Explaining Ethnic Differences in First-Year Student Success at a University in New Zealand

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Abstract

Previous research has found that ethnic gaps in first-year university academic performances are substantial. We utilise unit record administrative data made available by the Strategy and Planning Department at AUT (Auckland University of Technology) to explain the possible origins of these ethnic gaps in academic achievement. These potential factors include socio-demographic characteristics, university admission types, and pre-university academic achievement. We examine the academic success of first-year students enrolled in Bachelors' degree programmes at AUT between academic years 2012 and 2015. We furthermore decompose the ethnic gaps in academic outcomes observed between Maori, Pasifika, Asian and European students into their explainable and unexplainable components. Our findings show that European students were more likely to 'succeed' than the three minority ethnic groups in terms of both paper completion outcomes and letter grades. The NCEA rank score was the single most powerful variable in explaining these ethnic disparities. Furthermore, identifying the contributions of different factors in explaining the ethnic gaps in first-year university outcomes provides important guidance for university administrators and policy makers in designing programmes and policies to reduce overall ethnic gaps for students when they first begin their university study.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signed _____ Date_____

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1. Introduction

Life is exciting as a first-year student at University. It is a truly memorable experience that involves making new friends and acquiring new knowledge. However, the first year of university study can be very challenging because students have to learn to efficiently manage their time to accommodate studying, working, and interacting with family and friends. Tertiary education providers and other government bodies have recognised that the first-year university experience is a dominant element in terms of students' likelihood of completing their degrees. From one perspective, the incidence of first-year paper non-completion may affect second-year retention and future educational performance. From another perspective, high rates of paper non-completion generate a heavy burden on a student's family and on society. Also, universities are only funded if they meet the requirements of the government's funding regime. Therefore, a current top priority for universities is to provide proper learning support services or other interventions to promote student success.

Over the last decade, factors associated with the academic achievement of university students have been widely studied both nationally and internationally (Wetzel, O'Toole & Peterson, 1999; Juhong & Maloney, 2006; Singell & Waddell, 2010; Jia & Maloney, 2014). These studies have considered hundreds of possible factors. However, it is commonly believed that personal background, gender difference, enrolment status, and pre-university background are the most relevant determinants for predicting students' retention and paper completion behaviours. Many of these past studies were carried out using "old" data, which is likely to have influenced their estimated results. In contrast, our research is built on a newer and more extensive administrative dataset with detailed information covering many areas; using these detailed records allowed us to investigate a range of issues in a way that would not have been possible without data of this kind. The dataset was developed by the Strategy and Planning Department at Auckland University of Technology (AUT). It gathers student information, including personal background (e.g., year of study, ethnicity, gender, and education status), high school educational background (e.g., NCEA rank score and school decile, and entrance type), and course related information at the university (e.g., programme enrolled in and paper level).

There are two advantages of using administrative data. Firstly, compared with survey data, administrative data are a more complete and trustworthy data source. Secondly, it is very

unlikely to suffer from sample selection bias as we were able to access information about every single first-year student enrolling at AUT during the sample period. However, nothing is perfect, and our dataset excluded some potentially important factors that have frequently been discussed in the previous literature, such as family environment, students' employment information and their marital status (Pantages & Creedon, 1987; Ortiz & Dehon, 2008; Jia & Maloney, 2014). Also, less than 50% of our observations had valid NCEA[1] rank scores due to some possible reasons, such as overseas high school attendance, international exams (e.g., International Baccalaureate or Cambridge) completion rather than NCEA, and older students who have completed their secondary education before the introduction of NCEA. Focusing only on first-year university students enrolled in Bachelor's degree programmes at AUT for the first time, this study firstly compared separated mean differences in successful paper completion and grade points for Maori, Pasifika, Asian, against European students.

Generally speaking, a simple comparison of mean differences only allows us to see the overall differences in paper completion and grade point performance across ethnic groups. This study aimed to address the following questions:

1. How large are these overall ethnic differences in first-year academic outcomes at university?
2. How much of these differences can be explained by risk factors that pre-date university entrance?
3. What factors seem to be particularly important for explaining these observed ethnic gaps in early success at university?

To respond to the questions above, modern statistical decomposition techniques (including both Fairlie non-linear decomposition and Blinder-Oaxaca linear decomposition) were used to estimate the proportions of the observed ethnic gaps in academic outcomes that could be associated with particular sets of broad factors. The Blinder-Oaxaca decomposition technique has been widely used to explain group differences in measurable outcomes, such as wage discrimination in the labour market between males and females or Blacks and Whites (Oaxaca, 1973). The non-linear decomposition technique is an extension of the Blinder-Oaxaca linear decomposition method to a binary dependent variables, which was originally

[1] NCEA is an acronym for The National Certificate of Educational Achievement that was introduced in between 2002 and 2004, which currently is the prime national qualification for secondary school students in New Zealand and used for selection by universities.

developed by Fairlie (1999) to explain the African-American/White-American gap in self-employment. As far as we know, however, the decomposition techniques have not been applied in any previous empirical studies to examine paper completion behaviour and grade point performance in first-year university students. This study is therefore a novel application of the decomposition techniques to analyse which factors (e.g., NCEA rank scores or school deciles) matter the most for explaining these ethnic differences in average academic performance at university.

This dissertation is organised as follows: Section 2 provides a brief literature review of the main findings regarding the factors influencing first-year university outcomes. Section 3 describes the data and the variables used. Section 4 presents the research methods. Section 5 reports the empirical findings, and Section 6 concludes.

2. Review of Literature

Past research studies show that there are substantial differences in early academic achievement as related to ethnicity in New Zealand (Juhong & Maloney, 2006; van der Meer, Scott, & Neha, 2010). Many measurable factors contribute to these differences. Overseas studies have claimed that pre-university academic achievement is one of the valid predictors of university outcomes. Specifically, grade point averages (GPAs) at secondary school and Scholastic Aptitude Test (SAT) scores, and college GPAs were found to be strongly correlated (Larson & Scontrino, 1976; Kuncel, Hezlett, & Ones, 2001; DeBerard, Spielmans, & Julka, 2004). Likewise, high school grades could be used to accurately predict GPA scores at university (Cyrenne & Chan, 2012). Students with a lower GPA were much more likely to drop out of university in New Zealand (Juhong & Maloney, 2006). However, while high school performance is the single most powerful influence on first-year college achievement, its predictive power is likely to be negligible once other relevant variables (e.g., gender, ethnicity, and financial support) are taken into account (McDonald & Gawkoski, 1979; Ting & Sedlacek, 2000; Olani, 2009), especially when predicting medical, dental and pharmacy students' academic success (Tracey & Sedlacek, 1982; Bandalos & Sedlacek, 1989; Sedlacek & Prieto, 1990).

Although students' demographic backgrounds including ethnicity, gender and age are not personal choices, they can adequately serve as an indicator of first-year academic success at

university (Grayson, 1998; Robst, Keil, & Russo, 1998; Wetzel et al., 1999; Mahseredjian, Montmarquette, & Houle, 2001; Juhong & Maloney, 2006; Mastekaasa & Smeby, 2008; Ortiz & Dehon, 2008; Vignoles & Powdthavee, 2009; Belloc, Maruotti, & Petrella, 2010; Rodgers, 2013; Jia & Maloney, 2014). A Belgian study (Ortiz & Dehon, 2008) surprisingly found that there were no significant differences for European and non-European students regarding their first-year university achievement, whereas students who belonged to an immigrating "European elite" would outperform ordinary Belgian students. In the United States, African American students were reported to be less likely to succeed than White American students in terms of academic performance in high school (Cook & Evans, 2000) and this pattern continued at university; Murtaugh, Burns, and Schuster (1999) found that African American and Latino students had lower university retention rates than White students. In the same vein, New Zealand evidence has shown that European and Asian university students are more likely to complete their foundation-year papers successfully than Maori and Pacific Island students (Jia & Maloney, 2014). Aside from this existing gap between students' success in academia due to racial difference, female students were reported to have higher pass rates in first-year papers than male students (Mills, Heyworth, Rosenwax, Carr, & Rosenberg, 2009). The relationship between age and university performance is arguable. Some investigators have shown the two factors to be negatively correlated with one another (Clark & Ramsay, 1990), while others have indicated that mature-age students perform better than younger students (Hoskins, Newstead, & Dennis, 1997; McKenzie & Gow, 2004), probably because older students have well-defined goals and clearer purposes for their university study (McInnis, James, & McNaught, 1995), or have some individual characteristics that are helpful for effective learning in higher education (McKenzie & Gow, 2004).

In general, first-year Students who major in degree programs with relatively higher difficulty and academic requirements, such as Science or Engineering, are reported to have higher probabilities of paper non-completion than Arts or Business Studies students (Robst et al., 1998; Rask, 2010; Rodgers, 2013). For example, retention rates in Engineering studies were observed in one study to be 46% for female students and 61% for male students (Hutchison, Follman, Sumpter, & Bodner, 2006). Similar overseas empirical evidence showed that course dropout rates for majors in Humanities, Software Engineering, and Economics were 63.3%, 49.6% and 43.6% respectively (Araque, Roldán, & Salguero, 2009). Not surprisingly, Medicine was one of the most challenging degree programs (Johnes, 1997) while Design,

Health Science and Education courses were found to be relatively easier to complete (Jia & Maloney, 2014). Finally, there are also other non-traditional factors that may explain post-secondary academic gaps, including academic self-efficacy and achievement motivation (Chisholm, Cobb, & Kotzan, 1995; McKenzie & Schweitzer, 2001); degree preference (Mills et al., 2009); socioeconomic backgrounds and parental educational levels as well as parental occupational activity (Ortiz & Dehon, 2008; Vignoles & Powdthavee, 2009); secondary school decile ratings (Cyrenne & Chan, 2012; Juhong & Maloney, 2006); class sizes (Jia & Maloney, 2014); and institutional factors (Pascarella & Chapman, 1983; Jia & Maloney, 2014).

However, previous empirical studies did not make formal attempts to decompose the overall mean ethnic differences in university outcomes for these various factors. How much of the ethnic differences in paper completion and grade points can be explained by individual, school and enrolment factors? How much of the ethnic gap in university outcomes remains once we control for observable differences between the groups? This dissertation aims to provide a much more in-depth understanding of the reasons for the different initial experiences of ethnic groups at a large university in New Zealand.

3. Data Source and Descriptive Statistics

Administrative data were provided by the Strategy and Planning Department of AUT for this study. The initial dataset contained detailed information covering all students who enrolled in pre-degree, undergraduate or postgraduate study at AUT during the academic years 2005 and 2015. It originally contained more than 1,350,000 paper observations. These data files contained information on personal backgrounds such as ethnic identification, country of origin, age, gender, enrolment status (part- or full-time); high school background information, including NCEA results, school decile and entrance type; academic information including programme enrolled in and enrolments for double degrees; and paper levels (e.g., from level 4 to level 10).

Since the main aim of this study was to explain the ethnic differences in the academic performance of first-year students enrolled in Bachelor's degree programmes at AUT, we therefore limited the data to just these students. This limitation gave us a sample of university

official ethnicity designation [2], which included 181,277 first-year paper observations including papers at levels from 5 to 7. In this subsample, students were allowed to report up to three ethnicities. A priority rule is used by AUT to produce official ethnicity designations for students. Firstly, a student who indicates Maori ethnicity in one of the three variables is considered to be solely Maori. Secondly, for all remaining non-Maori students, someone who indicates Pasifika is deemed to be solely Pasifika. Finally, all remaining non-Maori, non-Pasifika students are allocated across the Asian, European, Other or Unknown categories. However, 'Unknown ethnicity' is critical missing information and we excluded this group of students from our analysis at the outset. 'Other ethnicities' was also eventually discarded in our subsequent ethnic decompositions because we compared two known ethnicities at a time (e.g., Maori vs. European, Pasifika vs. European, Asian vs. European). Another sample allowing multiple ethnicities for students contained 211,183 paper observation[3]. We included students reporting multiple ethnicities in this subsample. For example, a Maori student can also report him/herself as European. However, this subsample was not used for regression and decomposition analyses because we were only interested in students stating their primary ethnic identification. Lastly, to sharpen the distinctions across ethnic groups we excluded all students who reported more than one ethnicity from the three variables that were allowed. For example, Maori students under this definition did not report any other ethnicity identification. The same was true with Pasifika, Asian and European students. This procedure allowed us to test the sensitivity of our results to possible overlaps among the ethnic groups. This ethnicity definition also provided us another sample with 144,816 paper observations[4]. The first and third subsamples were used to examine the ethnic gaps in terms of both successful paper completion and grade points at university for Maori, Pasifika and Asian students compared to European students. Table 1 explains how the covariates used in this analysis were defined. Descriptive statistics are presented in Tables 2 to 6 (see Appendix).

In this dissertation, successful paper completion and grade points are the two outcomes of interest tested in order to understand the ethnic disparities in first-year academic performances by using 51 relevant covariates. Successful paper completion is a binary variable that takes a value of one if an enrolled paper is successfully passed in a given semester; zero otherwise. Grade points are converted from letter grade codes based on the

[2] For convenience, we refer to this sample as 'subsample 1' in the rest of the discussion.
[3] For convenience, we refer to this sample as 'subsample 2' in the rest of the discussion.
[4] For convenience, we refer to this sample as 'subsample 3' in the rest of the discussion.

standard convention used at AUT, with the highest value of nine for a letter grade of A+ and the lowest value of zero for a failed grade of D or equivalent. These two dependent variables are regressed against relevant information of students, such as year of enrolment, ethnicity, gender, enrolment status, age, NCEA result, school decile, entrance type, the programme enrolled in, and paper level. We found that the overall mean values of successful paper completion rate and grade points were 78.70% and 3.72[5] respectively in subsample 1 (see Table 2), and the values stayed the same in subsample 2. They very slightly increased to 79.03% and 3.73[6] in subsample 3 (see Table 4).

Four dummy variables for years of enrolment including the years from 2012 to 2015 were used for examining potential differences in academic outcomes throughout the sample period, and 2012 was our reference variable. The five different dummy variables created for students' ethnicities were Maori, Pasifika, Asian, European and Other ethnicities. Definitions of these variables can be found in Table 1. The group of students who reported their first-order ethnicity as European was set as the reference group. As shown in Table 5 and Table 6, in any of these subsamples, Asian and European students were the primary ethnic groups, accounting for 28.33% and 38.18%, respectively, in subsample 1. Maori and Pasifika students were represented in this subsample at levels of 10.47% and 15.09%, respectively. Similarly, Asian and European students accounted for 32.27% and 43.10%, respectively, in subsample 3, while Maori and Pasifika together accounted for less than 16% in the same subsample.

Students' personal characteristics considered included gender[7] and enrolment status (e.g., part-time enrolment). In both subsamples, we found that nearly 60% of enrolments were female students, and about 10% of enrolments were for part-time study (refer to Tables 5 and 6). We used 11 age dummy variables including 'under 18' to 'aged 40 and above.' Age 18 is the omitted age category, and the proportion in this age group was the largest compared to other age groups. Apart from the age variables, students' NCEA results were another important element in our investigation. However, the proportion of observations with a valid NCEA rank score was about 48%, while the proportion of the observations showing NCEA admission (e.g., NCEA Level 3) was more than 53% in subsample 1 (see Table 5). In

[5] This is slightly less than a B- grade point average.
[6] Again, it is slightly less than a B- grade point average.
[7] All students were asked to state one of two genders (either male or female). The data do not allow consideration of any other gender classification.

subsample 3, the proportion of observations with a valid NCEA rank score was nearly 47% while more than 51% of the observations applied for university admission using NCEA qualifications (refer to Table 6). The comparisons indicated that our dataset was suffering from a significant problem and some missing information is valid in these subsamples. The missing NCEA information could be due to overseas high school attendance, students holding IB or Cambridge qualifications other than NCEA, or some older students who left high school at a time when NCEA was not being used. It could also be because of human errors that occurred during the data collection process but this is very unlikely. Thus, what we did was to include a dummy variable called 'Valid NCEA Score' to indicate how many of the observations had a valid NCEA rank score as a whole or for each ethnic group. NCEA rank scores were summarised by the variable 'NCEA Rank Score'. Students are allocated an NCEA rank score based on their best 80 credits at NCEA Level 3 or higher over a maximum of five approved subjects, weighted by the level of achievement reached in each set of credits. A high school's school decile[8] is another potential factor influencing university outcomes. We included dummies for school deciles 1 to 10 as well as unknown school decile and we choose school decile 5 as the category to be omitted. As expected, the proportions of Maori and Pasifika observations coming from schools in the lower deciles (i.e. school deciles 1 to 4) were greater than the percentages of Asian and European students from lower decile high schools. According to the results in Table 5, about 33% of Maori and more than 55% of Pasifika enrolments attended high schools in the bottom deciles and these numbers jumped to more than 38% for Maori and 60% for Pasifika in Table 6; whereas Asian and European observations only accounted for approximately 23% and 11%, respectively, and these figures were almost unchanged in Table 6.

Focusing on entrance admission to study at AUT, the categories are 'External', 'Internal', 'Bursary', 'NCEA Level 3'[9], 'Other Entrance Type', and 'Special Admissions'. Of these categories, 'NCEA level 3' is the most common way that school leavers gain access to this

[8] School deciles are a measure of the socioeconomic position of a high school's student community relative to other schools across the country. For example, decile 1 schools are the bottom 10% of schools with the highest proportion of students from low socioeconomic regions, whereas decile 10 schools are the top 10% of schools with the lowest proportion of these students. It is noteworthy that New Zealand high school deciles underwent some changes in November 2014, with some schools getting a decile upgrade or downgrade, and others remaining unchanged. However, this policy change on deciles is unlikely to affect the findings of this study that relate to the variable.

[9] University entrance through 'NCEA level 3' is awarded by the New Zealand Qualifications Authority (NZQA). Results are provided automatically to the university by NZQA. Students' results are matched to their application and their eligibility for entrance is examined.

institution, followed by ‘External’ and ‘Special Admissions,' with tiny a percentage of our sample entering via ‘Other entrance type.' We found that over 60% of our European enrolments had ‘NCEA level 3’ scores, as did about 55% of Maori enrolments. The percentage in this category was relatively small for Asians, which may be because many Asian students attended high schools overseas. ‘External’ includes students who applied to AUT using pre-degree qualifications awarded by other institutions, or those who were previously enrolled at other universities. In contrast, ‘Internal admission’ means the students had pre-degree qualifications from AUT and used them to applied for Bachelor’s programmes in the same university. Every semester, the university offers ‘Special admission’ to students who do not have University Entrance but are 20 years or over by the first day of the semester in which the programme begins. Interestingly but expectedly, higher proportions of Maori (more than 20%) and Pasifika (more than 20%) enrolments enter the university through ‘Special Admission’ compared to Asian (just over 10%) and European (nearly 16%) (see Table 5 and Table 6).

In order to understand how university students’ decisions on course enrolment affect their first-year performances, in our analysis, we took into consideration 11 different Bachelor’s degree programmes including Bachelor of Arts (BA), Bachelor of Computer Information Science (BCIS), Bachelor of Communication Studies (BCS), Bachelor of Design (BDes), Bachelor of Education (BEdu), Bachelor of Engineering Technology (BEngTech), Bachelor of Health Science (BHS), Bachelor of International Hospitality Management (BIHM), Bachelor of Sports and Recreation (BSR), other small programmes, and double degrees. We then created 11 dummies for each of those programmes and set BBus as the omitted category. BBus is the most popular programme with more than 20% of the total enrolments being in this field in each subsample (see Tables 5 and 6). The second and third most popular programmes are BHS and BA respectively. In contrast, very few students enrol in double-degrees because this programme presents greater challenges. For all Bachelor year one students, the majority are most likely to study level 5 papers, which makes sense as over 70% of first-year papers are level 5 papers. Students in some programmes need to study higher level papers (e.g., level 6 or 7 papers), and some high-achieving students also chose to do so. A small proportion of students, especially some of the Asian students in our subsamples, could only enrol in level 4 papers because they were not eligible to choose higher levels of paper. We included three dummies for papers at levels 4, 6, and 7, and level 5 papers were our reference variable.

Finally, the overall academic gaps between the minority groups and Europeans can be easily seen by examining the results of the descriptive statistics tables. In general, none of the ethnic minority groups had an average successful paper completion or average grade point that is higher than those of the reference European group. Table 2 shows that European students had a successful paper completion of 85.40%, which is 5.91, 9.95 and 21.36 percentage points higher than Asian, Maori and Pasifika students, respectively; the average grade point for Europeans was 4.46 and was the highest grade point value compared to Maori (3.66), Asian (3.48) and Pasifika (2.58). European students had the best academic outcomes as indicated in Table 3. The results of Table 4 show that 85.38% of European students successfully completed the papers they enrolled in. Asian and Maori students' successful paper completions were 79.45% and 71.10%, respectively, while only 60.22% of Pasifika students were able to successfully complete their papers. Table 4 shows that European and Asian students gained similar grade points as to Table 2, but Maori and Pasifika received worse grade points in Table 4 compared to Table 2. These findings show that European students do better in both paper completion and grade points compared to minority ethnic groups. This dissertation will attempt to attribute these ethnic differences in academic performance to observable factors (e.g., NCEA results, school deciles, age, etc.), using regression analysis and decomposition techniques.

4. Research Methods

To test the differences in academic outcomes of first-year students, we used Maximum Likelihood Probit models to estimate the factors that influence successful paper completion. Standard linear regression models allowed us to explore the determinants of grade point outcomes. The predictor variables used included personal characteristics, background factors that include pre-dated university entrance, and other programme-related information. These variables are listed in Table 1. The short-cut equation for the Probit model is expressed as follows:

$$(4.1)\ C_i^* = \beta X_i + \mu_i$$

Where C_i^* is a latent variable represents paper completion outcomes. In other words, it is a variable that is not directly observed but is rather inferred through another, observed binary

outcome. For example, instead of directly observing C_i^*, we observed a dummy variable C_i that took a value of 1 if the paper selected had been successfully completed that semester; 0 otherwise.

$$C_i = \begin{cases} 1, & if\ C_i^* > 0 \\ 0, & if\ C_i^* \leq 0 \end{cases}$$

X_i is a 'vector' including all of the predictor variables. β is the corresponding 'vector' of coefficients needing to be estimated, while μ_i is the residual term that is assumed to be normally distributed and independent of X_i.

The probability of successful paper completion can be expressed as follows:

$$P_i = \Pr(C_i = 1|X_i) = \Pr(C_i^* > 0) = \Pr(\beta X_i + \varepsilon_i > 0) = \Pr(\varepsilon_i > -\beta X_i) = \Phi(\beta X_i)$$

where $\Phi(.)$ is the Cumulative Distribution Function (CDF) of the standard normal distribution.

Our sample linear regression equation for studying grade point differentials can be written as:

$$(4.2)\ G_i = \gamma X_i + \nu_i$$

Where G_i stands for grade points gained by students and is the dependent variable in this linear regression model. It is directly influenced by X_i, the same 'vector' used in the previous regression. γ is the corresponding 'vector' of coefficients needing to be estimated, and ν_i is called a disturbance term, or 'noise'.

Once we noted the substantial overall differences in university performance across our sampled ethnic groups, we next aimed to discover the factors that are most important for explaining these observed ethnic gaps in early success at the university. Therefore, modern statistical decomposition techniques were used to estimate the proportions of these

differences in course completion and in grade points that could be associated with particular sets of factors in our subsamples.

We primarily used the Fairlie non-linear decomposition technique to explain the mean ethnic differences in successful paper completion. This is an extension of the Blinder-Oaxaca linear decomposition method to binary dependent variables, as initially introduced by the American economist Fairlie (1999). We used 100 decomposition replications in our study. We estimated four models in each of our subsamples. The models predicted to what extent our categorical information (e.g., year of enrolment, gender, course enrolment status, age, NCEA information, school decile, entrance type, programme enrolled in, and paper level) explained mean differences in academic success between Maori and European, Pasifika and European, Asian and European students. For example, the Fairlie non-linear decomposition of the Maori/European gap in the average value of the successful paper completion (Fairlie, 1999), $C= F(X\hat{\beta})$, can be expressed as:

$$(4.3)\quad \overline{C}^{E} - \overline{C}^{M} = \left[\sum_{i=1}^{N^E} \frac{F(X_i^E \hat{b}^M)}{N^E} - \sum_{i=1}^{N^M} \frac{F(X_i^M \hat{b}^M)}{N^M}\right] + \left[\sum_{i=1}^{N^E} \frac{F(X_i^E \hat{b}^E)}{N^E} - \sum_{i=1}^{N^E} \frac{F(X_i^E \hat{b}^M)}{N^E}\right]$$

Where $\overline{C}^{E}$ and $\overline{C}^{M}$ are paper completion outcomes for European and Maori students, respectively. N^i is the sample size for students from ethnicity *i.*, $\hat{b}^M$ are the Maori coefficient estimates used to weight the first term in the square brackets in the decomposition, and $\overline{X}^E$ are the European distributions of the control variable used as weights for the second term. The first term in square brackets shows the first portion of the ethnic gap that results from group differences in distributions of *X*, and an estimated contribution of ethnic differences in the whole set of independent variables to the academic gap is provided by this term. This is part of the ethnic gap in the average probabilities of paper completion that can be 'explained' by the differences in observable covariates. The second term shows the other portion, due to differences in the group processes determining levels of *C*. This is the part of the ethnic gap in the average probabilities of paper completion that 'cannot be explained' by the observable differences in background factors. We weighted the first term by using estimated coefficients

from a pooled sample of Maori (as for the linear decomposition that will be discussed later). Also, we included a dummy variable for Maori in our regression to take any potential influence on the coefficients away from ethnic differences that were correlated with any of our predictor variables.

The Blinder-Oaxaca decomposition for linear regression models is a procedure developed by Blinder and Oaxaca, to study wage discrimination in labour market between different groups of people (e.g., male/female, black/white and urban/rural) by decomposing mean differences in log wages based on linear regressions (Blinder, 1973; Oaxaca, 1973). In our analysis, for example, the standard Blinder-Oaxaca linear decomposition of the Maori/European gap in the mean value of the grade points can be written as:

$$(4.4)\quad \overline{G}^{E} - \overline{G}^{M} = \left[(\overline{X}^{E} - \overline{X}^{M}) \hat{b}^{E} \right] + \left[\overline{X}^{M} (\hat{b}^{E} - \hat{b}^{M}) \right]$$

Where $\overline{G}^{E}$ is the grade points achieved by European students while $\overline{G}^{M}$ is Maori students' grade point performance. $\overline{X}^{j}$ is a row vector of mean values of the independent variables, and $\hat{b}^{j}$ is a vector of estimated coefficients for students from ethnicity *j*.

The Blinder-Oaxaca decomposition technique separates the grade points gap between Maori and European students into a part that is 'explained' by group differences in the categorical information mentioned above, and a remaining part that cannot be accounted for by this kind of difference in grade points determines. The second part is known as the 'unexplained' part and is often used to include the effects of group differences in unobserved factors. We do not focus on this 'unexplained' part of the gap in our analysis because it is not easy to interpret these results.

5. Findings

We developed two independent Probit regression models for successful paper completion. The first model was for subsample 1 and the second model was applied to subsample 3. A Probit model is a type of non-linear regression in which coefficient estimates cannot be

interpreted in the way that we understand linear regression models. In other words, the coefficient estimates in Probit models do not measure the changes in the probability of successful paper completion given one-unit changes in our predictor variables. However, this does not prevent us from analysing these results, because using marginal effects enables us to measure the expected changes in successful paper completion given a change in a particular predictor variable while keeping all the other covariates unchanged. The coefficient estimates, estimated standard errors and marginal effects are shown in Table 7. However, these regression results are not directly used in subsequent decompositions because our decompositions are done in a 'pairwise process', where the outcomes for an ethnic minority (Maori, Pasifika, and Asian) are contrasted with the majority ethnic group (European). The regression estimates for the decomposition techniques are discussed subsequently. We therefore firstly report the basic regression results for the full subsamples, including 'Other' ethnic groups.

5.1 Basic Regression Results on Successful Paper Completion

We examined successful paper completion in two different subsamples. It is important to note that the discussion of this section is based on the regression results in Table 7 otherwise stated. In both subsamples, we found that the probability of a successful paper completion was lower in the later years (e.g., from 2013 to 2015), compared with the benchmark year 2012, holding all other factors constant. However, this adverse effect was <u>not</u> statistically significant for the year 2015 in subsample 3 (i.e., the second set of regression results reported in Table 7).

It is widely believed that female students tend to have better average performance with regard to successfully completing a paper compared to male counterparts (Mills et al., 2009; Rodgers, 2013). We also found that being a female student, holding other variables constant, increased the probability of successful paper completion on average by 3.4 percentage points compared to a male student in subsample 1, and this figure climbed to 4.0 percentage points in subsample 3. These effects are all statistically different from zero at better than a 1% level.

What is common in tertiary education is that a small proportion of students (roughly 9% in our case) enrol in part-time study, and they are the group who are at higher risk of failure to complete papers. Our results show that being a part-time student reduced the probability of

successful paper completion by 4.3 and 4.2 percentage points, respectively, in subsamples 1 and 3, compared to a full-time student, keeping other factors constant. These results are similar to the earlier empirical study by Singh (2015), who found that part-time study lowered the probability of successfully completing papers by 3.56 percentage points. Jia (2014) claimed that part-time enrolment could adversely affect the probability of paper completion. They both concluded that this adverse effect might be caused by lack of commitment to full-time study, or a weaker attachment to tertiary education.

Whether students' age can directly influence their academic performance is still unclear in the literature. However, the results of the age dummy variables give us an idea of this age pattern. Young university students (e.g., under 18) tended to do better than students at other ages. For instance, in subsamples 1 and 3, students who were younger than 18 had a probability of successful paper completion 5.4 and 7.0 percentage points higher, respectively, compared to the group of students aged 18, holding other factors constant. This outstanding achievement could result from the talents or strong academic backgrounds of these young students. Students aged 19 to 25 were particularly at risk of poor academic outcomes; all of these coefficients are negative and statistically different from zero at better than a 1% level for ages 19 to 22, but statistically insignificant for ages 23 to 25. Students aged 26 or above outperformed students aged 18. If other factors remained unchanged, being a mature student (ages 30 to 39) increased the probability of paper completion by 3.4 percentage points compared to an 18-year-old student in subsample 1, and this probability jumped to 4.0 percentage points in subsample 3.

Our results also emphasized the importance of NCEA performance. On one hand, only looking at students in subsample 1 who had a valid NCEA score[10], the results suggested that every 100-point increase in the NCEA rank score raised the probability of successful paper completion by 11.6 percentage points. On another hand, using the two results on the two NCEA variables together suggested that the positive effect occurred only when the NCEA score was higher than 144 (i.e., the breakeven point). This value was far below the subsample mean of 174.5 (see Table 5) and about 32% of enrolments in this subsample had an NCEA rank score less than 144. Relative to not having an NCEA score, receiving the mean or

[10] The marginal effects of having a valid NCEA score are -16.7 and -15.8 percentage points for subsamples 1 and 3, and they are highly statistically significant. But it is difficult to interpret these results in isolation. They are the marginal effect on successful paper completion of reporting a valid NCEA score of zero.

maximum NCEA rank score increased the probability of successful paper completion by approximately 3.5 or over 20 percentage points,[11] respectively. Similar outcomes were found in subsample 3; for example, a 100-point increase in the NCEA rank score increased the probability of successful paper completion by 10.8 percentage points, conditional on the NCEA information being available. The 'breakeven point' appeared when the NCEA rank score reached more than 146, which was also below the mean NCEA rank score of 174.5 (see Table 6) and nearly 33% of enrolments in this subsample with NCEA rank scores had a value lower than 146. Gaining the mean or highest level of NCEA rank score significantly increased the probability of course completion by nearly 3.1 or 18.9 percentage points, respectively.

Apart from NCEA results, other high school background such as school decile can also influence students' course completions. Students from the lowest school deciles (e.g., decile 1) were less likely to gain a passing grade for the papers they were studying, compared to those from school decile 5, holding other factors constant. Students attending high schools in deciles 6 and 7 tended to have a higher probability of passing papers than students who attended decile 5 high schools. The same result occurred in groups of students coming from unknown school deciles, which may be because this group consisted mostly of Asian students who attended overseas high schools.

Among all types of university entrance considered in our study, only 'Special Admissions' negatively affected the probability of paper completion. For example, students entering this university under 'Special Admissions' had their chance of passing a paper reduced by more than 5 percentage points, compared to students who entered with NCEA level 3. These effects are statistically different from zero at better than a 1% level. Students who were granted bursary qualifications were more likely to complete a paper than students holding NCEA level 3. However, bursary is an older secondary school qualification that has not been issued in New Zealand for some years. Therefore, these older students were the 'safest' students across our subsamples.

[11] The partial derivative of probability of successful paper completion with respect to having a valid NCEA score in subsample 1 can be expressed as:

$$\frac{dProbability\ of\ Successful\ Paper\ Completion}{dValid\ NCEA\ Score} = -0.1669+0.1156(\text{NCEA Rank Score})$$

The estimated marginal effects when NCEA rank score is 174.5 and 320 are 0.0348 and 0.2030, respectively.

Choice of studies may have a direct impact on the probability of successfully completing first-year papers. This could be due to the different entry requirements in the Bachelor's degree programmes, or the quality of the students that enter these programmes in unobserved ways. In particular, taking a first-year paper from BEdu increased the probability of successful paper completion on average by more than 16 percentage points in both subsamples, compared to taking a paper from BBus, holding everything else constant. Also, studying a paper from BSR resulted in a higher probability of successful paper completion but this effect was statistically insignificant. Taking a paper from BEngTech slightly increased the probability of paper completion in comparison with taking a paper from BBus. This finding seems to conflict with previous studies (Robst et al., 1998; Rask, 2010; Rodgers, 2013). The possible reason for this positive impact in BEngTech is that the dataset had not collected sufficient numbers of records for BEngTech students. Last but not least, compared to doing a level 5 paper, undertaking a level 4 paper decreased the probability of paper completion, while doing a paper at the higher levels (e.g., level 6 or 7) significantly increased the probability of completion.

As already mentioned in the last paragraph of Data Source and Descriptive Statistics, the overall probabilities of successfully completing a paper were, on average, 5.91, 9.95 and 21.36 percentage points lower for Asian, Maori and Pasifika students, respectively, compared to the benchmark group of European students (refer to Table 2). Moreover, according to the regression results on subsample 1, the probability of successful paper completion for Asian, Maori or Pasifika students on average decreased to 2.88, 7.39 and 12.99 percentage points, respectively, compared to European students, holding everything else constant. These values highlight that there are smaller Asian/European, Maori/European and Pasifika/European gaps once we control for the other factors.

Maori and Pasifika continued to be the more vulnerable groups in subsample 3 and they had even worse paper completion outcomes compared to subsample 1. For example, the overall probabilities of successful paper completion were on average 5.93, 14.28 and 25.16 percentage points lower for Asian, Maori and Pasifika students, respectively, compared to European students (see Table 4). Notably, if a paper was taken by Maori or Pasifika students, on average it decreased the probability of successful paper completion by more than 10 and nearly 16 percentage points, respectively, compared to when the paper was taken by European students, holding other factors constant. If a paper was taken by an Asian student, it

on average reduced the probability of successful paper completion by about 3 percentage points, compared to the same paper taken by European students. Once we controlled for other variables, the gaps in the probability of paper completion between the minor ethnicity groups and European became smaller, compared to the overall gaps. Finally, holding any other factors constant, by and large, Maori and Pasifika students were observed to have a relatively lower probability of successfully passing a paper than their European counterparts in any given semester. Thus, these two groups of students apparently suffer a higher risk of paper non-completion in comparison with European students; this finding is supported by past studies (Juhong & Maloney, 2006; Jia & Maloney, 2014). Thus far, our regression results are capable of explaining at least some of the overall ethnic differences in successful paper completion.

5.2 Basic Regression Results on Grade Points

Table 8 gives the regression results on grade points of students who enrolled at AUT during our sample periods. The discussion in this section is based on the regression results in Table 8 unless otherwise indicated. We ran two different regression specifications. Specification 1 was based on subsample 1. Specification 2 relied on subsample 3. Both specifications included the same covariates used in the Probit models.

In both subsamples, the average grade points in 2013 were lower than in 2012. Thereafter, grade points increased to higher levels in 2014 and 2015 than in 2012 when all other relevant factors were held constant. Female students were not just more likely to successfully complete papers, they also received higher average grade points. An average female student had a grade point that was more than 0.3 grade points higher than that of an average male. Even though this gap is small in magnitude, it is statistically significant at better than a 1% level. Compared with full-time students, part-time students tended to obtain a lower average grade point. Older students did better than young school leavers in terms of grade point performance.

Having a valid NCEA rank score positively and significantly affected first-year university grade points[12], conditional on this information being available. We found that a 100-point increase in the NCEA rank score raised the university grade points by more than 1 point in both our subsamples. However, we also found that this impact was nonlinear when considering 'Valid NCEA Score' and 'NCEA Rank Score' simultaneously. For example, in subsample 1, the estimated effect started to be positive only when the average NCEA rank score reached the 'breakeven point', at approximately 161. Supposing NCEA rank scores to be 100, 175 and 320, the estimated marginal effects accordingly are -0.72, 0.16 and 1.86 on university grade points[13]. Similarly, the 'breakeven point' in subsample 3 occurred when NCEA rank score exceeded 163 and the marginal effects of NCEA at rank scores of 100, 175 and 320, were -0.72, 0.13 and 1.77 on university grade points, respectively. Apparently, these 'breakeven points' are higher than they were for paper completions. These conclusions suggest that the relative importance of NCEA performance on university grade points increases with the level of success in this high school exam.

School decile had some impact on first-year grade points at university. Compared to the omitted category decile 5, attending high schools in the bottom deciles was negatively related to grade point. For example, if other factors were held constant, coming from a high school in Decile 1 was associated with an average decrease of 0.68 points in grade point in subsample 1, relative to someone from a school in the fifth decile. Meanwhile, no supportive evidence was found in subsample 1 or 2 that coming from schools in the top deciles had a positive impact on university grade points. Specifically, the coefficient estimates for Deciles 9 and 10 were negative numbers and statistically insignificant. Only those attending schools in middle deciles (e.g., decile 6 and 7) or unknown deciles were found to have higher grade points, compared to others from schools in the benchmark decile. Therefore, students who were studying at high schools in the top deciles did not necessarily have a significant advantage over others regarding grade point performance at university.

[12] The marginal effects of having a valid NCEA score are -1.89 and -1.85 points, respectively, in subsamples 1 and 3, and they are highly statistically significant. But it is difficult to interpret these results in isolation. They are the marginal effects on grade points of reporting a valid NCEA score of zero.

[13] The partial derivative of grade points with respect to having a valid NCEA score in subsample 1 can be expressed as:

$$\frac{dGrade\ Points}{dValid\ NCEA\ Score} = -1.8946+1.1736(\text{Grade Points})$$

The estimated marginal effects when the NCEA rank score is 100, 175 and 320 are -0.721, 0.159 and 1.861, respectively.

‘External,' ‘Bursary’, and ‘other’ entrances had positive and significant impacts on first-year university grade points, compared with ‘NCEA level 3' entrance. ‘Bursary' had the greatest effect on grade point among these entrance types. Students enrolling via ‘Internal' or ‘Special Admission' tended to have lower grade points. Studying a paper from BEdu or a double degree programme increased the average grade point by about 1.8 and 1.3 points, respectively, relative to studying a paper from BBus. With other factors held constant, enrolling in a paper from BCS, BEngTech, or BSR, compared to taking a paper in BBus, had a significant effect on grade point and these results were all statistically significant at better than a 1% level. Undertaking papers at levels 4, 6, or 7 led to slightly lower mean grade points, compared to undertaking level 5 papers.

Lastly, the differences in grade points between ethnicities were calculated very precisely in our results, meaning that they have relatively small standard errors. The numbers in the third column of Table 2 show that the overall ethnic gaps in grade points for Asian/European, Maori/European and Pasifika/European were 0.98, 0.80 and 1.89, respectively. These gaps declined to 0.62, 0.60 and 1.36 for Asian, Maori and Pasifika students relative to Europeans once we controlled for other measurable factors. In Table 4, the overall ethnic differences were relatively larger in magnitude: 1.00, 1.01 and 2.15, respectively. However, when we controlled for other factors these gaps decreased to 0.66, 0.79 and 1.68 for Asian, Maori and Pasifika students compered to European students.

5.3 Paper Completion Decomposition Outcomes

Table 9 provides the results of the nonlinear Fairlie decomposition for our regression model on ethnic gaps in successful paper outcomes using Official Ethnicity Designations. The actual Maori/European, Pasifika/European and Asian/European differences in paper completion were 9.96, 21.36 and 5.91 percentage points (see first row of Table 9), respectively. Here is where our decomposition technique starts working. First, we ran a similar Probit regression for just two ethnic groups (e.g., only Maori vs. European). We retrieved the estimated coefficients from this model. We then used these coefficient estimates to ‘weight’ the differences in each covariate between the two ethnic groups in our subsample regarding the probability of successfully completing a paper. These results were finally aggregated by groups of related factors. Year of enrolment could explain less than 1% of the actual

Maori/European ethnic differences. If we gave Maori students in the subsample the same NCEA rank scores as European students, this would raise the probability of paper completion by an average of 1.19 percentage points. This effect is statistically different from zero at better than a 1% level, and would account for 11.94% of the overall gap of 9.96 percentage points in paper completion probability between the groups. Similarly, if Maori students were given the same school decile distributions (or entrance types) as European students, this would increase the probability of paper completion by 0.57 (or 0.38) percentage points on average, and this effect accounts for 5.68% (or 3.85%) of the total gap in paper completion probability between the groups. Also, if Maori students enrolled in the same programmes as Europeans, this could explain 2.47% of the overall gap. In general, if Maori students were given the same observed covariates as European students, we could explain 2.23 percentage points or 22.39% of the overall Maori/European differences in successful paper completion. This means that more than three-quarters of observed differences in paper completion outcomes between Maori and European students could not be accounted for by the covariates used in this regression analysis.

For Pasifika students, if we gave them the same NCEA rank scores as European students, this would increase the probability of paper completion on average by 1.97 percentage points. This positive effect is also statistically significant at better than a 1% level, and could explain 9.23% of the overall difference of 21.36 percentage points in paper completion probability between the groups of students. Meanwhile, coming from the same school decile would reduce the Pasifika/European gap in the probability of paper completion by 1.82 percentage points. This could account for 8.52% of the actual ethnic difference in paper completion probability. If the groups all enrolled in the same Bachelor programme, this could explain 7.06% of the overall differences. If we gave Pasifika students the same observed covariates as European students, we could explain 5.75 percentage points or 26.92% of the overall differences in paper completion between these groups. This indicates that slightly less than three-quarters of observed differences in outcomes of paper completion between Pasifika and European students could not be accounted for by the covariates used.

The numbers in the last column show something different. Gender difference could account for 10.34% of the overall ethnic differences between Asian and European students. Age also seemed to be important in explaining the Asian/European gap. If we gave Asian students the same ages as Europeans, this would account for 6.69% of the overall difference of 5.91

percentage points in the probability of course completion. Moreover, if both Asian and European students gained the same NCEA rank score from high school the probability of Asians completing a paper increased by 1.75 percentage points, which is statistically different from zero at better than a 1% level. This statistically significant effect could account for about 30% of the actual gap in paper completion probability. The second powerful variable was the programme enrolled in. Enrolling in the same programmes alone could explain more than 22% of Asian/European differences. On the other hand, if Asian students were given the same school deciles as Europeans, the probability of paper completion would decrease by 0.74 percentage points. This adverse effect is statistically different from zero at better than a 1% level and would widen the overall gap of 5.91 percentage points by 12.54%. This effect was probably because most of the Asians in our sample attended high schools overseas. Finally, if we gave Asian students the same observed covariates as European students, we could explain 2.89 percentage points or almost 48.88% of the overall Asian/European difference in successful paper completion, which implies that slightly more than a half of observed Asian/European differences in paper completion could not be accounted for by the covariates used in our regression analysis. This effect is roughly twice the size of the effects on Maori or Pasifika compared to Europeans.

Table 10 reports the results of a similar non-linear decomposition for our full regression model, but we decomposed the ethnic gaps in successful paper completion in the sample of Single Ethnicity Identifications. The actual Maori/European, Pasifika/European, and Asian/European differences in paper completion were 14.29, 25.16 and 5.93 percentage points (see the first row of Table 10), respectively. It is worth noting that the separate contributions from ethnic differences in each set of covariates were quite similar to what we found in the previous decomposition outcomes. First of all, NCEA, entrance type, and programme enrolled in could together explain the majority of the Maori/European gap. In other words, if Maori students had the same NCEA rank scores, entrance types, and programme enrolments as European students, this would increase the probability of paper completion by an average of 2.75 percentage points. This effect is statistically different from zero at better than a 1% level, and would form 19.26% of the overall gap of 14.29 percentage points in paper completion probability between these two groups. In this subsample, we could explain 2.68 percentage points or 18.78% of the overall Maori/European paper completion gaps if Maori students were given the same observed covariates as European students. This

says that just less than one-fifth of observed differences in paper completion between Maori and European students could be accounted for using these covariates.

Compared with Maori vs. European, high school decile and programme enrolled in tended to explain more of the Pasifika/European gap in successful paper completion, whereas differences in entrance type explained less of the gap. If we gave Pasifika students the same NCEA rank scores, school deciles and programme enrolments as European students the probability of paper completion would increase by 5.2 percentage points on average. This would account for 20.67% of the Pasifika/European actual gap in paper completion probability. In addition, if Pasifika students were given the same observed covariates as European students, we could explain 5.56 percentage points or 22.10% of the overall Pasifika/European differences in paper completion. In other words, slightly under four-fifths of observed Pasifika/European differences in paper completion could not be accounted for by the covariates used in our analysis.

Even gender difference could negatively affect the gaps in Maori or Pasifika/European comparisons, but being female would on average raise the paper completion probability by 0.64 percentage points and account for 10.74% of the overall gap of 5.93 percentage points in probability of paper completion between Asian and European students. Moreover, having the same NCEA rank score (or programme enrolment) would raise the probability of paper completion by 1.84 (or 1.30) percentage points. These effects are both statistically different from zero at better than a 1% level, and would account for nearly 31% (or almost 22%) of the actual Asian/European ethnic gap of 5.93 percentage points in paper completion probability. The school decile variable could not explain any of the Asian/European gap. In the end, if Asian students were given the same observed covariates as European students, this could explain 2.88 percentage points or 48.58% of the overall differences between Asian and European students in paper completion. This means that just over half of observed Asian/European gaps in paper completion outcomes could not be accounted for by the covariates used.

5.4 Grade point Decomposition Outcomes

The results of Oaxaca linear decomposition of ethnic gaps in grade points using Official Ethnicity Designations are displayed in Table 11. The actual Maori/European difference in

grade point was 0.80 point (see the first row of Table 11). This grade point gap is divided into nine variable categories. For instance, NCEA results alone could explain 17.33% of this ethnic differential in mean grade points. If Maori students obtained the same NCEA rank scores as European students, this could increase the Maori students' grade point by about 0.14 points on average. This would account for 17.33% of the overall grade point gap of 0.80 between Maori and European, and this positive effect is statistically different from zero at better than a 1% level. If Maori students were given the same entrance types, or enrolled in the same programmes as European students this could on average lift the grade point by 0.05 points. These effects are all statistically different from zero at better than a 1% level and could account for approximately 6% or 5.73% of the overall gap of 0.80 points in grade point. We only could explain 0.18 points or 22.65% of the total Maori/European difference in grade point if Maori students were given the same observed covariates as European students, which means that more than three-quarters of the observed differences in grade point performance between Maoris and Europeans could not be accounted for by the covariates.

The second column shows the decomposition output for Pasifika versus European. The difference in mean grade point between Pasifika and European students resulted in a grade point gap of 1.89 (refer to the first row of Table 11). Firstly, adjusting Pasifika students' NCEA results to the same rank score as Europeans would raise the grade point by 0.29 points; this would account for 15.23% of the overall Pasifika/European gap of 1.89 points in grade point. The magnitude of explanatory power is higher than in Maori/European comparisons, which suggests NCEA results constitute a more important factor in explaining the existing grade point disparity in Pasifika versus European university students. Secondly, if we gave Pasifika students the same school deciles, or entrance types, or programme enrolments as European students, this could account for 4.55%, or 3.42%, or 6.30%, respectively, of the overall grade point gap of 1.89. Thirdly, if Pasifika students were given the same observed covariates as European students, this could explain 0.49 points or 25.97% of the overall gap between Pasifika and European students in grade point performances. In other words, just over one-quarter of the observed grade point gap between Pasifika and European students could be accounted for by the covariates used in our regression.

The decomposition results in the third column show something different. An Asian/European gap of 0.98 points in grade point can be seen in the first row of Table 11. Gender difference (e.g., being female) could account for 5% of the overall gap in grade point between Asian and

European students. If Asians had the same NCEA rank scores from high school as European students this would on average improve the grade point by 0.21 points; this effect could account for 21.29% of the grade point gap of 0.98 points and it is statistically different from zero at better than a 1% level. Enrolling in the same first-year programme at university could explain almost 15% of the overall Asian/European gap in grade points. If we gave both Asian and European students the same observed covariates, we could explain 0.35 points or 36.05% of the overall Asian/European differences in grade point performance. Therefore, more than three-fifths of the observed grade point differences between Asian and European students are unexplained by taking into account all the covariates.

The last decomposition table (Table 12) presents the outcomes of ethnic differences in grade points using Single Ethnicity Identifications. Firstly, the gap in mean grade points for Maori and European yielded a grade point difference of 1.01 points (see the first row of Table 12). Differences in the year of enrolment, gender, age, school decile, and paper level would somewhat widen the Maori/European gap in grade point. However, if we gave Maori students the same NCEA rank scores of European students, this would account for 20.34% of the overall gap of 1.01 points in grade point between the groups. If Maori had the same entrance types and enrolled in the same programmes as Europeans, together this would account for more than 12% of the overall Maori/European grade point gap. Furthermore, if we gave Maori students the same observed covariates as European students, we could explain 0.17 points or 17.23% of the overall Maori/European differences in grade points. This means that more than four-fifths of the gap in grade points between Maori and European students could not be accounted for by the covariates.

Secondly, there was a 2.15-point grade point difference between Pasifika and European students (see the first row of Table 12). If Pasifika students were given the same NCEA rank scores as European students, this alone could explain more than 14% of the gap of 2.15 points. If we allowed these groups to have the same entrance type and programme enrolments, this could account for 9.29% of the overall difference. If we gave Pasifika students the same observed covariates as European students, this could account for 0.38 or almost 18% of the overall grade point difference between Pasifika and European students. This effect is statistically different from zero at better than a 1% level. This means that slightly more than four-fifths of the observed differences in grade point between Pasifika and European students could not be accounted for by the covariates.

Thirdly, the differences in mean grade points between Asian and European students caused a 1.00-point actual ethnic difference in grade point (see the first row of Table 12). Gender and age differences seemed to be significant in this case. For example, if we gave Asian and European students the same proportion of female, this would raise the grade point by 0.05 points and would account for about 5% of the Asian/European overall gap in grade point. Having the same NCEA rank score or enrolling in the same programme could separately explain 21.86% and 14.61%, respectively, of the difference in grade point between Asian and European students. Unlike the Maori/European and Pasifika/European comparisons, entrance type appeared to explain a minor part of the grade point difference (0.77%) in Asians compared to Europeans. If Asian students were given the same observed covariates as Europeans, we could explain 0.36 points or 35.77% of the overall Asian/European differences in grade points. Again, more than three-fifths of the overall gap of 1.00 point in grade point between Asian and European students could not be explained by the covariates used in our analysis. It is important to note that the 'total explanation power' is higher in Table 12 than in Table 11 by including all of the covariates (see the bottom row of each table). This might suggest that the approach the university used to identify students' ethnicity may be more acceptable.

6. Conclusion

Using the extensive administrative data provided by Auckland University of Technology (AUT) allowed this study to provide empirical evidence of what determinants were associated with academic outcomes (e.g., successful paper completion and grade points) in first-year students at university. Maximum likelihood Probit and standard linear regression analyses clearly demonstrated the ethnic disparities in successful paper completion and grade points. Most importantly, we used modern statistical decomposition techniques to estimate the proportions of the observed racial gaps that could be associated with factors such as students' primary characteristics, educational backgrounds, degree programmes, study status, and paper level. Our decomposition outcomes should provide government policy makers and university administrators with a better understanding of what factors contribute to the first-year academic gaps between minority and majority ethnic groups undertaking university study.

Our regression results suggest that factors including personal characteristics, high school backgrounds, and university enrolment-related information could influence students' paper completion and grade points to a certain extent. A typical example is that minority ethnic groups, especially Pasifika and Maori students, are more likely to have a lower average probability of paper completion and lower mean grade points. Gender also matters; females tended to outperform their male university counterparts. Part-time status was found to have an adverse impact on study outcomes. Young school leavers (under than 18 years of age) and mature students (aged 26 and above) were more likely to succeed at university compared to students aged 18. Furthermore, pre-university educational background plays a crucial role in explaining students' performance at university. Every 100-point increase in the NCEA rank score dramatically decreased the probability of paper non-completion by more than 40% and increased average grade point by more than 1 point, for those students who had a valid NCEA rank score. However, attending high schools in the top deciles does not necessarily lead to better achievement at university and nor does attending the lowest decile secondary schools. Students who enter university through 'Internal' or 'Special admissions' are more likely not to complete their papers, and to receive lower grade points on average. Moreover, compared to studying a paper for a BBus degree, undertaking a paper from BCS, BDes, BEdu, or a double degree significantly improved the probability of paper completion in this study. Also, students who were studying at higher paper levels tended to do better than those studying at the most common level for first-year students.

Decomposition outcomes reported how much of the existing ethnic gaps could be explained by particular sets of factors. In subsample 1, 9.96 percentage points (or 21.36 percentage points) of the lower course completion for Maori (or Pasifika) students relative to European students could be explained by some of measurable differences between these ethnic groups at the time they entered the university. In particular, differences in NCEA performance accounted for about 12% of the overall gap of 9.96 percentage points in paper completion probability between Maori and European, while if we gave Pasifika students the same school decile distributions of European students, this would explain 8.52% of the Pasifika/European overall gap of 21.36 percentage points in paper completion probability. The difference in paper completion between Asian and European students was relatively small (5.91 percentage points) and it was mainly explained by differences in gender, age, NCEA result, and programme enrolment. If we gave Maori, or Pasifika, or Asian students the same observed covariates as European students, this could account for 22.39%, or about 27%, or 48.88% of

the observed differences, respectively, in successful paper completion. These factors offered similar predictive power in subsample 3. Combined differences in NCEA, entrance type, and programme enrolment could explain 19.26% of the Maori/European overall gap of 14.29 percentage points in probability of paper completion, while having the same NCEA rank score, school decile, and programme enrolment accounted for 20.67% of the Pasifika/European overall gap of 25.16 percentage points. Being female and differences in degree programmes accounted for 10.74% and 21.98%, respectively, of the Asian/European gap in paper completion, and NCEA performance alone could explain more than 30% of the difference in these two groups of students. Finally, in subsample 3, slightly more than four-fifths, more than three-quarters and about a half of observed Maori/European, Pasifika/European and Asian/European differences in paper completion, respectively, could not be accounted for by the covariates used in this regression analysis.

The differences in grade points in our subsample 1 yielded grade point gaps for Maori/European, Pasifika/European, and Asian/European of 0.80, 1.89, and 0.98 points, respectively. NCEA continued to be a significant single factor in explaining the differentials in grade points between the minority ethnic groups and European students. It could explain 15.23% of the Pasifika/European gap in mean grade points; in other words, if Pasifika students had the same NCEA rank scores as European students, on average, this would eliminate 15.23% of the overall Pasifika/European gap of 1.89 grade points. Likewise, if both Pasifika and European students entered university via the same entrance types this would reduce the grade point gap between these two groups by 3.42%. Taking all the covariates into account, we could explain approximately 26% of the overall Pasifika/European gap in grade point. In subsample 3, NCEA outcome seemed even more important for Pasifika students because it could explain more than 14% of the overall grade point difference relative to Europeans. Because most of the Asian students in our subsamples attended overseas high schools, school decile was less important for them. However, NCEA results and programme enrolment explained the major part of the difference in grade points. If Asian students had joined the same degree programmes as Europeans, this would increase the grade point by 0.15 point and narrow the mean Asian/European gap by 14.61%. Adjusting Asian students' NCEA rank score levels to the levels of Europeans would decrease the gap by 21.86%. However, if we gave Asian students the same covariates as Europeans, we could only explain just over 35% of the overall Asian/European differences in grade point. In other words, more

than three-fifths of the observed Asian/European gap in grade points could not be accounted for by the covariates. All of the factors, differences in NCEA outcomes were always relevant and necessary in explaining the differences in academic performance at university. Other factors such as school decile and entrance type seemed to be relatively important for Maori and Pasifika, while programme enrolment was particularly important for Asian and Pasifika students.

As already stated in the literature review, the family environment has been found to significantly influence the probability of university success for students in previous studies. Specifically, the mother's level of schooling is more important in relation to their children's college success, whereas the father's profession is more important to students' success than the occupation of the mother (Ortiz & Dehon, 2008). A healthy family environment might mean that parents provide sufficient financial resources to support their children's studies so that they do not need to borrow excessive amounts or work long hours while studying. Pantages and Creedon (1978) claim that university students who work more than 15 hours a week are more likely to have poor college outcomes, as will married students (Jia & Maloney, 2014). The absence of this kind of information in the dataset may have disadvantaged our study by either overstating or understating the importance of the covariates used. Some of the ethnic gaps in academic performance that could not be explained in this study could possibly be captured by a more complete set of covariates on family histories and circumstances. However, this problem could be eliminated by the use of Integrated Data Infrastructure (IDI) in future analyses. Our dataset could also be improved by adding NCEA information to more observations. Therefore, further research should be conducted to examine the first-year academic gaps between different ethnicities of students by adding data on parents' backgrounds and students' employment and marital status. Once these further factors are included in the analyses, we will be able to see whether or not NCEA is still the largest single explanatory variable in accounting for ethnic differences in academic performance in the first year at university. Apart from these unavoidable limitations, our empirical results will help readers to better understand the determinants associated with successful paper completion and grade point outcomes. These findings may also be useful to government policymakers and university administrators in considering possible strategies or interventions to close the substantial prevailing ethnic gaps in academic outcomes at university.

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Appendix:

Table 1. Variable Definitions

Variable	Definition
Dependent variable	
Successful completion	1 if paper was successfully completed
Grade points	From 0 to 9
Year of Enrolment	
Year 2012	The omitted category for student who enrolled in the year 2012
Year 2013	1 if student enrolled in the year 2013
Year 2014	1 if student enrolled in the year 2014
Year 2015	1 if student enrolled in the year 2015
Ethnicity	
Maori	1 if student reported Maori under ethnicity
Pasifika	1 if student reported Pasifika under ethnicity
Asian	1 if student reported Asian under ethnicity
European	The omitted category for those student who reported European under ethnicity
Others	1 if student reported none of the above ethnicities
Female	1 if student was female
Part-Time Enrolment	1 if student was enrolled as part-time
Age	
Age Under 18	1 if student was under aged 18
Age 18	The omitted category for student who was aged 18
Age 19	1 if student was aged 19
Age 20	1 if student was aged 20
Age 21	1 if student was aged 21
Age 22	1 if student was aged 22
Age 23	1 if student was aged 23
Age 24	1 if student was aged 24
Age 25	1 if student was aged 25
Age 26 to 29	1 if student was between aged 26 to 29
Age 30 to 39	1 if student was between aged 30 to 39
Age 40 and above	1 if student was aged 40 and above
NCEA Result	
Valid NCEA Score	1 if student's NCEA score was reported
NCEA Rank Score	Student's NCEA rank score (conditional on one's score was reported)
School Decile	
School Decile 1	1 if school decile was 1
School Decile 2	1 if school decile was 2
School Decile 3	1 if school decile was 3
School Decile 4	1 if school decile was 4
School Decile 5	The omitted category of school decile was decile 5
School Decile 6	1 if school decile was 6
School Decile 7	1 if school decile was 7
School Decile 8	1 if school decile was 8

School Decile 9	1 if school decile was 9
School Decile 10	1 if school decile was 10
School Decile Unknown	1 if school decile for a student was unknown
Entrance type	
External	1 if student held an equivalent pre-degree from other New Zealand universities
Internal	1 if student held a pre-degree from AUT University
Bursary	1 if student's entrance type was Bursary
NCEA Level 3	The omitted category for student's entrance type was NCEA Level 3
Other Entrance Type	1 if student's entrance type was not reported
Special Admission	1 if student's entrance type was special admission
Programme Enrolled	
BA	1 if student enrolled in Bachelor of Arts
BBus	The omitted category for student enrolled in Bachelor of Business
BCIS	1 if student enrolled in Bachelor of Computer Information Science
BCS	1 if student enrolled in Bachelor of Communication Studies
BDes	1 if student enrolled in Bachelor of Design
BEdu	1 if student enrolled in Bachelor of Education
BEngTech	1 if student enrolled in Bachelor of Engineering Technology
BHS	1 if student enrolled in Bachelor of Health Science
BIHM	1 if student enrolled in Bachelor of International Hospitality Management
BSR	1 if student enrolled in Bachelor of Sports and Recreation
Others	1 if student enrolled in other Bachelor programmes
Double Degree	1 if student enrolled in double degree
Paper Level	
Level 4	1 if student took a level 4 paper
Level 5	The Omitted category for those students took level 5 paper
Level 6	1 if student took a level 6 paper
Level 7	1 if student took a level 7 paper

Table 2. Descriptive Statistics on Academic Outcomes Using Official Ethnicity Designations

Student Ethnicity	Successful Paper Completion	Grade Points[1]
Maori	0.7545 *n*=18,979 (10.47%)	3.659 *n*=17,832 (10.30%)
Pasifika	0.6404 *n*=27,356 (15.09%)	2.577 *n*=25,819 (14.92%)
Asian	0.7949 *n*=51,352 (28.33%)	3.479 *n*=49,821 (28.79%)
European	0.8540 *n*=69,211 (38.18%)	4.463 *n*=65,805 (38.02%)
Others	0.7572 *n*=14,379 (7.93%)	3.230 *n*=13,802 (7.97%)
Total	**0.7870** **N=181,277** **(100.00%)**	**3.717** **N=173,079** **(100.00%)**

Notes:
n equals sample size, figures in parenthesis ('()') indicates the percentage of the overall sample.
[1.] Grade letter codes are converted into their usual grade points, such as A+=9, A=8, A-=7, B+=6, B=5, B-=4, C+=3, C=2, C-+1 and D or other failed grades=0. Also, some paper observations have to be excluded from this analysis because these paper outcomes do not translate into a letter grade or conventional grade point (e.g., a 'pass' grade received on a paper taken on 'pass/fail' basis). As a result, the number of valid observations in this sample for grade points is reduced to 173,079 (95.5% of the sample with paper completion outcomes).

Table 3. Descriptive Statistics on Academic Outcomes Using All Self-Reported Ethnicity Information[1]

Student Ethnicity	Successful Paper Completion	Grade Points
Maori	0.7545 *n*=18,979 (8.99%)	3.659 *n*=17,832 (8.85%)
Pasifika	0.6480 *n*=30,609 (14.49%)	2.639 *n*=28,893 (14.34%)
Asian	0.7875 *n*=57,495 (27.23%)	3.437 *n*=55,737 (27.67%)
European	0.8390 *n*=87,335 (41.36%)	4.324 *n*=82,940 (41.17%)
Others	0.7569 *n*=16,765 (7.94%)	3.259 *n*=16,057 (7.97%)
Total	**0.7870** **N=211,183** **(100.00%)**	**3.717** **N=201,459** **(100.00%)**

Notes:
n equals sample size, figures in parenthesis ('()') indicates the percentage of the overall sample.
[1.] The same paper observation can appear in multiple rows if students report more than one ethnicity. A maximum of three ethnicities can be recorded.

Table 4. Descriptive Statistics on Academic Outcomes Using Students Reporting Only a Single Ethnicity

Student Ethnicity	Successful Paper Completion	Grade Points[1]
Maori	0.7110 *n*=6,574 (4.54%)	3.447 *n*=6,124 (4.42%)
Pasifika	0.6022 *n*=16,297 (11.25%)	2.306 *n*=15,344 (11.08%)
Asian	0.7945 *n*=46,733 (32.27%)	3.460 *n*=45,364 (32.77%)
European	0.8538 *n*=62,419 (43.10%)	4.456 *n*=59,320 (42.85%)
Others	0.7450 *n*=12,793 (8.83%)	3.091 *n*=12,294 (8.88%)
Total	**0.7903** **N=144,816** **(100.00%)**	**3.726** **N=138,446** **(100.00%)**

Notes:
n equals sample size, figures in parenthesis ('()') indicates the percentage of the overall sample.
1. This separate sample of paper outcomes will be used in our regression and pairwise decomposition analysis.

Table 5. Descriptive Statistics for Official Ethnicity Designations

Variables	All Ethnicities	Maori	Pasifika	Asian	European	Others
Dependent Variables						
Successful Competition	0.7870	0.7545	0.6404	0.7949	0.8540	0.7572
Grade Points	3.717	3.659	2.577	3.479	4.463	3.230
Year of Enrolment						
Year 2012	0.2233	0.2184	0.1983	0.2187	0.2314	0.2550
Year 2013	0.2527	0.2402	0.2456	0.2529	0.2545	0.2736
Year 2014	0.2662	0.2656	0.2778	0.2668	0.2646	0.2506
Year 2015	0.2578	0.2758	0.2783	0.2616	0.2495	0.2208
Ethnicity[1]						
Maori	0.1047	(1.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pasifika	0.1509	(0.1811)	(1.000)	(0.000)	(0.000)	(0.000)
Asian	0.2833	(0.0208)	(0.1807)	(1.000)	(0.0146)	(0.0059)
European	0.3818	(0.5822)	(0.1770)	(0.0391)	(1.000)	(0.1190)
Others	0.0793	(0.0219)	(0.0148)	(0.0220)	(0.0097)	(1.000)
Female	0.5964	0.6816	0.6638	0.5042	0.6234	0.5547
Part-Time Enrolment	0.0849	0.0812	0.0990	0.0916	0.0742	0.0910
Age						
Age Under 18	0.0048	0.0038	0.0016	0.0065	0.0052	0.0036
Age 18	0.2269	0.2805	0.1804	0.1632	0.2969	0.1352
Age 19	0.2180	0.2189	0.2203	0.2103	0.2296	0.1849
Age 20	0.1478	0.1226	0.1692	0.1701	0.1266	0.1629
Age 21	0.1039	0.0757	0.1089	0.1340	0.0827	0.1262
Age 22	0.0674	0.0519	0.0738	0.0862	0.0523	0.0814
Age 23	0.0479	0.0396	0.0481	0.0633	0.0368	0.0562
Age 24	0.0334	0.0300	0.0325	0.0419	0.0254	0.0478
Age 25	0.0240	0.0229	0.0240	0.0278	0.0191	0.0360
Age 26 to 29	0.0544	0.0588	0.0592	0.0530	0.0480	0.0759
Age 30 to 39	0.0487	0.0629	0.0598	0.0338	0.0479	0.0656
Age 40 and above	0.0228	0.0325	0.0222	0.0100	0.0295	0.0243
NCEA Result						
Valid NCEA Score	0.4825	0.5284	0.4913	0.4109	0.5395	0.3867
NCEA Rank Score[2]	174.5	174.0	150.1	161.3	193.7	156.4
School Decile						
School Decile 1	0.0395	0.0588	0.1781	0.0125	0.0042	0.0161
School Decile 2	0.0399	0.0917	0.1014	0.0254	0.0159	0.0214
School Decile 3	0.0651	0.0752	0.1439	0.0774	0.0236	0.0578
School Decile 4	0.0970	0.1050	0.1290	0.1155	0.0621	0.1279
School Decile 5	0.0554	0.1051	0.0658	0.0321	0.0591	0.0355
School Decile 6	0.0614	0.0816	0.0406	0.0401	0.0827	0.0473
School Decile 7	0.0853	0.0834	0.0680	0.0835	0.0958	0.0764
School Decile 8	0.0814	0.0766	0.0473	0.0646	0.1113	0.0689
School Decile 9	0.1224	0.1226	0.0567	0.0952	0.1721	0.1048
School Decile 10	0.2018	0.1270	0.0485	0.1909	0.2957	0.1794
School Decile Unknown	0.1508	0.0731	0.1207	0.2627	0.0774	0.2645
Entrance Type						
External	0.1398	0.0958	0.1142	0.2276	0.0897	0.1738
Internal	0.1205	0.0764	0.1724	0.1758	0.0631	0.1584
Bursary	0.0342	0.0286	0.0102	0.0352	0.0492	0.0116
NCEA level 3	0.5320	0.5768	0.4905	0.4375	0.6284	0.4259
Other Entrance Type	0.0123	0.0091	0.0109	0.0160	0.0106	0.0123
Special Admissions	0.1612	0.2132	0.2019	0.1076	0.1590	0.2180
Programme Enrolled						
BA	0.1162	0.1661	0.1695	0.0763	0.1115	0.1141

BBus	0.2247	0.1889	0.2230	0.2950	0.1821	0.2284
BCIS	0.0708	0.0242	0.0621	0.1227	0.0498	0.0651
BCS	0.0619	0.0795	0.0372	0.0214	0.1028	0.0341
BDes	0.0497	0.0395	0.0265	0.0551	0.0627	0.0260
BEdu	0.0442	0.0486	0.0251	0.0173	0.0709	0.0426
BEngTech	0.0538	0.0244	0.0424	0.0853	0.0292	0.1204
BHS	0.1946	0.2206	0.1780	0.1352	0.2365	0.2031
BIHM	0.0367	0.0199	0.0261	0.0684	0.0249	0.0231
BSR	0.0632	0.0965	0.0686	0.0192	0.0890	0.0414
Others	0.0982	0.1047	0.1452	0.1106	0.0665	0.1082
Double Degree	0.0144	0.0131	0.0038	0.0071	0.0259	0.0065
Paper Level						
Level 4 paper	0.0038	0.0023	0.0029	0.0055	0.0026	0.0068
Level 5 Paper	0.7354	0.7467	0.7452	0.7189	0.7483	0.6988
Level 6 Paper	0.2394	0.2307	0.2323	0.2483	0.2324	0.2666
Level 7 Paper	0.0214	0.0202	0.0196	0.0272	0.0167	0.0278
Number of Observations	**181,277**	**18,979**	**27,356**	**51,352**	**69,211**	**14,379**

Note:

[1.] Values in parenthesis in this section indicate the proportions of students who also reported themselves as another ethnicity (e.g., 18.11% of students officially defined as Maori also reported themselves as Pasifika).

[2.] The number of observation with valid NCEA Rank Score was 87,465. These means are computed for those with a valid NCEA score.

Table 6. Descriptive Statistics for Single Ethnicity Identifications

Variables	All Ethnicities	Maori	Pasifika	Asian	European	Others
Dependent Variables						
Successful Competition	0.7903	0.7110	0.6022	0.7945	0.8538	0.7450
Grade Points	3.726	3.447	2.306	3.460	4.456	3.091
Year of Enrolment						
Year 2012	0.2247	0.2102	0.2024	0.2179	0.2315	0.2511
Year 2013	0.2551	0.2492	0.2456	0.2548	0.2551	0.2712
Year 2014	0.2649	0.2671	0.2738	0.2672	0.2631	0.2531
Year 2015	0.2553	0.2735	0.2781	0.2601	0.2502	0.2246
Ethnicity						
Maori	0.0454	(1.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pasifika	0.1125	(0.000)	(1.000)	(0.000)	(0.000)	(0.000)
Asian	0.3227	(0.000)	(0.000)	(1.000)	(0.000)	(0.000)
European	0.4310	(0.000)	(0.000)	(0.000)	(1.000)	(0.000)
Others	0.0884	(0.000)	(0.000)	(0.000)	(0.000)	(1.000)
Female	0.5892	0.6772	0.6991	0.5012	0.6259	0.5462
Part-Time Enrolment	0.0870	0.0923	0.1052	0.0933	0.0759	0.0918
Age						
Age Under 18	0.0050	0.0050	0.0014	0.0068	0.0049	0.0041
Age 18	0.2180	0.2381	0.1533	0.1542	0.2992	0.1272
Age 19	0.2132	0.2219	0.2010	0.2050	0.2288	0.1781
Age 20	0.1481	0.1200	0.1687	0.1718	0.1245	0.1642
Age 21	0.1064	0.0700	0.1163	0.1366	0.0806	0.1276
Age 22	0.0696	0.0453	0.0825	0.0897	0.0510	0.0833
Age 23	0.0492	0.0329	0.0493	0.0650	0.0373	0.0578
Age 24	0.0339	0.0284	0.0347	0.0427	0.0246	0.0491
Age 25	0.0249	0.0243	0.0278	0.0282	0.0193	0.0374
Age 26 to 29	0.0559	0.0680	0.0638	0.0541	0.0489	0.0799
Age 30 to 39	0.0520	0.0961	0.0739	0.0356	0.0505	0.0689
Age 40 and above	0.0238	0.0499	0.0272	0.0102	0.0305	0.0224
NCEA Result						
Valid NCEA Score	0.4695	0.4980	0.4453	0.4003	0.5421	0.3847
NCEA Rank Score[1]	174.5	165.8	142.8	159.6	193.8	150.9
School Decile						
School Decile 1	0.0384	0.0808	0.2409	0.0130	0.0044	0.0176
School Decile 2	0.0339	0.1123	0.1076	0.0244	0.0163	0.0206
School Decile 3	0.0586	0.0891	0.1261	0.0763	0.0235	0.0638
School Decile 4	0.0952	0.1040	0.1254	0.1173	0.0610	0.1379
School Decile 5	0.0510	0.1225	0.0638	0.0319	0.0591	0.0282
School Decile 6	0.0594	0.0786	0.0352	0.0372	0.0830	0.0468
School Decile 7	0.0840	0.0625	0.0548	0.0836	0.0957	0.0764
School Decile 8	0.0813	0.0657	0.0384	0.0624	0.1108	0.0688
School Decile 9	0.1221	0.1080	0.0412	0.0926	0.1710	0.1018
School Decile 10	0.2089	0.0881	0.0213	0.1817	0.2998	0.1657
School Decile Unknown	0.1672	0.0884	0.1454	0.2795	0.0755	0.2724
Entrance Type						
External	0.1516	0.1173	0.1340	0.2390	0.0899	0.1726
Internal	0.1235	0.0785	0.1760	0.1813	0.0629	0.1638
Bursary	0.0343	0.0181	0.0090	0.0337	0.0482	0.0095
NCEA Level 3	0.5182	0.5335	0.4509	0.4232	0.6264	0.4157
Other Entrance Type	0.0127	0.0026	0.0125	0.0165	0.0110	0.0122
Special Admissions	0.1597	0.2501	0.2176	0.1061	0.1616	0.2262
Programme Enrolled						
BA	0.1100	0.1903	0.1934	0.0698	0.1096	0.1111

BBus	0.2291	0.1920	0.2124	0.3007	0.1834	0.2306
BCIS	0.0761	0.0230	0.0624	0.1262	0.0504	0.0630
BCS	0.0583	0.0570	0.0300	0.0184	0.1024	0.0258
BDes	0.0494	0.0271	0.0220	0.0514	0.0631	0.0210
BEdu	0.0442	0.0304	0.0223	0.0175	0.0720	0.0414
BEngTech	0.0583	0.0186	0.0390	0.0888	0.0297	0.1313
BHS	0.1919	0.2256	0.1636	0.1355	0.2363	0.2004
BIHM	0.0382	0.0186	0.0261	0.0685	0.0239	0.0231
BSR	0.0617	0.1021	0.0741	0.0181	0.0909	0.0417
Others	0.0976	0.1298	0.1584	0.1114	0.0645	0.1146
Double Degree	0.0150	0.0143	0.0037	0.0068	0.0264	0.0041
Paper Level						
Level 4 paper	0.0041	0.0023	0.0030	0.0058	0.0026	0.0073
Level 5 Paper	0.7336	0.7399	0.7452	0.7169	0.7496	0.6991
Level 6 Paper	0.2402	0.2323	0.2312	0.2495	0.2312	0.2652
Level 7 Paper	0.0221	0.0256	0.0206	0.0278	0.0166	0.0284
Number of Observations	**144,816**	**6,574**	**16,297**	**46,733**	**62,419**	**12,793**

Notes:

[1.] The Number of observation with valid NCEA Rank Score was 67,995.

Table 7. Probit Results on Successful Paper Completions

Variables	Official Ethnicity Designations			Restricted to Students Reporting a Single Ethnicity		
	Coefficient	Standard Error	Marginal Effects	Coefficient	Standard Error	Marginal Effects
Constant	0.6952***	0.0223	-	0.6734***	0.0254	-
Year of Enrolment						
Year 2013	-0.0284***	0.0103	-0.0076***	-0.0302***	0.0115	-0.0079***
Year 2014	-0.0472***	0.0105	-0.0126***	-0.0414***	0.0118	-0.0109***
Year 2015	-0.0229**	0.0110	-0.0061**	-0.0147	0.0123	-0.0039
Ethnicity						
Maori	-0.2774***	0.0122	-0.0739***	-0.3865***	0.0104	-0.1016***
Pasifika	-0.4874***	0.0113	-0.1299***	-0.5924***	0.0185	-0.1557***
Asian	-0.1081***	0.0097	-0.0288***	-0.1159***	0.0140	-0.0305***
Others	-0.2305***	0.0136	-0.0614***	-0.2621***	0.0144	-0.0689***
Female	0.1257***	0.0079	0.0335***	0.1517***	0.0089	0.0399***
Part-Time Enrolment	-0.1624***	0.0119	-0.0433***	-0.1589***	0.0133	-0.0418***
Age						
Age Under 18	0.2014***	0.0580	0.0537***	0.2653***	0.0646	0.0697***
Age 19	-0.0270***	0.0113	-0.0072***	-0.0155	0.0129	-0.0041
Age 20	-0.0592***	0.0132	-0.0158***	-0.0602***	0.0150	-0.0158***
Age 21	-0.0771***	0.0155	-0.0206***	-0.0669***	0.0173	-0.0176***
Age 22	-0.0664***	0.0181	-0.0177***	-0.0545***	0.0203	-0.0143***
Age 23	-0.0076	0.0204	-0.0020	-0.0033	0.0227	-0.0009
Age 24	0.0181	0.0229	0.0048	0.0138	0.0255	0.0036
Age 25	0.0198	0.0255	0.0053	0.0048	0.0282	0.0013
Age 26 to 29	0.0761***	0.0203	0.0203***	0.0870***	0.0228	0.0229***
Age 30 to 39	0.1276***	0.0217	0.0340***	0.1536***	0.0240	0.0404***
Age 40 and above	0.0831***	0.0276	0.0222***	0.0567*	0.0304	0.0149*
NCEA Result						
Valid NCEA Score	-0.6263***	0.0167	-0.1669***	-0.5998***	0.0189	-0.1576***
NCEA Rank Score[1]	0.4337***	0.0097	0.1156***	0.4117***	0.0110	0.1082***
School Decile						
School Decile 1	-0.2786***	0.0215	-0.0743***	-0.1968***	0.0252	-0.0517***
School Decile 2	-0.0413*	0.0217	-0.0110*	0.0006	0.0261	0.0002
School Decile 3	-0.0073	0.0195	-0.0020	0.0254	0.0230	0.0067
School Decile 4	0.0106	0.0181	0.0028	0.0172	0.0210	0.0045
School Decile 6	0.1056***	0.0205	0.0281***	0.1075***	0.0238	0.0282***
School Decile 7	0.0691***	0.0189	0.0184***	0.0865***	0.0219	0.0227***
School Decile 8	-0.0199	0.0190	-0.0053	-0.0324	0.0219	-0.0085
School Decile 9	0.0335*	0.0178	0.0089*	0.0290	0.0206	0.0076
School Decile 10	0.0208	0.0168	0.0055	0.0314	0.0195	0.0082
School Decile Unknown	0.2054***	0.0181	0.0547***	0.2347***	0.0207	0.0617***
Entrance Type						
External	0.0071	0.0132	0.0019	0.0054	0.0147	0.0014
Internal	0.0565***	0.0121	0.0151***	0.0227*	0.0136	0.0060*
Bursary	0.2978***	0.0233	0.0794***	0.2823***	0.0262	0.0742***
Other Entrance Type	0.0739**	0.0337	0.0197**	0.0136	0.0370	0.0036
Special Admissions	-0.2035***	0.0127	-0.0542***	-0.2303***	0.0143	-0.0605***
Programme Enrolled						
BA	0.0735***	0.0123	0.0196***	0.0851***	0.0141	0.0224***
BCIS	0.0811***	0.0143	0.0216***	0.0882***	0.0156	0.0232***
BCS	0.4577***	0.0198	0.1220***	0.4588***	0.0231	0.1206***
BDes	0.4441***	0.0203	0.1184***	0.4494***	0.0230	0.1181***
BEdu	0.6064***	0.0211	0.1616***	0.6093***	0.0240	0.1601***

BEngTech	0.0265	0.0162	0.0071	0.0401**	0.0176	0.0105**
BHS	0.2731***	0.0113	0.0728***	0.2701***	0.0128	0.0710***
BIHM	0.3410***	0.0205	0.0909***	0.3654***	0.0228	0.0960***
BSR	0.0119	0.0154	0.0032	0.0217	0.0176	0.0057
Others	0.1045***	0.0128	0.0279***	0.1035***	0.0143	0.0272***
Double Degree	0.5613***	0.0432	0.1496***	0.5315***	0.0467	0.1397***
Paper Level						
Level 4 paper	-0.0514	0.0528	-0.0137	-0.0470	0.0570	-0.0123
Level 6 Paper	0.1442***	0.0085	0.0384***	0.1541***	0.0096	0.0405***
Level 7 Paper	0.3102***	0.0254	0.0827***	0.3239***	0.0282	0.0851***
N		**181,277**			**144,816**	
Number of covariates		**51**			**51**	
Pseudo-R^2 Statistic		**0.0807**			**0.0851**	
Log Pseudo-likelihood		**-93893.305**			**-74375.641**	

Notes:

1. The original NCEA score is divided by 100 to make the interpretation of the parameter estimates easier.

* denotes significance at 10% level

** denotes significance at 5% level

*** denotes significance at 1% level

Table 8. Regression Results on Grade Points

Variables	Official Ethnicity Designations		Restricted to Students Reporting a Single Ethnicity	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	3.1935***	0.0381	3.1786***	0.0431
Year of Enrolment				
Year 2013	-0.0542***	0.0175	-0.0504	0.0194
Year 2014	0.0193	0.0178	0.0461**	0.0198
Year 2015	0.1229***	0.0184	0.1473***	0.0204
Ethnicity				
Maori	-0.5959***	0.0212	-0.7914***	0.0335
Pasifika	-1.3551***	0.0203	-1.6846***	0.0257
Asian	-0.6238***	0.0161	-0.6581***	0.0172
Others	-0.9138***	0.0236	-1.0413***	0.0252
Female	0.3003***	0.0136	0.3365***	0.0152
Part-Time Enrolment	-0.2115***	0.0218	-0.2004***	0.0240
Age				
Age Under 18	0.3013***	0.0867	0.3046***	0.0935
Age 19	0.0134	0.0184	0.0100	0.0208
Age 20	0.0279	0.0224	0.0237	0.0250
Age 21	0.0646**	0.0266	0.0781***	0.0294
Age 22	0.1444***	0.0315	0.1436***	0.0347
Age 23	0.3370***	0.0352	0.3129***	0.0387
Age 24	0.4716***	0.0398	0.4365***	0.0439
Age 25	0.5868***	0.0446	0.5529***	0.0489
Age 26 to 29	0.7578***	0.0346	0.8263***	0.0382
Age 30 to 39	1.0314***	0.0364	1.0555***	0.0397
Age 40 and above	1.0163***	0.0469	0.9786***	0.0515
NCEA Result				
Valid NCEA Score	-1.8946***	0.0290	-1.8469***	0.0324
NCEA Rank Score	1.1736***	0.0153	1.1301***	0.0172
School Decile				
School Decile 1	-0.6752***	0.0401	-0.4299***	0.0466
School Decile 2	-0.0776**	0.0389	0.0623	0.0464
School Decile 3	-0.0343	0.0343	0.0525	0.0400
School Decile 4	0.0106	0.0315	0.0193	0.0362
School Decile 6	0.2436***	0.0345	0.2392***	0.0396
School Decile 7	0.0844***	0.0322	0.1009***	0.0369
School Decile 8	0.0073	0.0326	-0.0161	0.0372
School Decile 9	-0.0056	0.0303	0.0002	0.0347
School Decile 10	-0.0380	0.0287	-0.0219	0.0328
School Decile Unknown	0.2659***	0.0312	0.3191***	0.0354
Entrance Type				
External	0.0753***	0.0231	0.0569**	0.0255
Internal	-0.1055***	0.0215	-0.1298***	0.0239
Bursary	0.7981***	0.0363	0.7593***	0.0404
Other Entrance Type	0.3113***	0.0568	0.2373***	0.0622
Special Admissions	-0.4481***	0.0227	-0.4890***	0.0254
Programme Enrolled				
BA	0.7217***	0.0223	0.7419***	0.0253
BCIS	0.5153***	0.0260	0.5312***	0.0281
BCS	0.1820***	0.0284	0.1243***	0.0325
BDes	0.9938***	0.0299	0.9496***	0.0334
BEdu	1.7842***	0.0325	1.7485***	0.0362
BEngTech	0.2176***	0.0293	0.2347***	0.0316

BHS	0.9696***	0.0194	0.9541***	0.0216
BIHM	0.8033***	0.0332	0.7842***	0.0362
BSR	0.1735***	0.0276	0.1602***	0.0311
Others	0.6066***	0.0227	0.5902***	0.0253
Double Degree	1.2874***	0.0503	1.2524***	0.0551
Paper Level				
Level 4 paper	0.3826***	0.0974	0.3856***	0.1044
Level 6 Paper	0.1246***	0.0144	0.1258***	0.0159
Level 7 Paper	0.2744***	0.0408	0.2694***	0.0447
N	**173,079**		**138,446**	
Number of covariates	**51**		**51**	
Adjusted R^2	**0.1667**		**0.1737**	

Notes:

* denotes significance at 10% level

** denotes significance at 5% level

*** denotes significance at 1% level

Table 9. Decomposition of Ethnic Gaps in Successful Paper Outcomes Using Official Ethnicity Designations

	Maori vs. European	Pasifika vs. European	Asian vs. European
Actual Ethnic Differences	0.0996	0.2136	0.0591
Explained Ethnic Differences [1]			
Year of Enrolment	0.0003*** (0.0001) [0.32%]	0.0003** (0.0001) [0.16%]	0.0002*** (0.0001) [0.34%]
Female	-0.0014*** (0.0001) [-1.43%]	-0.0011*** (0.0001) [-0.53%]	0.0061*** (0.0004) [10.34%]
Part Time Enrolment	0.0008*** (0.0001) [0.82%]	0.0016*** (0.0001) [0.76%]	0.0007*** (0.0001) [1.16%]
Age	-0.0005*** (0.0001) [-0.48%]	0.0013*** (0.0003) [0.62%]	0.0040*** (0.0005) [6.69%]
NCEA	0.0119*** (0.0004) [11.94%]	0.0197*** (0.0006) [9.23%]	0.0175*** (0.0006) [29.66%]
School Decile	0.0057*** (0.0011) [5.68%]	0.0182*** (0.0018) [8.52%]	-0.0074*** (0.0007) [-12.54%]
Entrance Type	0.0038*** (0.0003) [3.85%]	0.0028*** (0.0006) [1.33%]	-0.0037*** (0.0006) [-6.26%]
Programme Enrolled	0.0025*** (0.0004) [2.47%]	0.0151*** (0.0005) [7.06%]	0.0131*** (0.0008) [22.13%]
Paper Level	-0.0008*** (0.0001) [-0.80%]	-0.0005*** (0.0000) [-0.22%]	-0.0016*** (0.0001) [-2.63%]
Total Difference Explained	0.0223 [22.39%]	0.0575 [26.92%]	0.0289 [48.88%]
Number of Replications	100	100	100

Notes:

All decompositions use pooled coefficient estimates from the whole sample and include dummies for Maori and European, Pasifika and European, Asian and European in the logit regressions. Other dummies for the general factors are included in these regressions; there are 51 covariates in total.

[1.] Standard errors associated with these individual or groups of variables are listed in parentheses ('()') below these estimated effects. Percentage changes in the actual ethnic differences associated with these individual or groups of variables are shown in square brackets ('[]').

* Statistically significantly different than 0 at P<0.1 using a two-tailed t-test.

****** Statistically significantly different than 0 at *P*<0.05 using a two-tailed *t*-test.

*** Statistically significantly different than 0 at *P*<0.01 using a two-tailed *t*-test.

Table 10. Decomposition of Ethnic Gaps in Successful Paper Outcomes Using Single Ethnicity Identifications

	Maori vs. European	Pasifika vs. European	Asian vs. European
Actual Ethnic Difference	0.1429	0.2516	0.0593
Explained Ethnic Differences			
Year of Enrolment	0.0005*** (0.0001) [0.36%]	0.0003** (0.0002) [0.12%]	0.0001* (0.0001) [0.24%]
Female	-0.0014*** (0.0001) [-1.01%]	-0.0028*** (0.0002) [-1.09%]	0.0064*** (0.0004) [10.74%]
Part Time Enrolment	0.0012*** (0.0001) [0.87%]	0.0018*** (0.0002) [0.70%]	0.0007*** (0.0001) [1.10%]
Age	-0.0021*** (0.0003) [-1.47%]	0.0003 (0.0004) [0.12%]	0.0041*** (0.0005) [6.95%]
NCEA	0.0144*** (0.0005) [10.08%]	0.0208*** (0.0008) [8.28%]	0.0184*** (0.0007) [30.97%]
School Decile	0.0023 (0.0017) [1.62%]	0.0136*** (0.0024) [5.41%]	-0.0086*** (0.0008) [-14.43%]
Entrance Type	0.0064*** (0.0005) [4.48%]	0.0044*** (0.0007) [1.75%]	-0.0035*** (0.0007) [-5.98%]
Programme Enrolled	0.0067*** (0.0006) [4.70%]	0.0176*** (0.0007) [6.98%]	0.0130*** (0.0009) [21.98%]
Paper Level	-0.0013*** (0.0001) [-0.92%]	-0.0004*** (0.0001) [-0.16%]	-0.0018*** (0.0001) [-3.04%]
Total Difference Explained	0.0268 [18.78%]	0.0556 [22.10%]	0.0288 [48.58%]
Number of Replications	100	100	100

Notes.
* Statistically significantly different than 0 at P<0.1 using a two-tailed t-test.
****** Statistically significantly different than 0 at *P*<0.05 using a two-tailed *t*-test.
*** Statistically significantly different than 0 at *P*<0.01 using a two-tailed *t*-test.

Table 11. Decomposition of Ethnic Gaps in Grade Points Using Official Ethnicity Designations

	Maori vs. European	Pasifika vs. European	Asian vs. European
Actual Ethnic differences	0.8034***	1.885***	0.9837***
	(0.0225)	(0.0185)	(0.0154)
Explained Ethnic Differences [1]			
Year of Enrolment	-0.0034***	-0.0026***	-0.0023***
	(0.0008)	(0.0010)	(0.0006)
	[-0.42%]	[-0.14%]	[-0.23%]
Female	-0.0235***	-0.0142***	0.0482***
	(0.0020)	(0.0014)	(0.0023)
	[-2.93%]	[-0.75%]	[4.90%]
Part Time Enrolment	0.0018***	0.0079***	0.0037***
	(0.0007)	(0.0011)	(0.0006)
	[0.22%]	[0.42%]	[0.38%]
Age	-0.0399***	-0.0564***	0.0031
	(0.0041)	(0.0048)	(0.0046)
	[-4.97%]	[-2.99%]	[0.32%]
NCEA	0.1392***	0.2871***	0.2094***
	(0.0055)	(0.0062)	(0.0058)
	[17.33%]	[15.23%]	[21.29%]
School Decile	0.0149*	0.0857***	-0.0571***
	(0.0077)	(0.0121)	(0.0062)
	[1.85%]	[4.55%]	[-5.80%]
Entrance Type	0.0480***	0.0644***	0.0059
	(0.0031)	(0.0047)	(0.0056)
	[5.97%]	[3.42%]	[0.60%]
Programme Enrolled	0.0460***	0.1187***	0.1468***
	(0.0045)	(0.0051)	(0.0067)
	[5.73%]	[6.30%]	[14.92%]
Paper Level	-0.0012**	-0.0010*	-0.0032***
	(0.0006)	(0.0005)	(0.0008)
	[-0.15%]	[-0.05%]	[-0.33%]
Total Difference Explained	0.1820***	0.4896***	0.3546***
	(0.0113)	(0.0146)	(0.0101)
	[22.65%]	[25.97%]	[36.05%]

Notes:

The Blinder-Oaxaca linear decomposition technique is used to exam the ethnic gaps. Ethnic dummies Maori, Pasifika, Asian and European, and so for other dummies for general factors are included in all decompositions. There are 51 covariates in total.

[1.] Standard errors associated with these individual or groups of variables are listed in parentheses ('()') below these estimated effects. Percentage changes in the actual ethnic differences associated with these individual or groups of variables are shown in square brackets ('[]').

* Statistically significantly different than 0 at P<0.1 using a two-tailed t-test.

****** Statistically significantly different than 0 at *P*<0.05 using a two-tailed *t*-test.

*** Statistically significantly different than 0 at *P*<0.01 using a two-tailed *t*-test.

Table 12. Decomposition of Ethnic Gaps in Grade Points Using Single Ethnicity Identifications

	Maori vs. European	Pasifika vs. European	Asian vs. European
Actual Ethnic differences	1.009***	2.149***	0.9958***
	(0.0365)	(0.0221)	(0.0162)
Explained Ethnic Differences			
Year of Enrolment	-0.0021*	-0.0030***	-0.0022***
	(0.0012)	(0.0011)	(0.0006)
	[-0.21%]	[-0.14%]	[-0.22%]
Female	-0.0203***	-0.0312***	0.0500***
	(0.0028)	(0.0023)	(0.0025)
	[-2.01%]	[-1.45%]	[5.02%]
Part Time Enrolment	0.0045***	0.0087***	0.0039***
	(0.0012)	(0.0013)	(0.0007)
	[0.45%]	[0.40%]	[0.39%]
Age	-0.1060***	-0.1047***	0.0031
	(0.0080)	(0.0070)	(0.0052)
	[-10.51%]	[-4.87%]	[0.31%]
NCEA	0.2052***	0.3104***	0.2177***
	(0.0084)	(0.0079)	(0.0064)
	[20.34%]	[14.44%]	[21.86%]
School Decile	-0.0283**	0.0034	-0.0660***
	(0.0126)	(0.0163)	(0.0069)
	[-2.80%]	[0.16%]	[-6.63%]
Entrance Type	0.0736***	0.0769***	0.0077
	(0.0054)	(0.0062)	(0.0062)
	[7.29%]	[3.58%]	[0.77%]
Programme Enrolled	0.0513***	0.1227***	0.1455***
	(0.0070)	(0.0063)	(0.0073)
	[5.08%]	[5.71%]	[14.61%]
Paper Level	-0.0041***	-0.0012**	-0.0036***
	(0.0012)	(0.0006)	(0.0009)
	[-0.41%]	[-0.06%]	[-0.36%]
Total Difference Explained	0.1739***	0.3819***	0.3562***
	(0.0184)	(0.0193)	(0.0110)
	[17.23%]	[17.77%]	[35.77%]

Notes:
* Statistically significantly different than 0 at P<0.1 using a two-tailed t-test.
****** Statistically significantly different than 0 at *P*<0.05 using a two-tailed *t*-test.
*** Statistically significantly different than 0 at *P*<0.01 using a two-tailed *t*-test.