuously. To determine the median enrolled years to complete, we find where the 50 per cent line on the vertical axis intersects with the data curve, and read the corresponding years off the time axis. Thus, 50 per cent of continuously-studying full-time students complete in about

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[10] We should emphasise that we are measuring time in enrolled years. We have used enrolled years because a student can't complete or drop out if they are not in fact enrolled in study in that year. See Section 6.3 for more details.

1.4 years. We will report median completion times to the next highest whole number of years, since while students may complete their qualification part way through the second year, we have no information about this in our data. For continuous part-time students, the results show that it is highly unlikely that any more than about 26 per cent of them ever complete the same qualification they started.

The right-hand panel of Figure 4 shows the additive-inverse survivor curve for dropping out. It can be seen that for continuous full-time students, 37 per cent drop out in their first year, but proportionally very few further students drop out in subsequent years. For continuous part-time students, about 60 per cent drop out over two years. Interestingly, the proportion dropping out in year one is the same for part-time and full-time students.

The results suggest that generally, students who start a one-year qualification do intend to complete it in one year. The majority study full-time and intramurally in year one, and of these students, nearly half complete in that year. We have also seen that of those who do not complete in year one, about 40 per cent of them drop out. Of those students who continue into a second year of study, the majority study part-time.

## 3.3  Controlling for school achievement and student ability

The results in this section use the study population from 2003 to 2011, corresponding to the years for which we have information on students' school achievement. We also limit our study population to students of average ability. We do this to control for the fact that the likelihood of completing or dropping out varies with student ability (see next section), so by just using students of average ability allows us to see the effect of school achievement on completion and dropping out without it being confounded by differences in student ability. This naturally further reduces our study population, so we only present the results for two years of study. We reiterate we are only considering intramural students at this stage.

Determining student ability is not straightforward. Previous studies which have controlled for ability have only considered a single level of school achievement, NCEA Level 3 (for example Scott 2008, Engler 2010b, 2010c). In our current study, we consider students across a range of achievement levels. We use the NCEA Level 1 achievement score as the best proxy for ability.[11] We are able to use this level because even though not all students achieved NCEA Level 1, sufficient numbers of them gained credits and received grades in level 1 achievement standards. The Pearson correlation coefficient between school achievement and student ability is 0.44. That this value is positive is not surprising, since higher ability might be expected to be correlated with higher levels of school achievement, but the value is not that high that it precludes the use of both variables in our analysis. In other words, there are many students with high ability scores but who have low school achievement, and vice versa.

To control for student ability, we limited the study population to those 15 to 24 year old students who had a standardised NCEA Level 1 achievement score in the range plus or minus half a standard deviation around the mean. Figure 5 shows the results.

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[11] The achievement score is calculated by comparing students' grades in their NCEA Level 1 standards against other students in the same year, producing a score between 0 and 100. Students who gained level 1 credits with excellence or merit grades in their standards will score higher than students who gained credits with relatively fewer merits or excellences. The score also adjusts for the level of difficulty within a standard. A student, who achieved an excellence in a standard where many people gained an excellence, will receive a lower score for that standard, while a higher score is given to a similar student in a standard where most people didn't received an excellence grade, for example. Refer to Ussher (2008) for a description of its calculation. Ussher refers to the statistic as the 'expected percentile'.

In previous reports (Engler 2010b 2010c) we have used this 'achievement score' as a measure of achievement, for students who gained NCEA Level 3. In this current report, we use the 'achievement score' variable as a proxy for 'ability', and the NCEA level attained as the measure of 'achievement'. This change in terminology may cause some confusion, but it reflects the development of our thinking about these two measures. It was also necessary to make this change because we are considering student achievment across a range of NCEA levels in this report, not just at the one level.

We have presented the data so that it highlights the differences between the school achievement categories. The top two panels of Figure 5 show the results for intramural full-time students, with the left-hand panel showing the results for year 1, and the right-hand panel the results for year 2. Similarly for intramural part-time students in the lower two panels.

The results show that school achievement clearly has a significant impact on both the likelihood of completing, and dropping out of, one-year non-degree qualifications. The upper-left panel of Figure 5 shows that for those studying full-time in year one, only students who gained NCEA Level 1 or 2 are more likely to complete their qualification than drop out. This difference is substantial for students who gained NCEA Level 2. Students who do not gain NCEA Level 1 are slightly more likely to drop out than complete.

**Figure 5**

Conditional likelihoods (and 90 per cent confidence intervals) of completing or dropping out of a one-year non-degree qualification, for young intramural students of average ability, by type of study, and school achievement categories
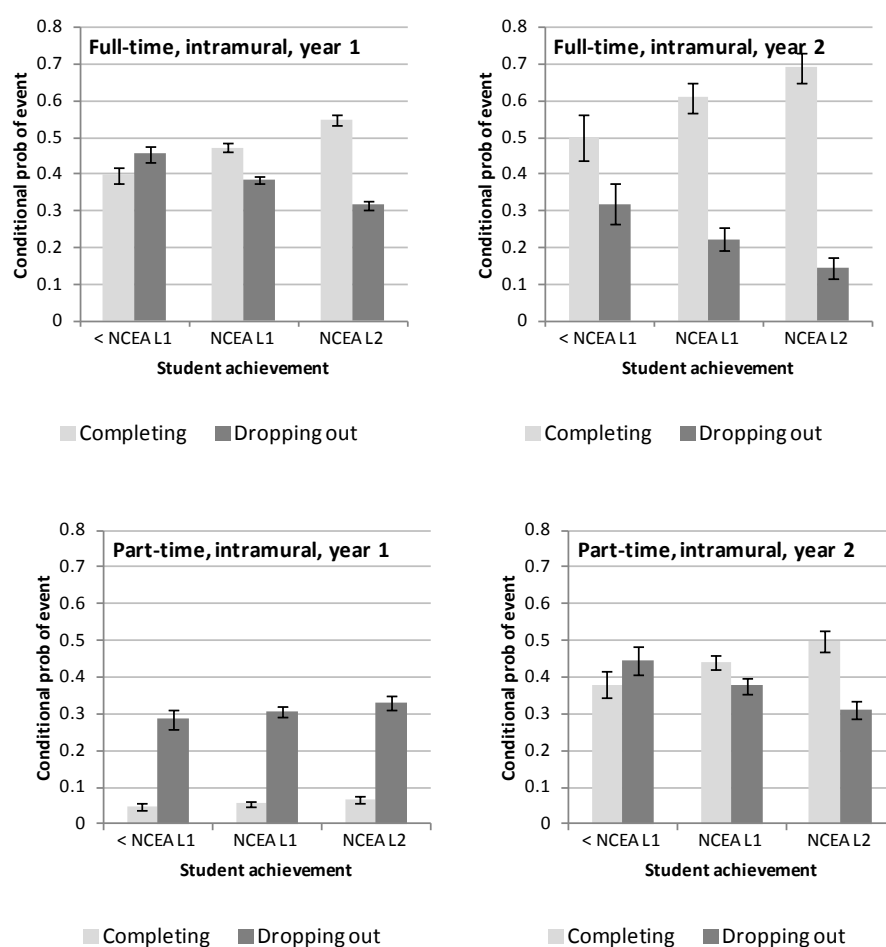


While increasing school achievement generally correlates with decreasing likelihoods of dropping out in both years one and two for full-time students, this is not the case for students studying part-time in year one (lower-left panel). For these students, the likelihood of dropping out is much the same for all achievement levels. In addition, part-time students in year one have a lower or equal likelihood of dropping out compared to full-time students in year one.

The upper-right panel of Figure 5 shows the results for students studying full-time in their second year of a one-year non-degree qualification. Few students overall fall into this category (Table 1), but they make up 19 per cent of all second-year students in these qualifications (Figure 1). These students may have studied full-time or part-time in year one. For each school

achievement category, the second year students are more likely to complete, and less likely to drop out, than the equivalent students in year one. This is most likely because these students are taking relatively few courses to complete their qualification.

The lower-right panel of Figure 5 shows the results for students studying part-time in their second year. This is a more sizeable group overall, being about 15 per cent (Table 1), and they make up 68 per cent of all second-year students. It can be seen that the likelihoods of completing across the school achievement categories for these part-time students in year two is quite similar to that for students studying full-time in year one. This is an important finding. It suggests that part-time study *per se* is not the reason why part-time students seem to do worse than full-time students (Figures 4 and 6). Instead, a more likely explanation is that part-time students have typically two years in which to drop out, compared to just one year for full-time students who complete in one year. The result is that proportionally fewer part-time students complete compared to full-time students. But the *likelihood* of a part-time student completing in their second year, given they are still studying, is about the same as a full-time student in year one, when comparing students with the same school achievement and same average ability.

Figure 6 shows the results of Figure 5 in the survivor curve format. We reiterate that the curves are for students studying full-time or part-time in each year.

**Figure 6**

Cumulative proportion of young intramural students of average ability completing a one-year non-degree qualification, by study type and highest school achievement categories
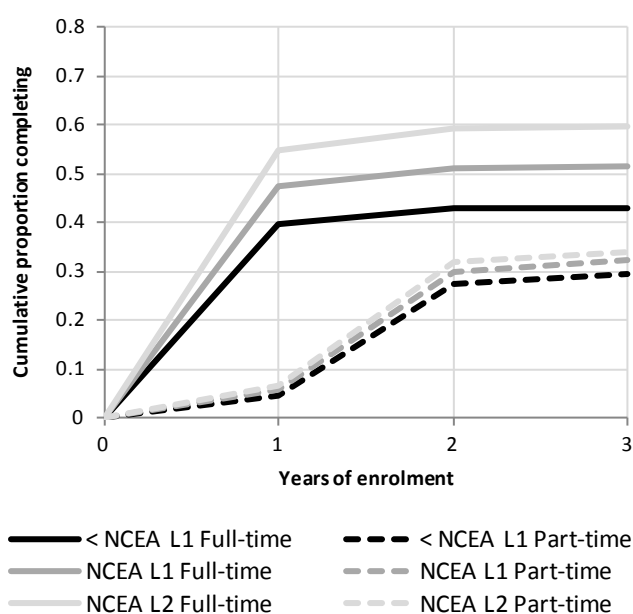


It is clear that school achievement has a significant impact on the cumulative proportion completing for continuous full-time students, but has almost no effect on the results of continuous part-time students. This is in spite of there being significant differences in the likelihood of part-time students completing in year two between the school achievement categories (Figure 5). There is little effect because there are so few students studying in year two.

It is also apparent that the median enrolled years to complete is one year for full-time students who gained NCEA Level 2, and two years for similar students who gained NCEA Level 1. For students who did not gain NCEA Level 1, or for part-time students at any level of school achievement, less than 50 per cent of students who start out studying these qualifications ever complete.

## 3.4  The effect of student ability

We know that student ability, as measured by the NCEA Level 3 achievement score, is strongly correlated with bachelors-level first-year course completion rates for students who gain NCEA Level 3 (Engler 2010c, and see Ussher 2008 for a description of its calculation). The conclusion is that students who do better in their studies at school do better in their studies at university. We were interested to find out if this conclusion also applied to completing qualifications at lower levels of tertiary study for students with lower levels of school achievement.

As we discussed in the previous section, controlling for student ability is problematic when comparing students across a range of school achievement categories. We used the NCEA Level 1 achievement score, standardised to have a mean of zero, and a standard deviation of one. Figure 7 shows the results.

The results in Figure 7 for a zero (or average) ability score correspond to the results for average students in the upper-left panel of Figure 5. The single result in Figure 5 for average students in each school achievement category is now shown for students across a range of student ability scores for each of the school achievement categories.

**Figure 7**

Conditional probability (and 90 per cent confidence intervals) of completing and dropping out, for young full-time intramural students in one-year non-degree qualifications, in their first year of study, by school achievement and student ability
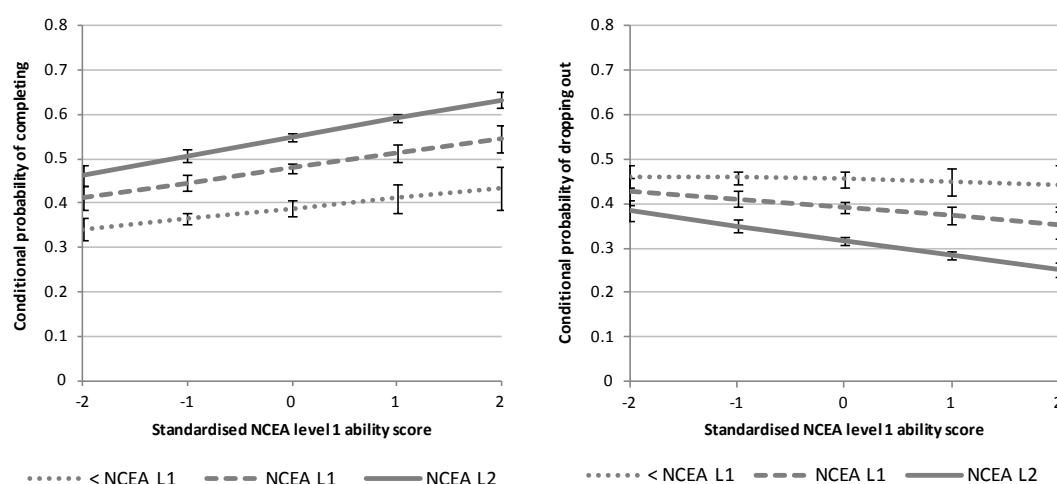


It is clear from the figure that student ability is important in understanding these results. We elaborate on this in the next section.

It can be seen in the left-hand panel of Figure 7 that for the same level of school achievement, say NCEA Level 1, increasing levels of student ability are associated with increasing likelihoods of completing the qualification. And certainly within the range of plus and minus one standard deviation around the mean, these differences in likelihood are statistically significant. These findings, for these students at least, mirror the finding for bachelors students.

The left-hand panel of Figure 7 also shows that students who gain NCEA Level 1, but have an achievement score one standard deviation above the mean, have about as high a likelihood of completing their qualification in one year as students who gained NCEA Level 2, but who have an achievement score one standard deviation below the mean. A similar result can be seen for students who achieved versus those who did not achieve NCEA Level 1. Students who did not gain NCEA Level 1 but who are one standard deviation above average in ability, have about the same likelihood of completing their qualification as students who gained NCEA Level 1 but

who are two standard deviations below average in ability. That is, to some extent, higher ability can offset lower achievement.

An interesting finding, we think, is that when we control for student ability, increasing levels of achievement result in significant increases in the likelihood of completing a one-year non-degree qualification. That is to say, for students of the same ability, those who gain higher school qualifications do better in their tertiary study. The results suggest that actually completing an NCEA qualification, as opposed to having the potential to do so, is the better indicator of tertiary performance. This point will be taken up in the discussion.

The likelihood of dropping out also varies with student ability (right-hand panel of Figure 7). Just as we saw this likelihood decrease with increasing achievement, it also broadly declines with increasing student ability.

So the results show that student ability is associated with higher likelihoods of completing, and lower likelihoods of dropping out, for the same level of school achievement, and these differences are significant.

We have not shown the results for changing qualifications, but there is no difference in this likelihood between school achievement categories across the range of student ability. It is likely that students who change their qualification before completing do so for a variety of reasons. Some may have realised they are not as interested in the subject matter as they first thought, or there could be any number of personal reasons why someone might change their study direction. It is precisely this variety that would preclude those reasons from being associated with a particular level of achievement, or vary systematically across the range of student ability. Anyone can change their mind.

Figure 8 shows the same results as Figure 7 but the data is rearranged to make it easier to compare the likelihoods of completing versus dropping out within school achievement categories.

**Figure 8**

Conditional probability of completing or dropping out, for young full-time intramural students enrolled in their first year of a one-year non-degree qualification, by school achievement and student ability
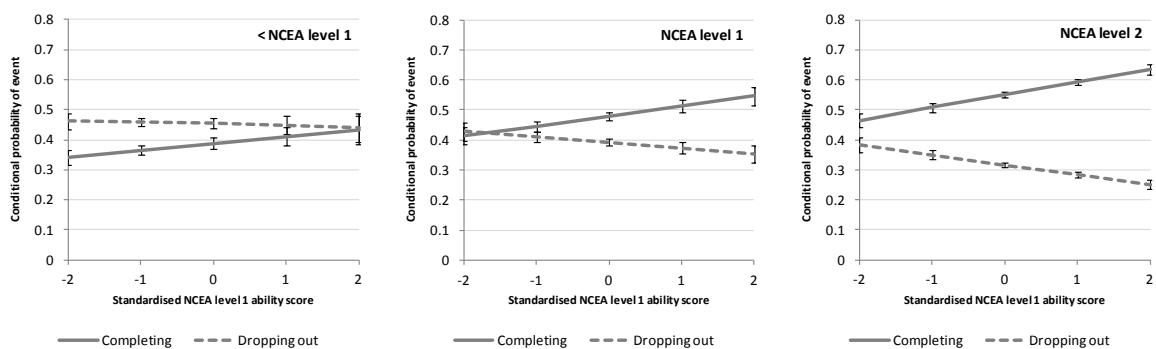


It can be seen that the likelihood of completing is higher than the likelihood of dropping out for all students who gain NCEA Level 2, and for average to above average students who gain NCEA Level 1. For students who don't achieve NCEA Level 1, dropping out is always more likely than completing for below average students, but as ability increases, the chances of dropping out and completing converge, so that students with above average ability have essentially equal likelihoods of completing and dropping out.

For part-time intramural students in year two we find almost identical results. The confidence limits are wider, so we can be less certain of differences, but this is primarily because the numbers of students who study part-time are much smaller. It would have been surprising if the relationship between ability, achievement and tertiary performance for part-time students would have been different from that of full-time students.

## 3.5 Understanding these results

We have found two apparently contradictory results. Firstly, looking at all young intramural students, those studying part-time are less likely to complete a one-year non-degree qualification in year two compared to similar students studying full-time completing their qualification in year one (Figure 3)—in other words, in their respective expected years of completing. On the other hand, when we compare students with the same level of school achievement and ability, these likelihoods are much the same (Figure 5).[12] What is the association between achievement and ability and how a student studies, and by what mechanism might these factors interact to produce the observed results?

We first consider the association between school achievement and study type in the first and second years of study for young intramural students using a chi-squared test of association. Table 2 shows the results.

**Table 2**

Per cent full-time study of young intramural students by school achievement for the first two years of study in a one-year non-degree qualification

| Highest school achievement | Year 1 | Year 2 |
|---|---|---|
| Less than NCEA Level 1 | 64% | 20% |
| NCEA Level 1 | 68% | 21% |
| NCEA Level 2 | 75% | 26% |
| Number of students | 38,488 | 7,833 |
| Chi-squared statistic | 424.01 | 33.72 |
| Degrees of freedom | 2 | 2 |
| Probability | <0.0001 | <0.0001 |

Table 2 shows there is strong evidence for an association between highest school achievement and the likelihood of studying full-time in both years one and two.

Student ability also appears to be associated with how a student studies (Figure 9). Young intramural students in one-year non-degree qualifications who start studying part-time have a significantly lower average ability score than those starting these qualifications full-time. The ability scores are standardised across all students starting in year one, although Figure 9 only shows the results for intramural students.

In year two, the average ability of the entire student population declines markedly, and while full-time students have on average a slightly higher ability score than part-time students, it is not statistically different. This shift in average ability occurs because students with higher ability are more likely to complete in year one, so those who progress to a second year of study necessarily have a lower average ability. We look at this in a little more detail below.

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[12] The results in Figure 3 and Figure 5 vary in two ways; Figure 5 controls for school achievement for students of average ability, *and* it is based on a different dataset, the short time series starting in 2003. It is important to ensure the difference in the results are due to controlling for school achievement and student ability, and not because we are using a different, albeit overlapping, time series. We tested this by running the regression that does not control for school achievement or student ability using the short time series data. We found exactly the same results as when we used the long time series. So, we can be sure this result is not spurious.

The results in Figure 9 do not control for a student's school achievement. Figure 10 shows the results when we do this.

**Figure 9**

Average standardised ability scores (and 90 per cent confidence intervals) for intramural students in one-year non-degree qualifications by study type over two years of enrolment



**Figure 10**

Average standardised ability scores (and 90 per cent confidence intervals) for intramural students in one-year non-degree qualifications over two years of enrolment by study type and school achievement



Note.
The first three bars in each panel are repeated from Figure 9.

It is clear there are distinct differences in the average ability of students across the school achievement categories, with higher achievement associated with higher levels of ability.

However, in contrast to the results seen for *all* full-time and part-time students, when comparing students with the same level of school achievement, there are essentially no differences in average ability between full-time and part-time students. The important comparison is between full-time students in year one with part-time students in year two, their respective expected years of completion. Only for students with NCEA Level 2 is there a statistical difference in average ability, but it is small in magnitude, and this difference is smaller than the difference in average ability between all full-time students in year one and part-time students in year two (Figure 9).

This then explains our apparently contradictory results for full-time and part-time students' likelihood of completing. Higher-achieving students are more likely to study full-time. These higher-achieving students are also more likely to be of higher ability, who in turn are more likely to complete their qualification. With no control for achievement, full-time students are more likely to complete, but it would be wrong to attribute this to the method of study. Because when we do control for achievement, comparing like students with like, we find full-time and part-time students have the same average ability. This means they have much the same likelihoods of completing their tertiary qualification, when looking at their expected year of completion.

Finally, we present some data which helps us to understand more fully why the average ability of students varies between years one and two (Figure 11).
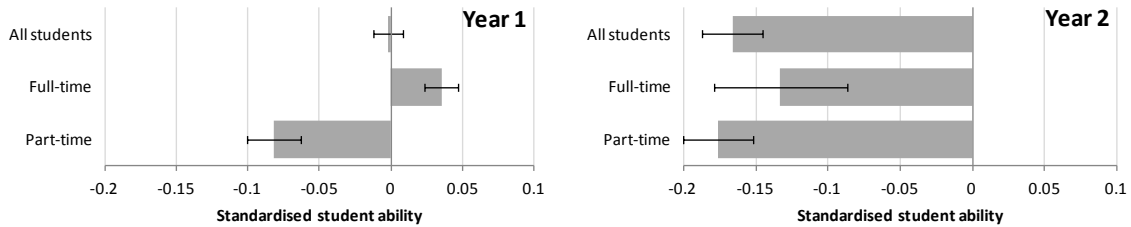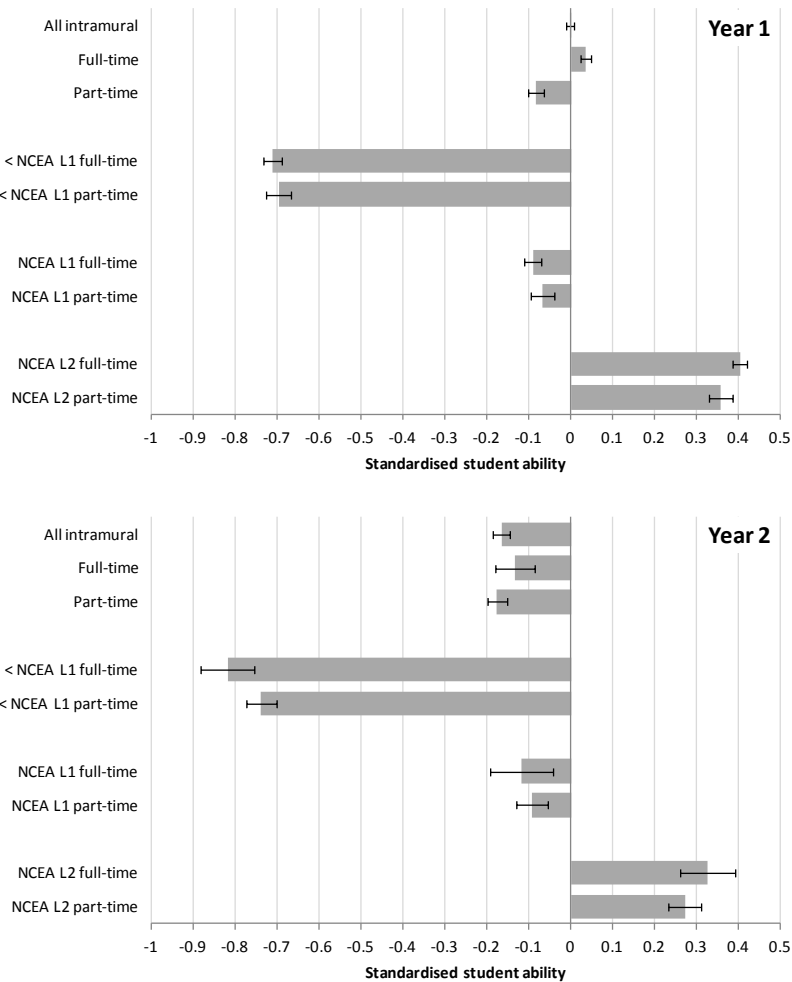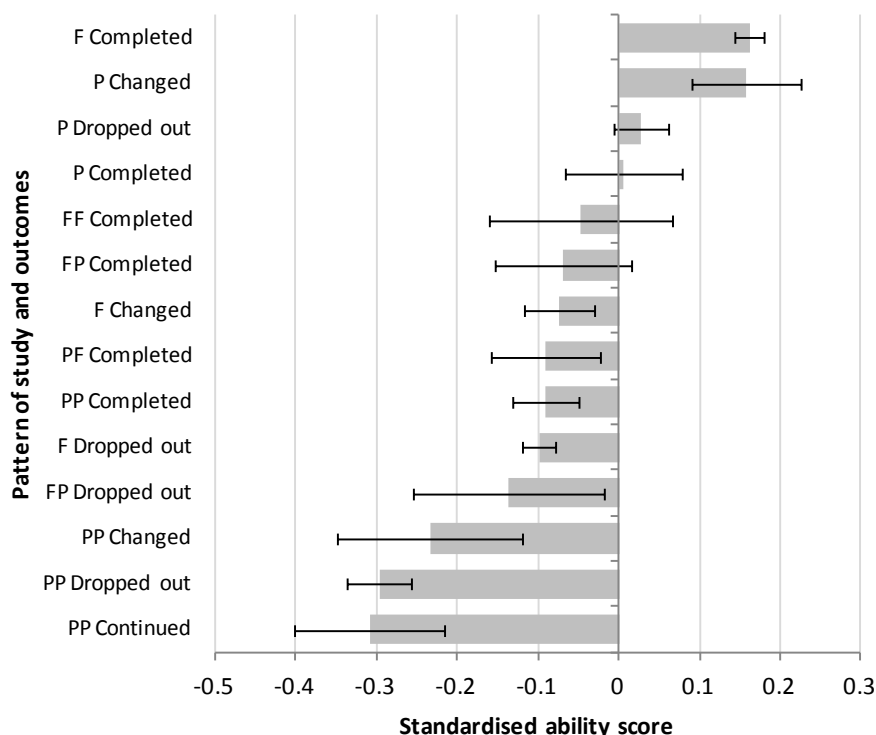
**Figure 11**

Average standardised ability scores (and 90 per cent confidence intervals) for intramural students in one-year non-degree qualifications over two years of enrolment by study type and the event which caused them to stop studying, if any



Notes.
P=one year of part-time study, F=one year of full-time, PP=two years of part-time study, FF=two years of full-time study etc.
'Changed' means the student changed to another qualification without completing the original qualification they were enrolled in.
Only combinations of study type and event with more than 250 students are shown.

We speculated above that it resulted from students with higher achievement more likely to complete, which left students of lower achievement to continue into a second year of study.

While this is true, the reality is more complex. Students not only complete, but drop out and change to another qualification. Each of these events removes students from the group that continues onto a second year of study, and because each of these groups of students has a different average ability, the result we see in the second year is the combined effect of these events on the first year student population.

It can be see that the average ability is highest for students who study full-time for one year and complete, and lowest for students who study part-time for two years and then continue onto a third year. Part-time students who changed to another qualification are also above average in ability, while students who studied part-time for two years and then dropped out are also on a par with those who go on to a third year of study.

It is now clear why full-time students are above average in year one, and below average in year two; the students with above average ability complete in year one, reducing the average ability of the group that continue onto a second year. Of course we have seen this result in terms of the likelihood of completing, shown in Figure 5. We can also see that part-time students who drop out, or change to another qualification, will also lower the average ability of part-time students in year two, since those part-time students leaving study have a higher average ability than all part-time students in year one.

These findings may have implications for our understanding as to why students study part-time. Traditionally, part-time student's lower performance has been explained in terms of the reasons why someone might be studying part-time in the first place. Work, family or social commitments have been hypothesised as being activities that take time and energy away from study (Kember 1999, MacCann et al 2012), at least for older students, so it is argued that part-time students naturally have lower completion rates. Others have suggested that part-time students do not intend to complete their qualification (Scott 2009). However, neither of these scenarios explains why younger students in these one-year non-degree qualifications, who have lower levels of achievement, are more likely to study part-time. An alternative hypothesis might be that a student who did not do well at school, but either wants to or needs to continue with tertiary study, might start that study with less intensity—choosing to study part-time in other words—and balance that study with work or other activities. They might also be testing themselves to see if they like study at this level, or are able to do it (Higgins *et al* 2008), especially if they did not do well at school. So it might be that it is not that these other commitments take time away from study, but that the student is deliberately devoting more time to other non-study activities. This of course does not mean these other non-study activities do not interfere with study (Williams and Kane 2010), or have some deleterious effect on a student's performance. But the direction of cause and effect might be reversed, at least for some students, from what has been suggested. And clearly the situation will be different for older students, who do have other time commitments prior to starting their studies.

# 4 EXTRAMURAL STUDENTS

Proportionally few students study extramurally in the first two years of these one-year non-degree qualifications, and those who do study extramurally mostly study part-time. While the proportion of extramural students increases in years three and four, there are few students enrolled in these years in absolute terms (Figure 1). This makes it difficult to study the performance of extramural students. In spite of this, it is worthwhile making some observations, and contrasting the findings with those for intramural students.

We have used the shorter time series data for these results. This is so we could compare the results for students of average ability with and without controlling for student achievement. We decided not to use the longer time-series data because it appears that while intramural students have behaved quite similarly over the years, this is not the case for extramural students. Our testing showed that across the fifteen years of data in the longer time series, extramural students varied systematically in the likelihood of completing and dropping out.[13]

We start this section by considering differences between students in intra- and extramural study.

## 4.1 Controlling for attendance type and study type

Figure 12 show the results for students of average ability, contrasting intra- and extramural study.

**Figure 12**

Conditional likelihoods (and 90 per cent confidence intervals) of completing and dropping out of a one-year non-degree qualification, for young extramural students of average ability, by study type and attendance type



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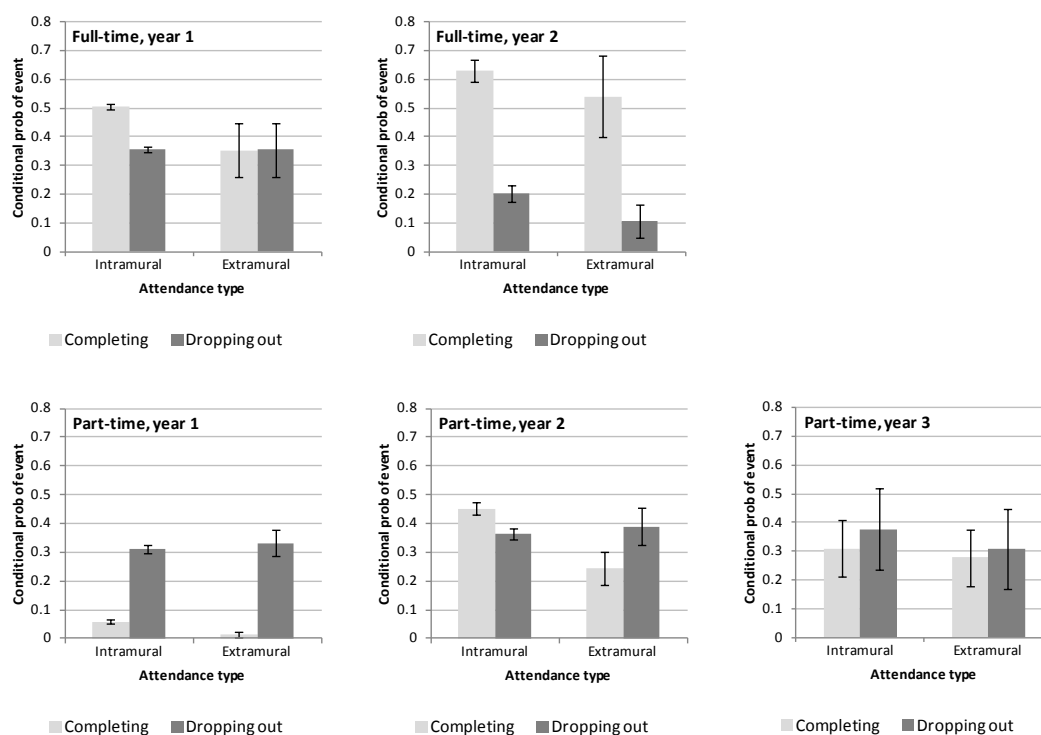
[13] This may have been because extramural study has experienced more fundamental changes over the past 14 years than intramural study. The use of technology in the delivery of these programmes would appear to be one major change.

Immediately obvious are the wider confidence intervals for extramural students. We can be far less sure of these results because of the smaller number of students who study in this way. We have also shown results for year three for part-time students, since so few of them complete in years one and two. Too few full-time students make it to year three for the results to be meaningful.

We also see that the likelihoods of completing are generally slightly lower for extramural students compared to those studying intramurally. And the likelihoods of dropping out for extramural students are much the same as, or indeed lower, than for intramural students. This result runs counter to the commonly held perceptions about extramural students.

These year-to-year likelihoods of completing, changing qualifications and dropping out of extramural students result in the cumulative proportions of students completing shown in Figure 13.

**Figure 13**

Cumulative proportion of students completing, by study type and attendance type, for young students of average ability in their first one-year non-degree qualification
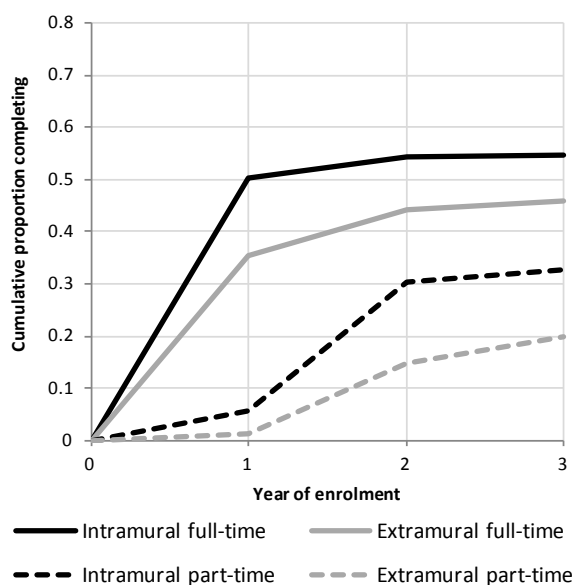


The additive-inverse survivor curves show quite significant differences between continuous part-time and continuous full-time students. In spite of the similarities however, the median enrolled years to complete for full-time intramural students is one year, whereas for full-time extramural students it is not possible to estimate from just three years of data. We should point out that very few students study full-time and extramurally, so this result is somewhat academic.

## 4.2  Controlling for study type and school achievement

In this section we consider extramural students, and look at the results when we control for study type, school achievement and student ability. Figure 14 shows the results. Student numbers in these categories become smaller still, so error bars widen, and our confidence in the results diminish. Nonetheless, some clear patterns are evident.

**Figure 14**

Conditional likelihoods (and 90 per cent confidence intervals) of completing and dropping out of a one-year non-degree qualification, for young extramural students of average ability, by study type and school achievement categories
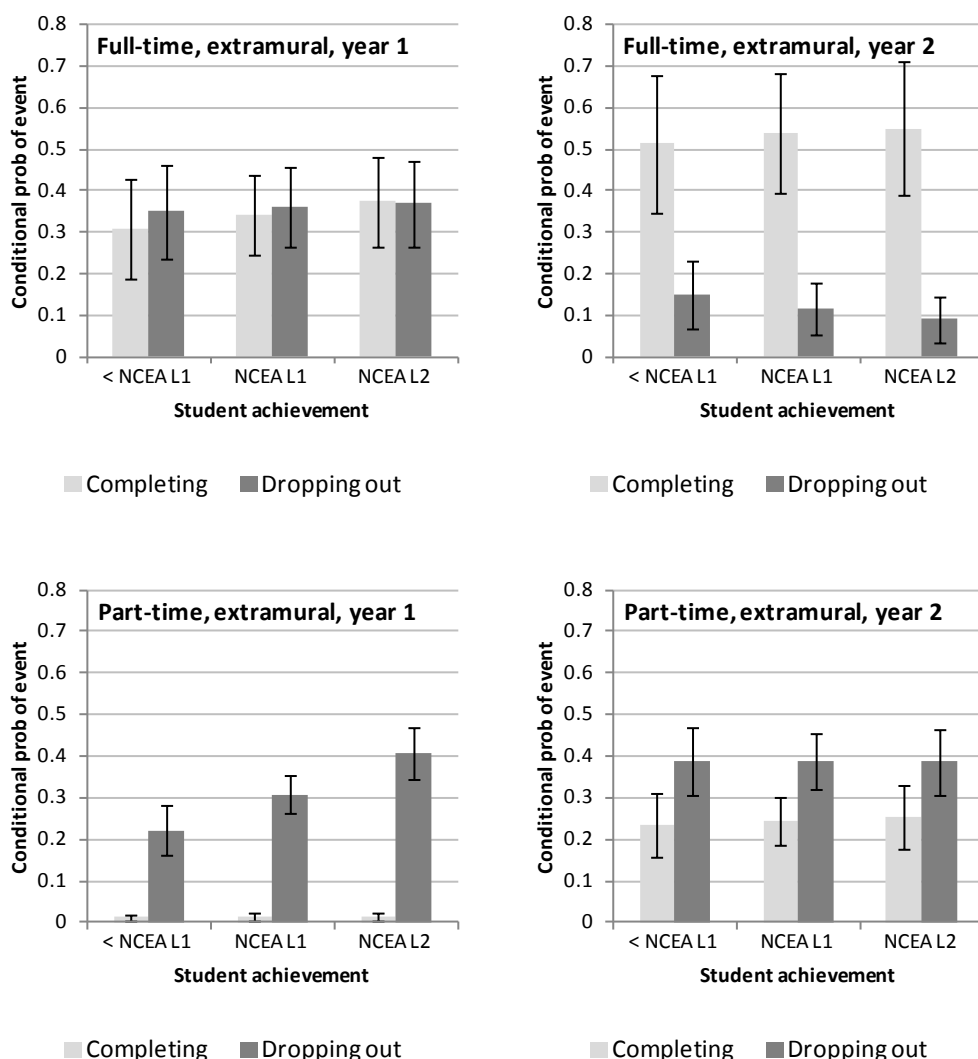


The patterns of likelihoods of completing and dropping out are quite different from those seen for intramural students (contrast with Figure 5). In particular, there is far less difference between students across the school achievement categories, especially in the likelihood of completing.

There are some similarities however. Full-time students in year two have the highest likelihoods of completing, and the likelihood of completing is higher than dropping out. Part-time students in year one are quite unlikely to complete, and the likelihood of dropping out increases with increasing school achievement.

Lastly, unlike the situation for intramural students, the likelihood of part-time students completing in year two is not the same as that for full-time students in year one. Certainly, of the four panels of results in Figure 14 they are the two most similar, but it is clear, in spite of the wide confidence bars, that the factors considered in this report and their association with tertiary performance are different for extramural and intramural study.

# 5   DISCUSSION

We conclude this study by returning to the questions we posed in the introduction. We then comment on the efficacy of the methodology used.

We initially asked how school achievement is associated with qualification completion, for students with lower levels of school achievement, studying for one-year non-degree qualifications. We have seen however, that completing a qualification varies not just with the level of school achievement, but also with student ability, the type of study, attendance type and on the particular year of enrolment.

We remind the reader these results only apply to students 15 to 24 years of age, with school achievement up to and including NCEA Level 2, studying for their first-ever one-year non-degree qualification.

**How does the likelihood of completing a qualification vary with school achievement?**
For intramural students, increasing school achievement is generally associated with increasing likelihoods of completing, and lower likelihoods of dropping out. There is almost no association between school achievement and completing or dropping out for extramural students.

When controlling for school achievement and student ability, part-time intramural students have much the same likelihood of completing a qualification in year two as full-time intramural students have in year one. In other words, for students who persist in their studies, full-time and part-time students are just as likely to complete in the year they are expected to finish, being one year for full-time students, and two years for part-time students for these one-year qualifications. We believe this to be an important insight into qualification completions. It helps to explain the apparently contradictory finding that, overall, fewer part-time students complete. Clearly this is not because they are less likely to complete, and not even because they are more likely to drop out. Fewer part-time students complete because their study takes longer, so they have more opportunities to drop out. This insight shifts the focus from why students are not completing, to why they are dropping out. And since the likelihood of dropping out is much the same for full-time and part-time students, after controlling for student achievement and ability, the search for the reasons why students drop out, and the remedies to reduce this, needs to look further than how students study.

**Do students with NCEA Level 2 complete in a shorter time than other students; specifically, do they complete a one-year qualification in one year?**
We use the median enrolled years to completion—the time it takes for half of the initial cohort of students to complete—to compare different students' completion times.

The median enrolled years to complete for intramural full-time students who attained NCEA Level 2 is one year. For similarly studying students with NCEA Level 1 it is two years. No other combination of school achievement or study type reaches the 50 per cent threshold.

These results broadly match those found by Scott (2005) for certificate level study. He found that the average certificate completer took 0.8 years of equivalent full-time study, enrolled over 1.8 calendar years. Scott considered qualification completions at the same *level*—that is, a student could change to another qualification at the same level of study and still be included in his cohort—and his study did not control for school achievement.

While it may seem counter-intuitive that so many students take two years to complete a one-year qualification, we should point out that the majority of full-time students who are ever going

to complete do so in one year. Similarly, the majority of intramural part-time students who are ever going to complete do so in two years. The majority of part-time extramural students complete in three years.

**And if other students take longer, do the same proportions of students complete over the long run, or do fewer overall complete?**
An alternative measure to the median time to complete is the exhaustion summary (Scott and Kennedy 2005). This statistic indicates the proportion of the original starting cohort that remains after a specified period of time. It is used in competing-risks event history analysis to estimate the overall proportion of a population remaining after taking all events into account. But it can also be used to provide the proportion experiencing a single event after a constant period of time.

To make the comparison a fair one between full-time and part-time students, we compare the proportion of full-time students completing after *one* year, against the proportion of part-time students completing after *two* years for intramural students, and *three* years for extramural students, noting that three years data is all we have. The results are tabulated below.

| Highest level of school achievement | Intramural study | | Extramural study | |
|---|---|---|---|---|
| | Full-time study in year 1 | Continuous part-time study over 2 years | Full-time study in year 1 | Continuous part-time study over 3 years |
| Less than NCEA Level 1 | 0.40 | 0.27 | 0.31 | 0.24 |
| NCEA Level 1 | 0.47 | 0.30 | 0.34 | 0.21 |
| NCEA Level 2 | 0.55 | 0.32 | 0.37 | 0.17 |

Intramural results are also shown in Figure 6.
Students who change their study or attendance type from year to year will have results intermediate to those shown in the table.

It can be seen that in spite of the *likelihoods* of completing being much the same between intramural full-time and part-time students in years one and two respectively, the overall outcomes for these groups of students are quite different. And the results show that even with more time, some combinations of study and attendance type do not reach the levels of completion of full-time intramural students with NCEA Level 2.

It is also interesting to note the levelling effect of extramural study. Higher school achievement is associated with significantly higher proportions of intramural students completing. But for extramural students, each level of school achievement is associated with a smaller increase in the proportion completing, and there is even a slight negative effect for part-time extramural students. It would seem that the benefits accruing from doing well at school—good study habits, time management skills, self efficacy—that usually lead to better academic success at tertiary level, doesn't occur for extramural students. While the number of extramural students in one-year non-degree qualifications considered in this study is quite low, for other qualification types extramural study makes up a larger sub-group of students. It would be interesting to find out whether there is a similar relationship between school achievement and tertiary performance for these students.

**How does school achievement interact with student ability?**
Society places a lot of emphasis on gaining credentials. How else will an employer know that a prospective employee is able to do the job, or how will a training institute know if a prospective student is potentially capable of completing a course of study? But whereas the certificate or diploma is the primary guide, the grades a student achieves in gaining that qualification also provide guidance. This is why in recent years NCEA certificates have included endorsements; whether a student gained the particular certificate with merit or excellence. In general though, it

is the qualification gained, not how well it is gained, which is regarded as the educational benchmark.

On the other hand, there are many reasons why a student might not gain a qualification, and not all of those reasons are related to academic ability. Everyone has heard of students who don't succeed in the education system, yet become successful in business or other pursuits. So not achieving a qualification does not always indicate a lack of ability. In our analysis, we have attempted to distinguish between achievement and ability by using the highest level of qualification gained at school as the measure of achievement, and how well a student performs in their NCEA Level 1 standards as a proxy for ability.

When we considered both student achievement and ability and the likelihood of a student completing a one-year non-degree qualification, the results suggested that higher ability *can* offset lower achievement. While not conclusive, it would appear that generally, students with lower achievement and higher ability are about as likely to complete as students with higher achievement and lower ability.

As we discussed above, for students of average ability, only intramural full-time students with NCEA Level 2 have a median completion time of one year, and it is two years for those with NCEA Level 1. Yet intramural NCEA Level 1students, with an ability-score one or more standard deviations above average, also have a median completion time of one year. And NCEA Level 2 students, with an ability-score two standard deviations below average, have a median completion time of two years. These results show that ability, in addition to achievement, clearly makes a difference to how long it takes to complete one of these qualifications.

This result is not simply of academic interest. In our study population, for students for whom we had an ability score, those with above average ability made up 41 per cent of students with NCEA Level 1 as their highest qualification.

Finally, while higher ability can offset lower achievement, we think that higher school achievement is still the stronger factor associated with tertiary performance. When controlling for ability, higher achieving students still have higher likelihoods of completing. This may be because we are using a student's results in NCEA Level 1 as the proxy for ability for all students, regardless of their final level of achievement. But it is more likely that school achievement is the stronger factor because it is an indication that a student has translated their *potential* ability into *actual* achievement. By achieving a school certificate a student has shown they have done the reading, understood the material, and sat the exams for a whole programme of study. They have demonstrated they have the wherewithal—particularly the motivation—to succeed academically. Achieving successfully at school therefore quite naturally signals academic success in a tertiary setting, all else being equal. Our measure of ability indicates a student may be capable of doing well in individual standards, but if they don't gain the school qualification, that ability remains as an indicator of academic potential, rather than realised achievement.[14]

**Dropping out**
One of the striking results from our study is the fact that such a large proportion of students drop out of their studies. And this occurs for both full-time and part-time students, intramural and extramural, and across the spectrum of school achievement and student ability. We realise the criteria that we use to select our study population may inflate this figure, since we are concerned with students starting and completing their first exact same qualification. Clearly students can

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[14] It may also be that a high measure of ability indicates proficiency in a narrow range of standards, perhaps just a particular subject. Being good at one subject may not be sufficient to pass the range of subjects required to gain a NCEA certificate.

enrol in another qualification and complete that one. In that case, from a systems point of view, a completion event has still occurred.[15]

Our results also show that the likelihood of dropping out remains relatively high over the first four years of study. This is not as great a problem as it might first seem, since the numbers of students in a cohort decline rapidly after the first year. In spite of this, the ongoing high *likelihood* of dropping out suggests more could be done to help students persist in their studies. It might also signal a need to review the career advice and guidance students receive, so students don't start qualifications they won't want to finish, or improve the processes that prepare students for their first foray into tertiary-level study. The support students receive while studying, in terms of pastoral care or other forms of support and encouragement may also be a factor contributing to students dropping out.

But as we mentioned above, some of those dropping out will have decided that the particular qualification, or even tertiary study itself, was not the right choice for them at that point in their lives. And there may be no other way for them to find this out than to try it. This means there will always be a certain percentage of students who drop out, no matter how good the career advice, how well prepared a student is for tertiary study or the level of pastoral care they receive on campus, or indeed, on the academic ability of the student to complete the qualification. Higgins *et al* (2008) report that students experiment with study, to discover their interests and abilities, and their interest in study relative to employment. This may apply even more so to students with lower levels of school achievement, particularly those with higher ability. In any event, dropping out cannot always be regarded as a failure.

If it is true that dropping out depends more on the interest a student has in the qualification, rather than their ability to complete it, then we might see a gradient in the likelihood of dropping out across a range of qualification levels, with higher qualification levels showing lower likelihoods of dropping out. This is based on the idea that higher level qualifications might be considered more prestigious, or beneficial to gaining employment or in attracting higher remuneration, so there might be more incentive for a student to complete them.

The evidence suggests there may be some merit in this idea. The figure at right shows the relationship between the level of study and the overall likelihood of dropping out in year one of a one-year qualification. The graph is based on the 1997 to 2011 data series, and combines both full-time and part-time study types for intramural students. Levels 1 to 4 are certificates and level 5 represents certificates and diplomas at levels 5 to 7. The Pearson correlation coefficient is minus 0.93, and even with these few levels of study, this value is significantly different from zero at the 95 per cent level of confidence.
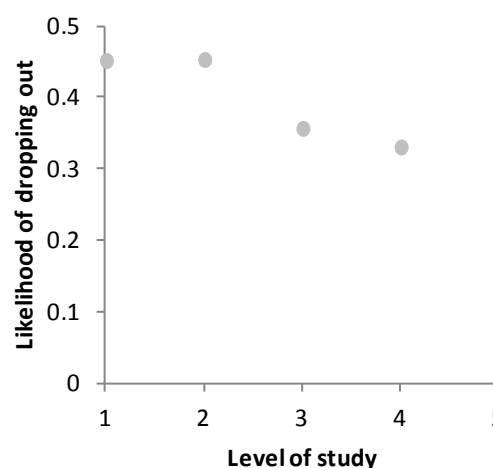


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**Has using event history analysis helped us?**

When completion rates are calculated as the proportion of students who have completed a qualification after a certain number of years, we are answering the question *whether* a student has completed or not. It is a yes/no question.

Knowing *if* a student completes does not tell us *when* a student completes. But we can answer this using event history analysis. And by using competing events—completing, dropping out and changing qualifications without completing the first one—we gain a better understanding of the complexities and dynamics of the qualification completion process.

Event history analysis also allows us to more fully investigate the factors that might be influencing completions and drop outs, especially those factors which vary with time. We have focussed on full-time and part-time study, since it is such a fundamental driver of when a student completes, but as we have explained, since a student can change how they study from year to year, exploring the effect of this variable without including time in the analysis is quite problematic. And the same considerations apply to intra- and extramural study. Event history analysis allows us to easily include these time-varying variables in our models, allowing the study or attendance type to vary as they occur in the data. There is no need to partition students into sub-groups which are consistent in their study characteristics, but which represent only some of the patterns of study behaviour.

We think the finding that full-time intramural students in year one are about as likely to complete their qualification as part-time intramural students in year two, after controlling for school achievement and student ability, might not have been found had we not used event history analysis. This finding changes the focus from why part-time students do not *complete*, to why so many *drop out*. And both full-time and part-time students are generally about as likely to drop out, so it is a problem faced by all students, independent of how they study. The insights gained by knowing *when* students complete, rather than *if* they complete, we believe, makes event history analysis an important analysis tool.

# 6 METHOD AND DATA SOURCES

In this section we outline the data sources and methods used in the analysis. We have departed quite significantly from the way qualification completions have been previously analysed by the Ministry of Education. We think it prudent therefore to outline our methods in some detail.

## 6.1 Data sources

Data on student enrolments in, and completions of, tertiary qualifications is taken from the Ministry of Education's *Tertiary Student Enrolment and Completions* datasets. At the time of writing this report, data is available from 1997 to 2011.[16]

Data on student attendance at secondary school comes from the Ministry of Education's *Enrol* dataset. Data regarding the qualifications students achieve at school come from the New Zealand Qualifications Authority. These two sources are merged, via the national student number, and further linked to post-secondary education enrolments. This matched data is known as the *Transition* dataset. At the time of writing, data is available from the 2005 tertiary enrolment year (for students who were last at secondary school in 2004) to 2011.

## 6.2 Data preparation

Tertiary qualification enrolment and qualification completion records from 1997 to 2011 were extracted from the *Tertiary Student Enrolment and Completions* dataset. Only records for domestic students receiving Student Achievement Component (SAC) funding in 'formal' study are included. Formal study excludes students in tertiary study for less than a week. Using SAC funded students excludes study at tertiary institutions which are part of industry training or Modern Apprenticeship programmes.

The level of study was determined in each year for each student *for each individual qualification* they were enrolled in or had completed. Study at the New Zealand Qualifications Framework levels 1 to 7 were individually identified and levels 8 and above were combined. Levels 1 to 4 comprise certificates. Diplomas can be offered at levels 5 to 7, and bachelors degree level study is also at level 7. For this study we considered non-degree study at levels 1 to 7.

Information on the type of study (full-time or part-time, full-year or part-year), the type of attendance (extramural versus intramural), the equivalent full-time student (EFTS) weighting of the qualification (how long it would take to complete the qualification), and the student's study load (the amount of study the student undertook) was captured for each qualification for each year of enrolment for each student.

The full-time or part-time status of the study was determined using the Ministry of Education's business rules. Students are regarded as part-time if they study part-time for either a full year or for part of the year. Full-time study for a full year is clearly considered full-time study.[17] Students studying full-time for part of the year are also considered to be full-time students if their study load, in EFTS, is equal to or higher than the study required to complete the qualification for that part of the year.

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[16] The data actually starts in 1994, but information about student funding is only available from 1997 onwards, so this latter year is used as the starting point for the analysis.

[17] One equivalent full-time student is approximately equivalent to 1,200 hours of study a year, including contact time with tutors or lecturers, plus time spent in independent study, doing assignments and examinations. This is equivalent to 35 hours per week for 34 weeks (Scott 2005).

We removed students from the study population if they were enrolled in tertiary study, or had completed a qualification, at the beginning of our time series in 1997. We do this because it is not possible to tell how long these students had been enrolled prior to 1997, and therefore how long it took them to complete the qualification. In the terminology of event history analysis, these students are left censored. For the data used to analyse school achievement, left censoring is based on the year 2003.

Other demographic variables were also calculated: the year a qualification was started, the age of the student when they started a qualification, the number of concurrent qualification enrolments at the same level, the highest level enrolled during a year, and whether a student had ever completed a qualification at a particular level. These variables were used to select particular students for analysis, or as control variables in statistical modelling.

A second dataset was created using the procedure outlined above, but only for 2003 to 2011. This data was then merged with the *Transition* dataset to obtain students' school achievement and a measure of their ability. School achievement is measured as the highest NCEA qualification attained. How well a student performs in gaining that qualification, in terms of the relative number of achieved, merit or excellence grades, is used to calculate a score between 0 and 100. We use this variable as a proxy for student ability. Refer to Ussher (2008) for a description of this variable and its method of calculation.[18]

## 6.3  Event history analysis

As we have said, we use a method of analysing our data which is not widely used in education research generally. The method is known as a 'competing-risks, discrete-time event history analysis'. Our understanding of and use of this method was guided by a number of sources, but we made most use of articles by Judith Singer and John Willett (Willett and Singer 1991, Singer and Willett 1993, Willett and Singer 1993, Willett and Singer 1995, Singer and Willett 2003).

**General points**

Event history analysis is also known as failure-time modelling, life-time modelling, survivor analysis, and hazard modelling, among others terms (Vermunt 2009). They all determine the likelihood of an event, or hazard, at particular points in time. The term hazard has traditionally been used because these methods were initially applied to events which caused harm, or death. In our context, it is not sensible to view the likelihood of completing a qualification as a 'hazard', so we will use the more general term 'event'.

In the same vein, the 'survivors' in a survivor analysis were those who had not experienced the 'hazard'. In our study, we will use the additive-inverse survivor function, counting those who *have* experienced the event of interest. In event history analysis, a summary statistic termed the 'median lifetime' can be calculated from the survivor curve. This is the value, in years, when the survivor function equals 0.5, or when half of the starting population have experienced the event of interest, or in our case, when half of the students of a particular group of interest have completed or dropped out.

If an event is measured in continuous time, a rate can be calculated for it. For events measured at discrete points in time a rate cannot be determined, but the event has a probability of occurring at a particular point in time (Singer and Willett 1993). The plot of these probabilities through time is known as the hazard function. It is the hazard function that provides the insights into completing and dropping out that is not possible with traditional methods. Using the hazard function we can answer the question; "when is it more likely that a student completes, or drops out?".

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[18] In Ussher's report the variable is known as the *expected percentile*.

### Right censoring of students

We previously mentioned left censoring (Section 6.2), where we exclude those cases where we don't have a complete view of a student's past enrolment history. There is an analogous concept called right censoring, where we exclude those cases where the event hasn't yet occurred but where the possibility of the event still occurring cannot be excluded. In our study, while a student may not have completed by the time we get to the end of that student's data, we cannot treat them as *not* having completed either, because they may complete in future. This is why completion rates have traditionally been calculated as 3-year, or 5-year, or 7-year rates, because for any one of these time periods, there are students who are still enrolled but who have not yet completed.[19] Event history analysis deals with these cases by right censoring them. In essence, the method includes right censored students in the analysis up to the point where their data stops, and ignores them after that.

Right censoring is associated with an important assumption: right censoring must be independent of the event of interest. That is, if we are interested in students completing qualifications, then the right censoring of students must be independent of the completion event. This is clearly not the case if the right censoring is due to a student dropping out, or changing to another qualification without completing the first one, because these events would preclude a student from completing. We deal with this situation by considering competing risks (see below). By modelling other events that could lead to a student being omitted from the data, and using enrolled years, right censoring only occurs in the year of the most recent data.

### Competing events of interest

In our study, the primary event of interest is the completion of a qualification. It is possible to model a single event in an event history analysis. These models are quite simple and easily interpreted. But as we noted above, one of the assumptions of event history analysis is that right censoring is independent of the event of interest. As we have described, this assumption does not hold in our study.

To determine the likelihood of a student completing a qualification, it is therefore necessary to also consider what other circumstances might prevent that event from occurring. Thus, if a student withdraws from their study, they won't be able to complete, at least not without re-enrolling. And if a student changes their enrolment to another qualification, then they too are unable to complete their original qualification, again not without re-enrolling in that original qualification. If we model these events, then the cessation of enrolment data does not result in those students being right censored because they have experienced an event of interest and are captured in our data.

### Measuring time

The decision as to how to measure time is also an important consideration in event history analyses (Scott and Kennedy 2005). This is not just because we are dealing with events through time, which makes time an important variable in its own right.

Time can be measured continuously, or discretely. If we could determine exactly when an event occurred, we could use continuous time models. A well known example of an event history model that uses time measured continuously is the Cox Regression or proportional hazards model. When data is only collected at discrete points in time however, or for events that are clumped, these models are not appropriate, and discrete time models should be used (Vermunt 2009). In our case, the data is collated and summarised on an annual basis. But in any case, qualification completions will usually occur at the end of the year or at the end of semesters. This clumping will also mean that continuous time models are not appropriate.

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[19] These longer time periods are usually used for multi-year qualifications. But the same principle applies to shorter qualifications. In our data, some students were still enrolled 5 years after starting a one-year qualification.

While we have used discrete years as the measure of time, we also have to decide between using *elapsed* years or *enrolled* years. In the former case, we would include in our data the years that a student might have taken a break from their studies. But clearly, a student cannot complete a qualification if they are not studying. For this reason we have used *enrolled* years. This should be borne in mind when interpreting and reporting our results, because we have included students who took one year off while studying, essentially ignoring the year not in study. For these students, the enrolled years to complete will be less than elapsed years.

## Completing the same qualification versus completing any qualification

In the qualification completion tables produced by the Ministry of Education, completion rates are for particular *levels* of study. Therefore, a student who enrols in qualification A at level 1, then changes to qualification B at level 1 and completes it, is counted as having completed a qualification at level 1. Students change qualifications reasonably frequently (Scott and Grice 2008), and from the entire tertiary education system's point of view, it does not matter what particular qualification they complete, as long as they complete one.[20]

In our study, to control for the many factors that affect completing a qualification, we chose to consider just the first qualification a student started, and to see how a student fared in completing that exact same qualification. This has implications when attempting to reconcile our results with those published elsewhere. In particular, our method will report higher likelihoods for dropping out and lower likelihoods for completing.

## Timing of events of interest

There are further considerations regarding the timing of the events. For annual data, a qualification completion, by definition, occurs in the last year of enrolment of that qualification. In the data, we see an enrolment record and a completion record, for the same qualification, for the same student, in the same year. But when a student changes their enrolment to another qualification (and discontinues their enrolment in the first qualification), this is seen in the data as a change in enrolment *in the year after* their last enrolment in the previous qualification. This is an artefact of the processes used to construct the dataset. In practice, a student may change to a new qualification at any time during the year, subject to the provider's rules. The Ministry's completion dataset uses the primary qualification which is provided to the Ministry by the providers in their final data submission in any one year. What this means is that a student can't change their enrolment in the first year of their studies, because, by definition, they are enrolled in their first qualification in that year. While we can model the change as occurring in the first year of enrolment in the new qualification, it means there is always a zero likelihood of changing qualifications in the first year.

This consideration also applies to dropping out. We only know a student has dropped out of their studies when we don't see an enrolment for a specified number of years (we will elaborate more on this below). So we could assign the event of dropping out to the year after their last enrolment. But like the case for changing qualifications, this means students cannot, by definition, drop out in their first year of study. When we assign both of these events, changing qualifications, and dropping out, to the year we see these events in the data, neither event can occur in the first year of study, and our models become extremely unstable.

To solve this problem, we assign all events to a student's last year of enrolment. The statistical models are far more stable, and the results are just as interpretable. It also means all three events of interest are tied to the last enrolment seen for a student in a qualification; they effectively stop enrolment at that point in time.

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[20] Of course if a student completes a qualification at a different institution from the one they started at, this will lower the completion rate for the original institution. And if the new institution is in a different tertiary sub-sector, it will lower the original sub-sector's completion rate. Whether this change improves the new institution's or new sub-sector's completion rate depends on whether the student actually completes the qualification at the new institution.

**Drop out period**

We use a period of one year of non-enrolment in the same qualification as the definition of dropping out. This may seem rather short, but we are only considering one-year qualifications. In addition, using a longer time period did not appreciably alter the results. This is because the majority of students who took a one-year break did not return to that *exact same* qualification in some later year. So taking a one-year break is effectively a permanent dropping out of study.[21]

The length of time we use to define whether a student has dropped out affects which students are included in the study population. This is because it is not possible to detect a drop-out event in a shorter period of time than the drop-out period. In other words, we can't detect a drop-out event for students where the end of the data series truncates their enrolment to less than this number of years. By defining drop out as one year's non-enrolment, we are able to use more of our data. While this is not such a problem for the longer time series data, it is of much greater concern for our shorter data series, that which includes the NCEA school achievement data.

Not using students who start their studies in 2011 also solves the problem of detecting a change in qualification event, since this too can only be detected in the year after an initial enrolment. Completions of course can be detected in the same year as an initial enrolment, so unless we remove students who start in 2011, completions will be over-represented in the data.

**Conditional probabilities**

The probabilities of the events we calculate using event history analysis are conditional—they depend on the student still being enrolled in a particular year. For example, if the event we are interested in is completing a qualification, then the likelihood of that event is the probability of completing a qualification in that year, *given* the student is enrolled in the year in question, and hasn't either completed, dropped out or changed to another qualification in previous years. We note that this is the main difference between the method we use in this report and that used by the Ministry of Education to calculate completion rates.

**Time-invariant and time-variant factors**

In event history analysis, we can look at how the likelihoods of events vary with different explanatory factors. These factors can be time-invariant, or time-varying.

Time-invariant factors are those which are constant through time. An example is a student's highest school achievement. Once a student leaves school, this attribute of the student will not change. The model results are simply displayed for each level of school achievement, and interpreting the result is straightforward.

Time-varying factors, as the name suggests, change with time. Traditionally, these variables have been difficult to analyse. In the case of the Ministry of Education's published qualification completion tables, completion rates are provide for full-time and part-time students. But this distinction is not as straightforward as it seems, because a student can study full-time in one year, and part-time in another. The method used by the Ministry is to adjust the denominator each year, such that the full-time rate is for students who only ever study full-time and never take a break from their study. Any students who study part-time, or take a break (that is, those not studying continuously full-time) are categorised as 'part-time' students.[22] The part-time denominator therefore increases through time. The situation can arise where the full-time completion rate increases in later years, not because any more students are completing, but because the denominator is decreasing. In effect the methodology penalises the part-time

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[21] Of course the students may go on to enrol in another qualification later. We *are* capturing those who change qualifications and continue with their studies, but as the results show, there are relative few of these students.

[22] The use of the term 'part-time' for this diverse group is obviously an over-simplification.

completion rate, because it transfers to the part-time denominator those full-time students who take a while to complete, and then take a break or continue their studies part-time.

Using event history analysis, time-varying variables are handled far more easily. They are simply included in the analysis as they occur in the data. Using study type as an example, two graphs can be produced, one for full-time study, and one for part-time study. What do these mean? They are interpreted as the likelihood of, say, completing a qualification, if a student was studying full-time (or part-time) *in a particular year*. The results for the next year are interpreted as the likelihood of completing in that year, given they were still enrolled in that year, for students studying full-time (or part-time) in *that* year.

The time-varying variables used in this study are study type (full- versus part-time study) and attendance type (intra- versus extramural study).

**Proportional versus non-proportional effects**

In the continuous-time event history models mentioned above, factors are assumed to act on the likelihood of events proportionally. This explains their alternative name of proportional hazards models. What this means is that the effect of, say, studying part-time, is assumed to be constant over time, affecting the likelihood of completing, or dropping out, to the same extent in each year.[23]

In discrete-time event history analysis, the factors do not have to act proportionally over time. This is achieved by including in the mathematical model an interaction between the factor of interest and time (see Section 7, *Model details*). In our models, we include an interaction between study type and time, attendance type and time, and between school achievement and time. In addition, we use an interaction term between the non-time factors (study and attendance type, and school achievement), so that, for example, the effect of study type can also vary with the level of school achievement.

Had the interaction terms with time not contributed much to the explanatory power of a model, we could have used a simpler model omitting the time interaction, but in every case, the addition of the interaction terms significantly improved the models' explanatory power. In other words, in each case, the factors were acting non-proportionally with time, and it would not have been appropriate to use proportional hazards models to analyse the data.

## 6.4  Data modelling

The statistical model used in competing-risks, discrete-time event history analysis is a multinomial logistic regression. This is an extension of the more commonly used binary logistic regression, but instead of the event of interest having two states—did or did not complete the qualification for example—the modelled event can take more than two states. In our case, the event states are: continues enrolment, completes the qualification, changes enrolment to another qualification, or drops out. As there is no intrinsic ordering to these states, we used multinomial logistic regression.  The statistical analysis software package SAS version 9.2 was used to fit these models to the data.

## 6.5  Combining qualification levels

Our study is focussed on how school achievement influences qualification completion. The qualifications are one-year non-degree qualifications, and the students are those who achieved up to NCEA Level 2 at school. While we have enough students in our larger population to

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[23] More precisely, the effects in proportional hazards models are linear for the logit of the hazard. That is, the logit-hazard profiles represented by all possible values of the predictors share a common shape and are parallel (Singer and Willett 1993).

consider these tertiary qualifications at each individual level, we have fewer years of data which includes school achievement. We therefore made the decision to combine the tertiary non-degree qualifications across levels 1 to 7.

We are comfortable with this approach because the results at the individual qualification levels are remarkably similar. Only level 2 certificates are slightly different, but the general pattern of the results is the same. Figure 12 shows the cumulative proportion of students completing a qualification by level of tertiary study. The conditional likelihoods for completing, changing to another qualification or dropping out in each year are also very similar.

**Figure 12**

Cumulative proportion of young intramural students completing their first one-year non-degree qualification, by level of qualification
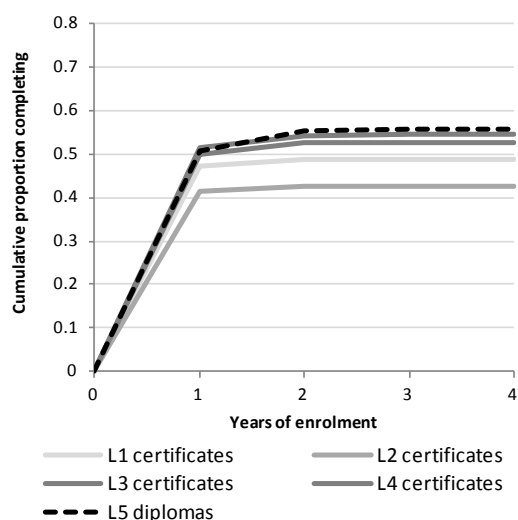


We did not explore the reasons why level 2 certificates might be different, but fewer students enrol in level 2 certificate qualifications. Including level 2 certificates does not change the conclusions of our study.

## 6.6  Changes through time

There were differences in the likelihoods of completing or dropping out between the various cohorts of students in the study. In general, students starting their studies more recently had higher likelihoods of completing. This study however was interested in how school achievement, student ability and study habits were associated with completing, rather than the precise likelihood of completing. There is therefore less emphasis on the actual likelihoods themselves, and more on how the likelihoods vary with the particular combination of factors under consideration. Indeed, by combining the data across all one-year non-degree qualifications essentially means that the specific likelihoods represent the characteristics of a large group of students across several levels of qualification.

## 6.7  The study population

Our study is focussed on how student achievement at school affects their performance in their tertiary studies. Specifically we consider students with school achievement up to and including NCEA Level 2, and who have recently left school and embarked on tertiary study. This necessarily means we are interested in younger students. In our study, students were between 15 and 24 years of age at the start of their study.

There are also a number of other factors that are known to influence the completion of qualifications. We are less interested in exploring these factors, but we need to control for them so that any results we see can be attributed to the factors we are interested in, and not confounded by these other factors. We can control for these other factors statistically, or we can select students who share the same characteristics. This latter option is preferable when a confounding factor is unevenly distributed in the study population.

Finally, there are factors that affect the likelihood of completing a qualification which have not been explored in much detail. These factors include: the effect of first completing a qualification at a lower, the same, or a higher level; the effect of changing from one qualification to another, without completing the first qualification (but see Scott and Grice 2008); the effect of taking a break during study; the effect of studying multiple qualifications simultaneously, either at the same, lower or higher levels, or in various combinations. Event history analysis provides a mechanism where these factors can be explored, but this was not done in this study.

In our analysis, study type, attendance type, school achievement and student ability were statistically controlled for in the models. The student's age at the start of their study, whether they had previously studied or completed a qualification, or whether they took an extended break from their studies were controlled by selection. In some cases student ability was controlled for by selection, where only students of 'average' ability (that is, those between -0.5 and +0.5 standard deviations from the mean) were used in the models.

In summary, the following selection criteria are used.

1. Students are excluded if they were already studying, or had completed a qualification in the first available year of data. These students are left censored.

2. Students are excluded if they had previously been enrolled in another qualification. This limited our students to those in their first-ever qualification, as far as we could determine.

3. Students are included if they are enrolled in a qualification of duration 0.9 to 1.0 EFTS. We regard these as one-year qualifications.

4. Students who took a one year break without re-enrolling in the same qualification are deemed to have dropped out.

5. Students are excluded if they were starting their qualification in the last year of data available, being 2011. This was done as we could determine whether any of these students dropped out or changed qualifications in the following year. They are right censored.

6. For the second study population, students are included if they studied at tertiary level between 2003 and 2011 and their highest school achievement was NCEA Level 2 or lower.

There were 41,132 students in total the 2003-2011 study population, and 10,163 of these were of average ability. There were 139,781 students in the 1997-2011 study population. Table 3 shows the number of students by enrolment years. Note that the enrolled year can be a different year for the different cohorts of students used in the study.

**Table 3**
Sample sizes for each enrolled year for the two data series used in the data modelling

| Enrolled year | 1997-2011 data series | 2003-2011 data series (all students) | 2003-2011 data series (average ability) |
|---|---|---|---|
| 1 | 139,781 | 41,132 | 10,163 |
| 2 | 27,624 | 8,701 | 2,203 |
| 3 | 1,447 | 350 | 77 |
| 4 | 306 | 49 | 5 |
| 5 | 82 | 11 | 1 |

# 7   MODEL DETAILS

This section provides details and summary statistics for the logistic regression models used in this analysis. Five models are used. Model 1 provides the overall results, using the 1997-2011 study population (Figure 2). Model 2 uses the same study population, but includes full-time and part-time study (Figure 3). Model 3 uses the shorter 2003-2011 study population to contrast study and attendance type (Figures 9 and 10). It is essentially the same as model 2 but for two years of data rather than four. Model 4 also uses the shorter time series, and introduces school achievement into the model (Figures 5 and 11). The fifth model is described below. The first four models are:

Model 1

$$Log(e_{ijk}/e_{ij4}) = [\alpha_{1k}T_{1ij} + \ldots + \alpha_{4k}T_{4ij}] + \mathcal{B}_{1k}(T_{1ij}*A_{ij}) + \ldots + \mathcal{B}_{4k}(T_{4ij}*A_{ij})$$

Model 2

$$Log(e_{ijk}/e_{ij4}) = [\alpha_{1k}T_{1ij} + \ldots + \alpha_{4k}T_{4ij}] + \mathcal{B}_{1k}(T_{1ij}*A_{ij}) + \ldots + \mathcal{B}_{4k}(T_{4ij}*A_{ij}) + \\ \mathcal{B}_{5k}(T_{1ij}*S_{ij}) + \ldots + \mathcal{B}_{8k}(T_{4ij}*S_{ij}) + \mathcal{B}_{9k}(A_{ij}*S_{ij})$$

Model 3

$$Log(e_{ijk}/e_{ij4}) = [\alpha_{1k}T_{1ij} + \alpha_{2k}T_{2ij}] + \mathcal{B}_{1k}(T_{1ij}*A_{ij}) + \mathcal{B}_{2k}(T_{2ij}*A_{ij}) + \\ \mathcal{B}_{3k}(T_{1ij}*S_{ij}) + \mathcal{B}_{4k}(T_{2ij}*S_{ij}) + \mathcal{B}_{5k}(A_{ij}*S_{ij})$$

Model 4

$$Log(e_{ijk}/e_{ij4}) = [\alpha_{1k}T_{1ij} + \alpha_{2k}T_{2ij}] + \mathcal{B}_{1k}(T_{1ij}*A_{ij}) + \mathcal{B}_{2k}(T_{2ij}*A_{ij}) + \\ \mathcal{B}_{3k}(T_{1ij}*S_{ij}) + \mathcal{B}_{4k}(T_{2ij}*S_{ij}) + \mathcal{B}_{5k}(T_{1ij}*H_{i}) + \mathcal{B}_{6k}(T_{2ij}*H_{i}) + \mathcal{B}_{7k}(H_{i}*A_{ij}) + \\ \mathcal{B}_{8k}(H_{i}*S_{ij}) + \mathcal{B}_{9k}(A_{ij}*S_{ij})$$

where $T_n$ are the time dummy variables, where $T_1$ is 1 in year 1, and 0 in the other years, $T_2$ is 1 in year 2, and 0 in the other years, and similarly for the other time dummies; $A$ is a dummy variable indicating whether student $i$ studied intra- or extramurally in enrolment year $j$, $S$ is a dummy variable indicating whether a student studied full-time or part-time in a particular year, and $H$ indicates a student's highest school achievement. The subscript $k$ refers to the events. $e$ is the probability of a particular event occurring, with $e_{ij4}$ referring to the event 'continuing with study' for student $i$ in year of enrolment $j$.

The $T*A$, $T*S$ and $T*H$ terms represent the interaction between Time and these other variables. These allow these variables to vary non-proportionally with time. The $H*A$, $H*S$ and $A*S$ terms are interaction terms which allow for the effects of highest school achievement, study type and attendance type to vary with each level of the other variables. In those models where interaction terms are included, the inclusion of those terms significantly reduced the log likelihood value, indicating they contributed significantly to the explanatory power of the model.

Note there is no single intercept term in these models. Instead, there are the coefficients $\alpha_{nk}$ which correspond to the variable 'time' in our models, one $\alpha_{nk}$ for each time period of interest. These terms are bracketed in the model equations above.

As we outline in the section *Method and data sources*, the mathematical model use to analyse a competing-risks discrete-time event history is a multinomial logistic regression model. The subscript $k$ represents the different event outcomes in the model.

A fifth model was used to investigate the interaction between school achievement and student ability on the likelihood of completing, changing qualifications and dropping out (Figures 7 and 8). The model specification is given below. It differs somewhat from the other models in that it is limited to full-time intramural students in their first year of study. It uses the short time series data, but unlike models 3 and 4 which also use that data, model 5 includes all students, not just students of average ability, but it is necessarily restricted to those students who have a NCEA Level 1 achievement score.

Model 5

$$Log(e_{ijk}/e_{ij4}) = \alpha_{1k}T_{1ij} + \mathcal{B}_{1k}H_i + \mathcal{B}_{2k}I_i + \mathcal{B}_{3k}(T_{1i}*H_i) + \mathcal{B}_{4k}(T_{1i}*I_i) +$$
$$\mathcal{B}_{5k}(H_i*I_i) + \mathcal{B}_{6k}(T_{1i}*H_i*I_i)$$

where $I_i$ represents the student ability of the $i$-th student, and the other variables and subscripts have the same meaning as defined above for the other models.

Summary statistics for the five models are shown in the table below. The number of observations represents student-time records, not individual students.

| Statistic | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Total number of observations | 169,279 | 169,279 | 12,449 | 12,449 | 19,101 |
| Number continuing | 30,812 | 30,812 | 2,519 | 2,519 | 1,300 |
| Number completing | 58,703 | 58,703 | 4,745 | 4,745 | 9,707 |
| Number changing | 15,740 | 15,740 | 935 | 935 | 1,394 |
| Number dropping out | 64,024 | 64,024 | 4,250 | 4,250 | 6,700 |
| Log likelihood | 419,117 | 373,564 | 27,082 | 26,922 | 41,161 |
| Adjusted R-squared | 0.2738 | 0.4609 | 0.4796 | 0.4871 | 0.4915 |

It is useful to note how the inclusion of study type into model 1 to give model 2, and school achievement into model 3 to give model 4, significantly improve both models in terms of the reduction in the log likelihood value. And while not directly comparable with models 1 and 2 because of the use of the two time series, model 4, which includes all of our variables and interactions, is the 'best' fit to the data based on the adjusted R-squared statistic. As mentioned above, model 5 is a special case, but it is also a model with good explanatory power.

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