**2018 Census Graduate Outcomes:**

**Project Overview**

Understanding the product: purpose & high-level methodology

March 2020

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# Introduction

In 2015, an interactive resource for investigating graduate earnings, qualifications and occupations was produced and published on the Universities New Zealand (UNZ) website. At that time, it was created using data from the 2013 Census.

This resource was created to support the argument that university qualifications are financially valuable investments that more than pay for themselves over time, as a result of increased lifetime earnings of graduates compared to school-leavers.[[1]](#footnote-2)

It also was created to help potential students understand the qualifications they may need for certain jobs, and which jobs their qualifications could get them. We believe this analysis could be a useful resource to inform discussions around government funding for universities and the fees-free policy.

This document contains the business-level documentation of the methods and assumptions used to produce this tool, which has been updated with release of the 2018 Census (<https://www.nzgraduateoutcomes.ac.nz/>).

A supplementary technical document for technical users, *GO code methods*, provides the detailed steps and processes undertaken in writing a programming code.

# Final product

The online Graduate Outcomes tool was created using the following tables:

Excel spreadsheet “Graduate ROI Occupation by Field of Study.xls”

* For each occupation/profession:
  + (Up to) top 30 qualifications (field and level of study)
  + Count of people in that occupation
  + Typical level of study

The typical study variable refers to the most common highest level of study attained by people in this profession. See *4.2 Business Rules* for how this variable was created.

* For each qualification (field and level of study), limited to those who earned something:
  + Average full-time annual income for 30-39-year-olds
  + Average annual income for all 30-39-year-olds
  + Total fulltime employed 30-39-year-olds
  + Total employed all 30-39-year-olds
  + Average full-time annual income for 20-65+ year-olds
  + Average annual income for all 20-65+ year-olds
  + Total fulltime employed 20-65+ year-olds
  + Total employed 20-65+ year-olds
  + Lifetime earnings above school leaver full-time 20-65+ year-olds
  + Lifetime NPV for all Level 4+ full-time employed 20-65+ year-olds
  + NPV of income tax paid to government above school leaver
  + Age when better off as a graduate compared to school leaver (Level 4+ only)
  + (Up to) top 30 occupations

This data underlies the UNZ interactive *NZ Graduate Outcomes (Census-based)* tool. (<https://www.nzgraduateoutcomes.ac.nz/>).

# Background and purpose

## Project rationale

At the start of 2015, a range of online tools aimed at providing advice to school students on potential study and career options was either available or in development. These included the Ministry of Business, Innovation and Employment’s (MBIE’s) Occupational Outlook, the Ministry of Education’s Vocational Pathways, the Tertiary Education Commission’s (TEC’s) Information for Learners, the New Zealand Qualification Authority’s (NZQA’s) mapping of jobs to qualifications, and Careers New Zealand’s (Careers NZ’s) suite of online tools.

New Zealand’s eight universities shared concerns that the information being provided across these sites was incomplete, poorly linked and, in some cases, more misleading than helpful.

Universities NZ began this project to ascertain if all the information available or in development could be brought together in one dataset for eventual publication in one online location.

As the project proceeded, it received strong interest and, ultimately, strong support from Careers NZ, the Ministry of Education and the TEC.

By the end of 2015 when these data tables were complete:

* Careers NZ had agreed to publish the key information through their various online tools over 2016 and 2017
* the TEC had agreed to take over annual updating of the datasets for Careers NZ.

## Updating for the 2018 Census

To provide the most up-to-date information on graduate earnings, occupations and qualifications, the website has been updated for release of the data from the 2018 Census of Population and Dwellings. However, the low response rate of this census resulted in poorer quality ratings for several variables, meaning care must be taken in interpreting the results of analysis using these variables. Information on the quality of specific variables used in this analysis can be found in section 6 of this document.

The previous tables were produced using a set of formulas in Excel. To improve efficiency and reproducibility, these methods have been incorporated into a set of R codes.

## Project outline

The main concept behind this project was to generate a comprehensive analysis of three topics:

1. average earnings for every possible combination of field of study and level of study, including lifetime earnings and comparison with school-leavers
2. the most common occupations for every combination of field of study and level of study
3. the most common qualifications for every major occupation.

To achieve this, the project needed information on everyone in the New Zealand workforce. Currently, only the New Zealand census can provide this information.[[2]](#footnote-3)

The four pieces of information required are:

* 1. what job title people are employed under (eg, lawyer, farmer, etc)
  2. what their highest level of education was (eg, certificate, diploma, degree)
  3. what subject they gained their qualification in (eg, law, teaching, etc).
  4. what income bracket their earnings fall into (eg, $70,001-$100,000 per year).

Once the census data was finalised, we submitted a custom data request to Statistics NZ for all the information above. Due to some technical limitations of the custom data team, we were unable to receive data on detailed occupations. To extrapolate the data at the detailed occupational level, we had to wait until census data became available in the IDI. Ideally, we would have access to census data to construct tables the way we want for future updates.

# Methodology

## Standard classifications

The following classifications were used in Census 2018 to describe NZ qualifications and occupations.

### Level of Study

The standard New Zealand Qualifications Framework (NZQF) for levels of education study has been used for this exercise. The ten levels are defined by the NZQA and all qualifications offered by NZ institutions are mapped to the NZQF, which maps each to a level:

* No qualification: means no qualification at all—including anything gained at school
* Level 1-3 equates to NCEA levels 1-3 but includes a range of certificates through the tertiary education system
* Level 4 is most likely to be a 6-12-month certificate of some sort
* Levels 5-6 are most likely to be a 1-2-year diploma of some sort
* Level 7 is most likely to be a Bachelor’s degree of some sort, but there are some graduate diplomas at this level
* Level 8 is most likely to be an Honours degree of some sort
* Level 9 is usually a Master’s degree
* Level 10 is a doctorate (PhD).

### Fields of study: NZSCED

All subject areas are from the ‘New Zealand Standard Classification of Education’ (referred to as NZSCED). NZSCED is used by Statistics NZ and other government agencies to categorise all courses and qualifications into a standard set of subject areas at ‘broad’, ‘narrow’ and ‘detailed’ levels. A ‘broad’ classification might be Society and Culture. A ‘narrow’ classification within Society and Culture would be ‘Political Science and Policy Studies’, or ‘Language and Literature’. A ‘detailed’ classification within ‘Language and Literature’ would be ‘English Language’, ‘Literature’, or ‘Foreign languages’. Note that there are challenges with NZSCED as many inter-disciplinary and multi-disciplinary subjects have emerged over the past decade that cannot be easily classified under one broad or narrow field of study.

For this exercise, all reporting is at the lowest level available in the Census—which is ‘narrow’.

### Occupation titles – ANZSCO

Statistics New Zealand also uses the ‘Australian and New Zealand Standard Classification of Occupations’ (ANZSCO) to classify all people in employment into one of a number of standard titles. There are 722 different occupation titles used for Census results—such as Ambulance Officer, or Archivist. These include a number of catch-all titles such as Social Professional NEC (Not Elsewhere Classified) where a person’s job is matched to a broad area, but there is no ANZSCO job title that matches their specific job title.

# Business rules

We exclude from our income analysis those who reported their income as ‘loss’ or ‘none’.

When calculating mean income, we use the midpoint of each income bracket. In the case of the maximum income bracket ($150,001+) we must choose a midpoint, as there is no upper boundary and we do not know the actual distribution of these highest incomes. We have chosen $200,000 as a reasonable value; that does mean people who earn between $150k and $200k will have their incomes overestimated.

When calculating *yearly* mean income (for estimating lifetime earnings), we perform linear interpolation to get the average income by age within each age bracket. *See section 5.1.2.2.* This should not be an issue as we do not report on average incomes by age in the final output.

When constructing the “typical study” variable for each occupation in the Top 30 Qualifications table, we used the following rules:

If more than 85% of job holders have a Level 7-10 qualification, the result is ‘Degree’. If more than 85% have a level 4-6 qualification, the result is ‘Cert/Dipl’. If more than 85% have a level 1-3 qualification, the result is ‘School’. If none of those conditions is met, then the question is ‘Do more than 85% have a level 4 or higher qualification?’ and, if so, the result is ‘Tertiary’. Otherwise, the result is ‘mixed’.

All measures/statistics (counts, means, medians, etc) corresponding to original cell counts below 6 have been suppressed, and replaced by ‘NA’ or ‘<6’.

All income summary statistics (means, medians, etc) have been rounded to the nearest multiple of $100. NPV measures have been rounded to 0dp.

All counts have been randomly rounded to one of the two nearest multiples of 3. For instance, the count 7 is rounded to 6 with probability 2/3 or to 9 with probability 1/3.

## Assumptions for estimating lifetime earnings

*The conditions under which the results of the analysis will hold true.*

* Marginal tax rates do not change (correct as of March 2019).
* Income reported for level 7+ 15-19-year olds is unreliable/unhelpful for this analysis (because people of this age are very unlikely to have completed high-level qualifications) *See 5.1.2 for how these values are replaced.*
* The fee and duration estimates obtained are representative. Because these are taken from the Careers NZ website where they are reported for individual institutions but for broad fields of study, we have taken the average fees and duration across institutions for each qualification.
* We have assumed a discount rate for NPV calculations of 3%. This rate was chosen because it is the rate currently used by the OECD and this is useful for comparative purposes.

*Required false assumptions*

For this analysis to be undertaken a few things are assumed that are not quite true but are true enough in some cases:

* All study is completed consecutively (without any gap years), full-time, and without working. *The non-working assumption is considered acceptable due to generally low incomes of students who do work.* This is according to the following rule:
* It was assumed that all students left school at age 17 and either started work (no post-school education) at 17 or started tertiary studies at age 18. It was then assumed that all students involved in post-school education completed in the standard minimum time and *did not earn income while they were studying*. Standard minimum times were determined by looking at a sample of qualifications offered by education providers at different levels. Some Level 4 qualifications are therefore 6 months long and others 12 months. Some Level 5 and 6 qualifications are 1 year and others, 2 years. All Level 7 qualifications are 3 years. All Level 8 qualifications are 1 additional year on top of the Level 7 qualification (eg, 4 years total). All Level 9 qualifications are 1 year on top of the Level 8 qualification (eg, 5 years total). All Level 10 qualifications are three years on top of the Level 9 qualification (eg, 8 years total).
* For comparative modelling purposes it was assumed that all students would take out a loan for fees and for course costs and living expenses (even though we know 1 in 5 borrowers take out a loan only for course fees).[[3]](#footnote-4) The course-related costs and living expenses were based on median annual living and course-related costs for the most recent year available ($6,983 a year).[[4]](#footnote-5) Average loan costs derived from this methodology are therefore higher than actual average loan costs for the student population as a whole.
* All students take out full course fees and some living costs on their student loan; we use the median living costs withdrawn for lifetime earnings calculations
* Students pay only minimum student loan repayments once earnings reach the minimum threshold.

## Known issues/constraints around the Census data

The following limitations or issues are known regarding the Census data.

The Census questionnaire asks respondents to indicate their income in one of the following bands:

* Loss
* Zero income
* $1-$5,000
* $5,001-$10,000
* $10,001-$15,000
* $15,001-$20,000
* $20,001-$25,000
* $25,001-$30,000
* $30,001-$35,000
* $35,001-$40,000
* $40,001-$50,000
* $50,001-$60,000
* $60,001-$70,000
* $70,001-$100,000
* $100,001-$150,000
* $150,001 or more

As can be seen, the bands are not even, and it is not possible to know what the distribution of income is within bands.

To give more accurate average incomes for each qualification—without having to calculate income at every age—all incomes have been age-standardised. An age-standardised income figure can be interpreted as the average annual income of an individual (aged 25 and over) with a particular qualification in a given field, if the age distribution within that field and qualification is the same as the chosen standard age distribution. Census returns for income are provided in broad bands, so means are based on the linear interpolations of broad bands. Actual averages may be slightly higher or lower where sample sizes are small.

Everyone who completed a Census in 2018 filled out free-text fields on their return stating their job title, their highest qualification and the subject they gained their qualification in. The Census process tries to match responses to ANZSCO job titles and NZSCED subjects—first through an automated character recognition process and then through the best judgement of analysts at Statistics NZ. Given the size of the task, a few odd things appear. For example, according to the Census, the public service in 2013 was employing six bed and breakfast operators, six butchers and smallgoods makers, nine taxi drivers, nine jewellers and 51 baristas. Also, job titles are fairly antiquated and would need a fair bit of updating. Medical doctors often mistakenly list their MD qualifications at level 10 on the framework, which skews returns for graduates with a level 10 health qualification.

Other unusual results very occasionally occur, eg, people who report that they completed a PhD in Office Administration.

Income is likely to be understated for qualifications that end up either (a) working through a company structure, where the graduate has equity in the company and chooses how much to pay themselves; or (b) where a job typically has non-cash benefits (for example farm accommodation for farm workers); or (c) where an occupation has a low income but a capital gain that is realised when the business is sold—for example a farmer or business owner.

Some combinations of level of study and field of study are far more likely to contain part-timers. For example, the average income for people in 0799 Other Education at level 4 in both full and part time employment shows up as just $22,300. In reality, almost all are part-time teachers’ aides who only work some hours during school terms. This brings the median well down.

Caution is needed in determining the value of tertiary education qualifications at level 3 or 4—given some may be in the form of foundation studies (making up for not completing some necessary school-level studies) or in gaining basic skills necessary to get a first job (eg, a certificate in hospitality). Some people may have gained hospitality experience by working while studying, while others may not have any relevant experience when they enter the job market and training may be required for them to get interviews.

Income was skewed upwards for some lesser qualification types where the sample was small and older. For example, there were only 9 people working who held an Earth Science Level 1 Certificate. All were aged 55+ and their average income was $85,000. No young certificate-level graduate could expect to get into this profession or to earn that sort of money today.

Income was also skewed downwards for higher-level qualifications. Because the proportion of people with a tertiary qualification has risen over time, earnings for Bachelor’s level qualifications appear higher on average than for Master’s or PhD level qualifications. This is because Master’s and PhDs are more likely to be earlier in their careers on average and many jobs today that require a tertiary qualification are being done by senior, highly remunerated older staff with lower qualifications.

The income figures are averages for graduates in each field at each level. They also cover a mix of graduates who work in the field they trained for and those who end up working elsewhere or who are not in work. As such it’s possible that average earnings for graduates who work in the field they train for may be raised or lowered by graduates who work in other fields.

Despite adjusting the maximum income to $200,000, some incomes in this upper income bracket may still be understated, especially for more senior specialist and management roles in nearly all fields. Meanwhile, incomes of health professionals at levels 9 & 10, when considering broad field of study, may be overstated due to this adjustment.

We also don’t yet know how Statistics NZ classifies conjoint qualifications, as they do not currently appear in the data provided.

Finally, the quality of the variables from the 2018 Census were generally of poorer quality than previous censuses due to the low response rate—see section 6 for more detailed information.

## The focus on 30-39-year-olds

One part of this exercise was to report on outcomes for relatively recent graduates who have had time to settle into their professions. Because the Census does not indicate when graduates undertook their studies or how long they took to complete studies, UNZ had to choose an age range that would: (a) include the majority of NZ’s tertiary education graduates; (b) would allow at least a few years for them to transition from studies to the workforce noting that a level 10 qualification might take up to 8-9 years overall; (c) was broad enough to get large enough numbers of graduates to support reporting; and (d) aligned to the Census age bands used for reporting.

UNZ experimented with a number of different age ranges before settling on 30-39 year olds. This gave the best balance between the requirements above.

# Process

Below is a high-level summary of the steps involved in transforming the raw data to the desired output. For programming-level processes, see the *GO Code methods* document.

## Getting yearly earnings

### Extraction of data

Codes -> 01\_clean\_income\_dataset.rmd

The data are taken from a Census special request of earnings by qualification for each age bracket. We remove data for people who reported their earnings as ‘loss’ or ‘none’.

### Calculate average earnings for every age from 17-65

Codes -> 02\_income\_imputation\_v2.rmd

For calculating lifetime earnings, we need mean income values for every age bracket for every combination of employment code, qualification level and field. To do this, we need to perform imputation on some rows.

Previously, imputation was performed on yearly incomes and used averages across qualification levels and ages when necessary. In this version, it is performed on age-bracket incomes, using the mean of adjacent age brackets in that row.

We do this by taking the mean of the next youngest and next oldest age bracket within that row (employment\_code\*level\_code\*field\_code). Mean income cannot be imputed when there are four or more values missing in a row, or three or more in the last four age brackets.

Where one value is missing, the mean of the preceding and succeeding incomes is taken. Where two values are missing, the preceding value (whether actual or imputed) is given a weight of two thirds, and the next actual value is given the weight of one third.

In some cases, this is extended to three missing values, where the preceding value (whether actual or imputed) is given a weight of three fourths and the next actual value is given the weight of one fourth.

Although this method could be extended to larger gaps, the more it is used, the less meaningful the resulting data will be, so most records that are missing four values in a row are not imputed and are dropped from the analysis.

The 15-19-year-old category is often missing for degree level and higher; this makes sense as most individuals finish degrees and start working after this age band. As a result, any data in this age band for the higher study groups (levels 8+) are not very representative of the general population. Therefore, these are replaced with a value of the maximum income of levels 7 and below for 15-19-year-olds.

#### Constructing yearly income for every age

Each five-year point is taken to represent the mid-point. So, 15-19 represents 17-year-olds and 20-24 represents 22-year-olds. The four years between those points are imputed, creating what would be a straight line between those points. The preceding value (whether actual or imputed) is given 4/5 weight, and the next actual value is given 1/5 weight.

The 65+ band is taken to represent 65-year-olds, so there are only two values to impute between 62 and 65. A weight of 2/3 is applied to the preceding value and the next actual value is weighted at 1/3.

#### Age-standardising incomes

Codes -> 03\_age\_standardised\_income.rmd

Calculating a weighted mean based on the proportion of people in each age bracket. *See section 4.4*. This standardised income is not used for the 30-39-year-old age bracket analysis, which we perform separately in 04\_income\_30\_39\_y\_analysis.rmd

## Calculate lifetime earnings, taking into account tax paid and student loan deductions

Codes -> 04\_lifetime\_earnings.rmd

1. Remove income recorded for graduates for the duration of their degree (eg, students completing a Bachelor’s degree will have 0 income recorded for the ages of 17-19).
2. Calculate tax (according to marginal tax rates) and student loan payments (according to minimum 12% payment for income over $19084) for each year.
3. Set income and tax of school-leavers (no post-school qualification) as baseline variables. Calculate average difference in tax paid and income received for each qualification graduate compared to baseline, taking into account student loan repayments. Sum incomes to get lifetime earnings and tax paid minus SAC funding.
4. Extract fees and duration data for each qualification from Careers NZ and TEC websites.

## Calculate NPV and compare graduates with school leavers

Codes -> 04\_lifetime\_earnings.rmd

To try and quantify the financial value of a tertiary education to a graduate, we use the economic measure of Net Present Value (NPV). NPV is a measure of the ‘profitability’ of an investment over a period of time. We cumulatively sum these values over a graduate’s lifetime to find when they are “better off”.

These calculations eventually result in the following variable: **Age when better off than a school leaver**. This is the age at which a graduate is financially better off than school leaver, taking into account discount effects and student loan repayments (and the other assumptions discussed previously). In other words, the point in their lifetime when the cumulative NPV income increases above school leavers from the same age (ie, the difference becomes positive). The NPV calculations were all done on a net basis by comparing (a) average annual income from the average school leaver with no higher education to (b) average annual income for graduates by level & field of study minus loan repayment amounts.

For example:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Calculation | a | b | c | d=b-c | e=d-a |
| $NZ in 2018 | School leaver with no higher education Gross Fulltime Income | Law graduate with a level 7 LLB Gross Fulltime Income | Law graduate Loan repayment | Law grad Adjusted income | Net cost or benefit used in the NPV calculation for the law graduate |
| Age 20 | $30,000 | $0 | $0 | $0 | -$104,696 |
| Age 27 | $42,700 | $67600 | -$5741 | $61,859 | -$49,104 |
| Age 40 | $53,300 | $126,600 | $0 | $126,600 | $314,629 |

Rather than just the three rows shown above, the NPV calculations are done on 48 rows—one for each year between ages 17 and 65. Net present values are as at age 65.

We also calculate the NPV for the difference increased tax paid by graduates, to find the **NPV lifetime tax paid above school leaver** minus **SAC funding.**

These are the numbers for cynical economic minds as they answer the question: Does the government get a good return on investment from income taxes over SAC funding? Note, however, that this analysis does not consider GST income from the potential increased spending power of graduates, merely the extra tax they pay from higher incomes.

We calculate typical study levels for each qualification in code 05\_calculate\_typical\_study\_level.rmd

Finally, we output this data in code 05\_consolidate\_long\_income\_datasets.rmd and 06\_produce\_grad\_ROI\_executive.rmd, grouping by 30-39-year-olds and everyone (limited to those who earned something). Also output most common occupations by field of study and most common fields of study by occupation.

# Data sources and quality

## Data sources

* Fee and duration estimates: Careers NZ website via web-scraping
* SAC funding: TEC website via web-scraping
* Census data: Statistics NZ via custom request
* Occupation by field of study: IDI
* Metadata (NZSCED, ANZSCO, qual levels): Statistics NZ website

## Census data quality

**2018 Census External Data Quality Panel: Assessment of variables:** <https://www.stats.govt.nz/reports/2018-census-external-data-quality-panel-assessment-of-variables>

See ratings for each Census variable below. Note particularly low rating for Occupation variable: link reveals 20% of occupations were imputed.

*Occupation*

DataInfo+ link: <http://datainfoplus.stats.govt.nz/Item/nz.govt.stats/7889e133-a8e8-4c68-8d91-ea11ebc10c2f>

EDQ Panel rating: **Poor**

Stats NZ rating: **Moderate**

External assessment page: 50 - 53

*Highest qualification*

**DataInfo+ link:** <http://datainfoplus.stats.govt.nz/Item/nz.govt.stats/33e8dc17-1be8-446d-8f33-6f458e86f94c>

EDQ Panel rating: **Moderate/Poor**

Stats NZ rating: **Moderate**

External assessment page: 54 – 57

*Status in employment*

**DataInfo+ link:** <http://datainfoplus.stats.govt.nz/Item/nz.govt.stats/68c95ba5-cc3b-4cad-b286-1dfdcd86291d/>

EDQ Panel rating: **Moderate**

Stats NZ rating: **Moderate**

External assessment page: 63 – 65

*Total Personal Income & Sources of Personal Income*

DataInfo+ links:

*Total Personal Income:* <http://datainfoplus.stats.govt.nz/Item/nz.govt.stats/4dc6188a-e884-4be0-bd53-7f03c60121a9/>

*Sources of Personal Income:* <http://datainfoplus.stats.govt.nz/Item/nz.govt.stats/ab874ce5-0889-423c-a2c0-dd4a89a355a9/>

EDQ Panel rating: **High** (both ‘Total Personal Income’ and ‘Sources of Personal Income’)

Stats NZ rating: **High** (both ‘Total Personal Income’ and ‘Sources of Personal Income’)External assessment pages: 70 – 72

DISCLAIMER

Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the author, not Statistics NZ.

CONTRIBUTORS

2013 data analysis: NPV modelling was developed by Chris Whelan of UNZ. NPV modelling was independently validated by Dr Warren Smart at the Ministry of Education.

2018 update: Conversion of Excel formulae method into R codes was done by Scott Henwood and checked and documented by Daniel Wrench, both of UNZ

1. See Universities New Zealand report *A degree is a smart investment* <https://www.universitiesnz.ac.nz/latest-news-and-publications/degree-smart-investment-0> and American comparison *Is College Worth the Expense?* [*https://www.insidesources.com/college-worth-expense-yes/*](https://www.insidesources.com/college-worth-expense-yes/) [↑](#footnote-ref-2)
2. The New Zealand Census is an official count of people resident in New Zealand and a range of information on them and their households, including the information needed above. The most recent Census was held on 6 March 2018. [↑](#footnote-ref-3)
3. Page 26, Student Loan Scheme Annual Report 2019 [↑](#footnote-ref-4)
4. Table 4, Student Loan Scheme Annual Report 2019 [↑](#footnote-ref-5)