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authoritative analysis

The University of Auckland

Economic contribution to the Auckland region

Report to The University of Auckland

April 2006

Preface

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Executive Summary

This report is an update of an NZIER study, undertaken in 2002, to quantify the University of Auckland's economic and social contribution to the Auckland region. The initial study drew upon data from the University, the New Zealand University Students Association (NZUSA) and Statistics New Zealand. More recent data is now available from a number of sources, most notably NZUSA's student expenditure data and the University's financial records, and this update utilises that new data.

This report retains the previous methodology for estimating the University's net economic contribution, although with a slightly narrower focus: whereas the earlier work also noted the University's role in generating knowledge spillovers and enhancing the region's social, human and physical capital, at the request of the University this update focuses solely on its more immediate economic contribution. In particular, this study is limited to estimating the direct, indirect and induced economic impacts arising from the expenditure of the University and its students.

The key findings of the study – i.e. the estimated short run economic impacts of the University of Auckland ("the University") on the Auckland region - are summarised as follows:

- The direct expenditure of the University in 2005 was $675 million.
- The direct expenditure of students in 2005 that would not have occurred if the University were not present in the region was $662 million.
- The total direct expenditure impact of the University, its staff and students in 2005 was $1.34 billion.
- The University provided 4,332 full time equivalent jobs directly in 2005.
- After taking into account the direct, indirect and induced expenditure impacts of the University's expenditure, the University contributed $2.43 billion worth of output to the Auckland regional economy in 2005.
- After taking into account the direct, indirect and induced expenditure impacts of the additional expenditure of the University's students, a further $1.96 billion worth of output was added to the Auckland regional economy in 2005.
- The total expenditure of the University and its students therefore resulted in $4.39 billion of output being added to the Auckland region.
- For each full time equivalent job that the University creates itself, one more additional job is created in the wider Auckland regional economy.

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1. Introduction

1.1 Purpose of report

This report is an update of an NZIER study, undertaken in 2002, to quantify the University of Auckland's (henceforth 'the University') economic and social contribution to the Auckland region.[1] The initial study drew upon data from the University, the New Zealand University Students Association (NZUSA) and Statistics New Zealand. More recent data is now available from a number of sources, most notably NZUSA's student expenditure data and the University's financial records, and this update utilises that new data.

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As before, in the following section we also provide some context in terms of a brief overview of the Auckland regional economy, and of the University itself.

1.2 Economic overview of the Auckland region [2]

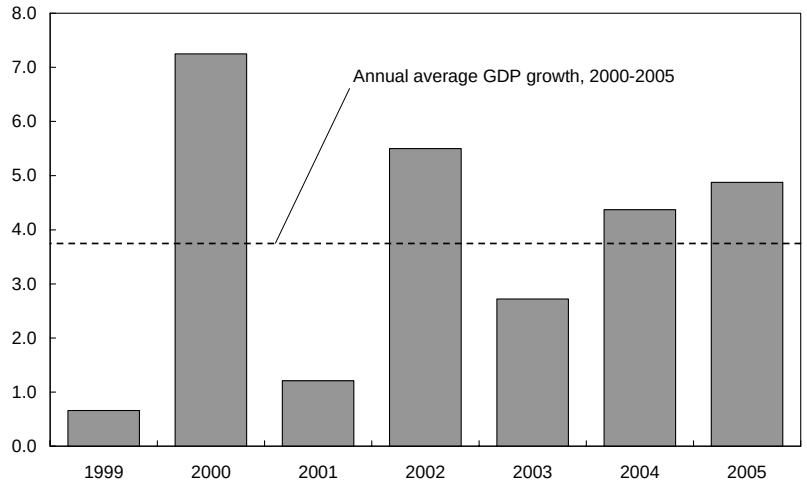
In the period between 2000 and 2005, the Auckland regional economy expanded by an average of 3.7% per year (see Figure 1). Growth over this period kicked off with a sharp rebound from the impacts of the Asian crisis in 1999; however, recent years have also seen Auckland expand at a rate greater than its long-term average growth rate. Growth in the Auckland region during the past five years was largely driven by the sectors supporting predominantly personal services: wholesale and retail trade, accommodation, cafes and restaurants; transport, storage and communication; and health, education, community and other personal services.

[1] *The University of Auckland: economic contribution to the Auckland region*, NZIER, September 2002.

[2] Much of this information is taken from NZIER's *Quarterly Predictions* publications, various editions.

Figure 1 Auckland regional GDP growth

Annual percent change



Source: NZIER

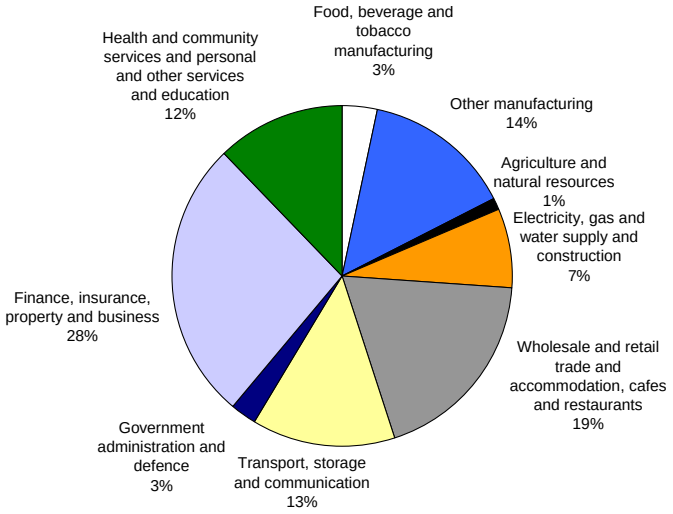
The most important sectors in the Auckland economy in terms of the size of their contribution to Auckland's GDP are similar to those identified in the earlier study, namely:

- Business and financial services – it is home to many of the country's head offices for firms in the accounting, marketing, consulting, law and IT sectors.
- 'Other' manufacturing including machinery, equipment and basic metals.
- Wholesale and retail trade, accommodation, and restaurants and cafes, reflecting the importance of domestic and international tourism to the region.
- Health, education and other services (primarily community and personal services such as parks, museums, broadcasting, landscaping, hairdressing, dry cleaning and automotive services).

The distribution of the region's economic production by broad industry grouping is shown in Figure 2.

Figure 2 Composition of the Auckland regional economy

Industry GDP as a percent of total regional GDP, March 2005



Source: NZIER

2. Analytical framework

This section outlines the framework used to estimate the economic contribution of the University to the local economy. It draws heavily from the material of the earlier study, and is re-presented here for completeness.

As noted in the introduction, this report focuses on the University's economic contribution, particularly via the expenditures of the University and its staff and students.

As before, the basic question that we are trying to answer is: what does the University bring to the Auckland region in terms of economic activity? The analytical framework that we employ addresses this issue by determining the net economic benefits that the Auckland region would *miss out on* if the University were *not* present.

The economic impact of the University is specified as "the difference between existing economic activity in [the Auckland region] given the presence of the institution and the level that would have been present if the institution did not exist". [3, 4] There are two main time horizons to consider:

(i) The short run: the focus is on the immediate direct and indirect flow-on effects of the spending of the University and its students.

[3] Beck, Elliott, Meisel and Wagner, (1995, p. 246)

[4] As stated by Kenyon and Doss (1999, p. 41), "the problem, of course, is that this counterfactual economy which does not contain a [university] can never be observed. …fortunately, this is not necessary to assess the economic impact…"

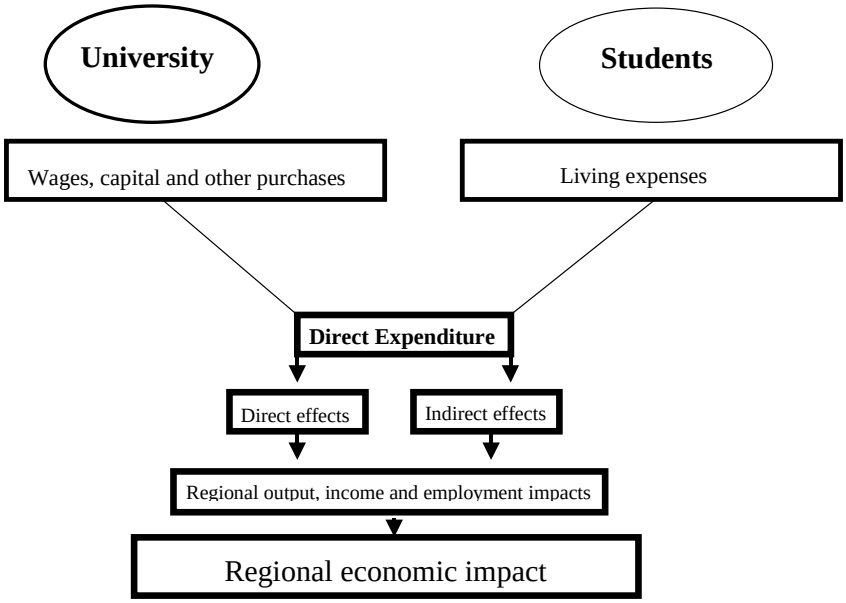
(ii) The long run: this refers to effect of the University in adding to the human capital stock of the region – the impact of the future income streams of University graduates who stay to work and live in Auckland.

As noted above, the focus of this update is on the shorter-run impacts associated with the spending of the University and its students. Estimating these impacts is largely a quantitative exercise as described in the following section.

2.1 Short run economic impact analysis

This analysis is concerned with the direct and indirect (i.e. flow on) impacts of the presence of the University and its students on the Auckland regional economy, in terms of output, income and employment. These impacts are represented in Figure 3.

Figure 3: Economic impact analysis: The University and student expenditure



Source: NZIER

The University triggers both *direct* and *indirect* expenditure impacts on the region, and we look at each type of impact separately.

2.1.1 Direct expenditure impacts

The wages, other current expenditure and capital expenditures of the University flow directly into economic activity in the Auckland region. To determine the direct contribution from expenditure by the University we

look at its statement of financial performance in its Annual Report, 2005. This analysis is presented in section 3.2.

Spending by students attending the University also impacts directly on the regional economy. The spending patterns of full time students are captured in the NZUSA's survey of student income and expenditure. We want to capture two figures:[5]

- The *additional* spending in the region (attributable to Auckland-based full-time and part time students) that would not occur without the University
- The *additional* expenditure that the University has induced by attracting out-of-town students to the region.

Whilst the data contained in the survey is not ideal, and some assumptions were necessary – see section 3.3 for further detail – it provides an indication of the direct expenditure by students. The direct contribution from part time students at the University is difficult to estimate. Many of these students are likely to have been residing in Auckland for employment or family reasons prior to starting their studies, and therefore would have been spending money whether or not they were students of the University. Their expenditure patterns are likely to be different to full time students. This makes identifying the *additional* expenditure that part time students bring into the region a little difficult.

The key point to remember is that we are trying to identify the *additional* expenditure that the University brings to the Auckland region. This requires careful consideration as to what spending patterns would be under the counterfactual scenario, i.e. if the University *wasn't* present in the regional economy.

2.1.2 Indirect expenditure (multiplier) analysis

Each time the University and its students spend a dollar in the region, successive rounds of spending and economic activity are initiated. For example, if the University purchases an item from firms, a portion of that dollar will be used to pay that firm's wages, and these wages will in turn be spent by employees of the firm on other goods and services, thus kick-starting further second- and third-round effects. Therefore the final economic contribution of the one dollar of expenditure is likely to be greater than just the dollar itself. These successive or subsequent round effects can be estimated using multiplier analysis, as discussed in section 4.

[5] Note that these figures are not to be summed – the latter is included in the former.

3. Economic impact analysis – direct expenditure and employment results

In this section, we present our analysis of the direct expenditure and employment effects of the University and its students on the Auckland region.

3.1 Direct employment impact of the University

In 2005, the University (including the Faculty of Education) employed 4,332 full-time equivalent staff (FTEs). This represents around 0.67% of the total employment of the Auckland region.

3.2 University expenditure

We obtained the University's consolidated expenditure data from the 2005 Annual report.

Table 1 Simplified expenditure data
Dollar millions, 2005 prices

Expenditure category	Year ended December 2005
People costs	362.8
Operating costs	202.8
Capital expenditure	109.8
Total	675.4

Source: Consolidated data from the University of Auckland Annual Report, 2005 (p.63)

Table 1 shows that the University's expenditure on staff, good and services and fixed assets was around $675 million in 2005.

3.3 Student expenditure

The University of Auckland attracts students from outside the region and retains within the region students who would otherwise attend universities elsewhere. It is thus reasonable to conclude that in the absence of the University, students seeking comparable courses of study would live elsewhere in New Zealand or overseas.

In 2005, 30,800 equivalent full-time students attended the University of Auckland. Of this number, 5,241 were full fee-paying overseas students.[6] The majority of these students were from Asia, with China (52% of total overseas students), Malaysia (5%) and Korea (5%) being the most significant countries of origin. Students from the USA and Canada (11%) and Europe (8%) accounted for a large proportion of the non-Asian overseas students.

Aside from the financial and cultural gains these students bring to the region, the presence of overseas students at the University is likely to increase the chance of trade links between the region and home countries, especially via tourist visits. Furthermore, a proportion of foreign students will remain in New Zealand following the completion of their initial studies. A 2003 study (Ministry of Education) found that 24% of foreign tertiary students planned to gain employment in New Zealand and a further 34% planned to undertake additional education in New Zealand. The Department of Labour (2005) also found that 16% of immigrants issued with a student visa in 2001/02, and 21% of those issued with a student visa in 1997/98 had gained permanent residence by 2004/05.

3.3.1 Snapshot of University of Auckland students [7]

- In 2005 there were 39,420 students, of whom 58% were female and 42% were male.
- Of these, 60% were full-time and 40% were part-time.
- By ethnicity, 40% were European, 33% were Asian, 7% were Maori, 8% were Pacific Islanders, and the remaining 12% responded to 'other' or gave no response.
- By faculty, the distribution of students was Business and Economics (19%), Science (18%), Arts (18%), Education (15%), Medical and Health Sciences (9%), Engineering (7%), Creative Arts and Industries (5%), Law (4%) and Theology (0.5%).[8]
- Of the 30,800 (EFTS) students, 4,926 were postgraduate students.

3.3.2 Full time students

We are interested in finding the net additional full time student expenditure that the University induces into the Auckland regional economy.

The NZUSA frequently surveys students regarding their income and expenditure. The most recent survey was published in December 2005, and

[6] Between 2001 and 2005 the number of fee-paying overseas students more than doubled (from 2,416), despite declining slightly from 2004. Note also that the number of students at the University born overseas would be much higher than 5,241, but most are permanent New Zealand residents.

[7] All data is from the University's Annual Report, 2005, pp. 8-9.

[8] The remaining 6.0% comprises students enrolled in University Programmes.

relates to the 2004 year.[9] The survey covers full time students only. It is likely that part time students have different spending patterns, reflecting the amount of study they undertake, relative to their other activities (employment, childcare, etc). Survey results are shown in Table 2.

Table 2 Weekly living expenses
Dollars per week, 2004

	Auckland University students	All New Zealand students	
Expenditure group	Mean expenditure	Mean expenditure	Median expenditure
All food [1]	69	61	50
Local transport [2]	33	32	20
Accommodation	131	116	100
Entertainment	40	36	20
Living expenses [3]	37	40	25
Personal items [4]	16	17	10
General bills [5]	40	38	20
Miscellaneous	42	30	20
Childcare costs	76	59	40
Total	484	429	305

Notes:
1 Includes groceries, lunches, takeaways and snacks
2 Includes costs of petrol, buses, trains, and taxis
3 Includes power and phone bills, appliance rental, other bills
4 Includes cosmetics, razors, magazines, etc
5 Includes insurance bills, maintenance, etc

Source: NZUSA (2004)

Mean weekly expenditure for all respondents has lifted slightly, from $406 per week in 2001 to $429 per week in 2004 (an annual average increase of around 1.9%). Notably, the gap between the weekly mean expenditure for Auckland students compared to all students is $55 per week, roughly in line with the "Auckland premium" we estimated in the earlier study of 10%.

Students were surveyed regarding other major expenses that they incurred in 2004. This does not include spending on tuition fees. The data is shown in

[9] Note that Auckland University students are now covered by the survey; in the previous survey (2001) Auckland students were excluded.

Table 3. In addition, we have multiplied the weekly living expenses by 40 to calculate annual living expenses.[10]

Table 3 Annual living expenses, University of Auckland students
Dollars per year, 2004

Typical, regular expenses		Other, irregular or one-off expenses	
Expenditure group	Mean expenditure	Expenditure group	Mean expenditure
All food	2,760	Textbooks and course costs	515
Local transport	1,320	Clothes	567
Accommodation	5,240	Travel out of town	657
Entertainment	1,600	Music and books	244
Living expenses	1,480	Medical, dental and optical costs	469
Personal items	640	Computer, stereo, appliances	784
General bills	1,600	Other non-vehicle items	608
Miscellaneous	1,680	Purchase of cars and bikes	1,112
Childcare costs	3,040	Other major expenses	601
Total	19,360		5,557

Notes: (1) See definitions in Table 2.
Source: NZUSA

Total living annual expenses in 2004 are therefore estimated to be $24,917 per student. If we multiply this per student expenditure by the 23,725 full time students (University of Auckland, 2005, p. 8), the total expenditure of full time students of the University of Auckland in 2005 was $591 million.

The University conducts very little extramural teaching other than the delivery of some postgraduate courses in medicine[11]. It is therefore a reasonable assumption that virtually all of the 23,725 full time students of the University live and spend money in the Auckland region.

It is important to remember that we are also interested in calculating the *additional* expenditure impacts of the University attracting students from

[10] This figure represents two 13-week semesters, plus 14 weeks where students are taking exams, preparing for the upcoming semester or relaxing in the post-exam period. It is acknowledged that some post-graduate students may spend more than 40 weeks (within a calendar year) to complete their studies

[11] Personal communication, April 3, 2006 and April 19, 2006. The University has a small number of extramural students in Rotorua and the Waikato region, and at the Tai Tokerau campus in Whangarei. In total, slightly less than 1% of all University of Auckland students, including online students, do not attend the Auckland campus.

outside of the Auckland region. Data supplied by the University (see Appendix C) suggests that 36.3% of full time students attending the University are from outside of the Auckland region.[12] We now multiply this percentage by the total annual expenditure by full time students figure ($591 million). The resulting $214 million is the annual expenditure by full time University of Auckland students who have moved from outside of the region to study at the University.

If we looked at this figure alone, we would most likely underestimate the impact of the University on attracting additional student expenditure to the Auckland region. In addition to bringing students in from outside of the region, the University also retains some students who would have left Auckland to study elsewhere if the University were not present. If the University was not there, some of these potential students may have stayed in Auckland and studied at other institutions (Massey University in Auckland, Manakau Institute of Technology, Auckland University of Technology, for example). Others may have stayed in Auckland and decided to enter the workforce. As such, it is fair to assume that the presence of the University does not bring any additional expenditure from these students – they would have been spending in the region regardless.

We need to make some assumption regarding the proportion of the 64% of the University's students that come from Auckland that would have left to study elsewhere if the University was not in the region. Without any data to use for this purpose, this assumption is entirely arbitrary. With this in mind, we assume that half of the University's students originally from Auckland would have moved outside the region to study if the University wasn't present. This retention effect accounts for another 31.8% of the University's total number of full time students. If we multiply the total real expenditure of full time students of the University ($591 million) by 31.8%, the figure obtained is $188 million. This is the annual expenditure by full time University of Auckland students who would have moved outside of the region to study in other regions if the University was not present in the region.

In total, this suggests that the total annual expenditure by full time students that the region would miss out on if the University were not present is $403 million (=$214 million + $188 million).

3.3.3 Part time students

As for our earlier study, no expenditure data was available for part time students. In order to calculate the direct expenditure impacts of part time students, it was necessary to make some assumptions. There were 15,695 part time students at the University in 2005. Of these part time students, data

[12] Note that this data relates to the 2001 year and is the same as that used in our previous work.

from the University (see Appendix C) suggests that 55.1% came to the University from areas other than Auckland.[13]

We (arbitrarily) assume that one-quarter of the part time students originally from Auckland would be studying part time or full time in another region if the University were not present. This accounts for 11.2% of part time students at the University, or 1,762 students.

Judging the expenditure level and patterns of part time students relative to full time students is difficult. If part time students are mainly full time employees seeking to upskill, they are likely to have a far greater income than the average full time student, and thus have correspondingly higher spending. However, if this expenditure would have happened anyway, even if the part time student was not studying, then the additional expenditure cannot be attributed to the University. On the other hand, some students are likely to be part timers because they cannot afford to study full time, and must balance study commitments with part time work. The income and expenditure of these part timers is likely to be similar to full time students. Weighing up these factors leads to no obvious conclusion as to the level or composition of expenditure by part time students. As such, we assume that their expenditure is the same as full time students (except for fees).

The number of part time students in the Auckland region specifically to study due to the presence of the University is thus 10,409 (=8,647+1,762). Multiplying this by the annual expenditure figure of $24,917, the annual direct expenditure contribution of part time students that the Auckland region would miss out on if the University was not present is $259 million.

3.3.4 Overseas students

We have not yet differentiated between the expenditure of domestic and overseas students (both full fee paying and those who have resided in Auckland for some time). In this analysis of short term direct economic impacts, it is possible that some overseas students (for example, those from the newly industrialised economies in Asia) have higher levels of expenditure than domestic students. However, it is unlikely to be the case that *all* overseas students spend more than domestic students. Some of those students are from relatively poor countries, with little financial support from either families or from scholarships.

On balance, and with no other data to suggest an alternative approach, we assume that overseas students have the same expenditure patterns as domestic students.[14] To the extent that this may underestimate the

[13] It is acknowledged that study may not be the primary reason for these part timers coming to Auckland – it may be due to greater part time work opportunities, family reasons, etc. However, we have no way of knowing these reasons.

[14] Some information on the impact of foreign fee-paying students is contained in reports by Infometrics (2000 and 2003).

expenditure of overseas students in the Auckland region, the direct and indirect expenditure impact of the University's students may be slightly negatively biased.

3.3.5 Total expenditure by students

The sum of the two expenditure figures calculated above for full time and part time students gives us $662 million. This is the total direct expenditure by students that the Auckland region would miss out on if the University was not present.

3.4 Total direct expenditure by the University and its students[15]

The University's personnel costs for 2005 were $363 million (see Table 1). While much of this will be spent locally, there is little data on which to base an estimate of this proportion. Certainly, as for any income earned in the region, a significant proportion will 'leak' into taxation, savings, and spending outside the region. That is, these components do not directly contribute to economic activity in the Auckland region. However, this is at least partly offset by injections into the regional economy from government spending. For simplicity in this analysis we assume that the leakages and injections are equal – there is a zero net impact.

When we add operating expenses, capital expenditure and student expenditure to this salary bill, the total direct expenditure impact of the University and its students on the Auckland region in 2005 was $1.34 billion (=$662 million + $671 million). This represents the direct expenditure that the region would miss out on if the University was not present.

4. Economic impact analysis – multiplier analysis

4.1 Why use multiplier analysis?

To this point we have considered mainly the 'direct' impacts of the University, because we have wanted to identify expenditure and employment directly attributable to the University.

[15] The spending of staff and students does need to be treated with caution in impact assessment, because of the potential for double counting. For example, we don't examine separately the direct impact of University staff members' expenditure on the regional economy. This is because we already take into account of this when looking at the University's expenditure data (in its wage bill).

Additional expenditure in a region – as a result of the presence of a particular organisation such as a university or a new construction project – leads to flow-on effects in the wider economy. For example, spending by the University, staff, and students on goods and services adds to the turnover of local businesses, and in turn will affect the incomes of owners and employees, and employment levels. Multiplier analysis seeks to take into account not just the direct impacts of expenditure injections, but also these indirect and induced effects where:

- The *direct effect* is the initial increase in expenditure (as reviewed in earlier sections).
- *Indirect effects* are the first round of purchases by the supplier industries, i.e. those receiving the initial expenditure.
- *Induced effects* include the second and subsequent rounds of output increases in supplier industries, and consumption increases by households whose incomes are enhanced by the initial and subsequent rounds of purchases.

The magnitude of these effects, within given boundaries, will depend not only on the size of the initial injection (in this case taken to be the annual expenditure by the University and students) but also on the level of 'leakages' of expenditure from the regional economy. This depends partly on the location of industries providing goods and services to the University (within or outside the region) and in turn where these supplier industries source their inputs from. It also depends on the propensity to consume or save of the industries or households concerned.

As we saw in the expenditure analysis above (Table 1), the major component of direct expenditure by the University is skilled labour, that is academic, administrative, and support staff. In addition, the University spends considerable sums on local services such as repairs and maintenance, cleaning, and utilities, as well as on equipment, library books, and periodicals. Each of these will give rise to different indirect and induced effects on output, income, and employment in the Auckland region. Student expenditure, mainly on living expenses within the region, also result in different multiplier effects.

For a description of the methodology used to calculate the multipliers used in this report, see Appendix A . It should be noted that multiplier analyses are often subject to a number of common criticisms, as explained in the box below.

Multiplier analysis: caveats

For a host of reasons, multipliers must be interpreted with caution. In particular, three key points should be noted:

1. Multipliers assume that sectors combine inputs, and produce outputs, in fixed proportions.
2. Multipliers take no account of induced changes in relative prices.
3. Multipliers assume that labour and capital are available in unlimited quantities.

As an illustration of the effect these assumptions can have on economic impact analysis, consider the example of an additional demand for University output of $1 million. In order for the University to meet this additional demand requires that it employ additional labour (and capital). In the real world these factors are not available in unlimited quantities, and basic economics tells us that additional demand for a limited resource will have a tendency to push up the price of that resource. In turn, changes in input prices will tend to lead to a degree of substitution away from the relatively more expensive inputs (to the relatively cheaper alternatives); however, the assumptions underlying multipliers preclude this.

These effects, alone or combined, will tend to lead to a multiplier which is greater than the true economic impact on a region of a change in one industry. That is, multipliers have a tendency to overstate economic impacts.

4.2 What types of multiplier have we used?

We start by highlighting the distinction between *Type I* and *Type II* multipliers:

- *Type I multipliers* measure the direct and indirect effects of a change. In the instance of an output multiplier, the direct effect is the initial rise in output in the industry which is experiencing higher demand. The indirect effects result from the need to produce more inputs for that industry.
- *Type II multipliers* include the direct and indirect effects, as well as the induced effect of a change. The initial direct and indirect effects result in higher employment, which in turn boosts demand, which lifts output, which then lifts employment further, and so on.

Since Type I multipliers do not fully capture the associated flow-on effects of a change in final demand, we shall focus on Type II multipliers in this short term impact analysis.

It is common in regional economic impact analysis to focus on three multipliers:

- *Output multiplier* – relates the change in sales to final demand (e.g. households or exports) by one industry to the total change in output by

all industries in the region. In this study, this is the measure of the change in regional output resulting from a $1 increase in final demand for the output of the University.

- *Income multiplier* – relates the change in direct income of one industry to changes in total income of the regional economy. In this study, it is the measure of the change in regional income resulting from a $1 increase in the income of the University.
- *Employment multiplier* – relates the change in employment within one industry to changes in total employment within the regional economy. In this study, it is a measure of the change in regional employment resulting from the hiring of one additional employee by the University.

Table 4 presents the multipliers, as described above, for the University of Auckland.[16]

Table 4 Multipliers for the University of Auckland

	Output multiplier	Income multiplier	Employment multiplier
Type I	1.4	1.2	1.2
Type II	3.6	1.9	2.0

Source: Statistics New Zealand, NZIER

4.3 What the multipliers mean for the University's contribution to the region

4.3.1 The University's employment contribution

The Type II regional employment multiplier for the Post-School Education sector was calculated as being 2.0 (see Table 4). This implies that for each job created in the University, one further job is created in the rest of the Auckland regional economy. In the year 2005 the University accounted for 4,332 FTE jobs. By applying the employment multiplier to this figure, this suggests that the presence of the University in the Auckland region leads to additional employment in the region of 8,664 FTE jobs (including 4,332 jobs created at the University).

Another way of looking at the contribution of the University to regional employment is to consider how the expenditure of the University creates

[16] These multipliers were calculated for the Post-Secondary school industry of the input-output tables from Statistics New Zealand. The University of Auckland accounted for 68% of FTE employment in the Post-Secondary school industry in the Auckland region for the year 2000. Thus it is reasonable to assume that the multipliers for the industry are the same as those for the University itself. Note that the input-output tables used in this study have not been updated from the earlier work because no new official input-output data has been released since that time.

jobs. To estimate the regional employment impacts of an increase in expenditure by the University, we employ the following steps:

- We first calculate the average expenditure per FTE of the University.[17] This is ($675,367,000/4,332 FTEs) = $155,901. So for every additional expenditure of $155,901, the University employs one more FTE.
- We assume that this average expenditure per FTE is constant across the whole Post-School Education sector in the Auckland region.[18]
- So for each additional $155,901 spent by the University, one FTE job is created at the University itself. By applying the Type II employment multiplier of 2, the total increase in regional employment from the University's additional expenditure is in fact 2 FTEs.

4.3.2 The University's expenditure contribution

The University's total expenditure in 2005 was $675 million. To derive the direct, indirect and induced effects of this expenditure on the Auckland regional economy, we apply the Type II regional output multiplier for the Post-School Education sector (3.6) to this figure. The result is that the University's own expenditure leads to an overall expenditure impact of around $2.43 billion in the Auckland region.

As shown above, the University also brings $662 million into the region as additional student expenditure. To determine the multiplier effects of this expenditure, we need to consider in which sectors students spend this money. That is, we need to work out which industry output multiplier to apply to this $662 million. Since students spend across a number of sectors, we worked out a weighted sectoral multiplier. We aligned the expenditure categories in Table 3 as closely as possibly with the sectors in the 126 industry input-output table. Each of these industries has an output multiplier. By weighting these multipliers by each expenditure category's share of total student expenditure, we calculated a weighted average multiplier of 3.0.[19] By applying this to the direct expenditure figure of $662 million, the overall impact of the additional expenditure of students that the University brings into the Auckland region is $1.96 billion.

Overall then, the University contributes around $4.39 billion a year to the Auckland region, when the direct, indirect and induced effects of the expenditure of the University and its students are considered.

[17] Ideally, we would use the *marginal* University expenditure per FTE, that is, the additional expenditure for the last FTE employed. This is not easily determinable due to a lack of data.

[18] To the extent that expenditure per FTE at the University may be higher than at other tertiary institutions in the region, this assumption may overestimate the expenditure impacts of the University on employment in the Auckland region. That is, the University may have to spend more to create one additional job at the University than other tertiary institutions in the region.

[19] Note that, coincidentally, this is the same rounded value as the weighted average multiplier derived in the earlier study, reflecting the fact that (i) the input-output table from which the individual multipliers are derived is unchanged and (ii) the share of student spending across items is relatively similar to earlier.

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Appendix A : Multiplier Methodology

A.1 Derivation of Type I multipliers

Given an *n*-sector economy, the transactions matrix and the vectors of final demands and outputs can be represented as:[20]

$$\mathbf{Z} = \left(\begin{array}{cccc|c} z_{11} & z_{12} & \cdots & z_{1n} & z_{1c} \\ z_{21} & z_{22} & \cdots & z_{2n} & z_{2c} \\ \vdots & \vdots & & \vdots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nn} & z_{nc} \\ \hline z_{c1} & z_{c2} & \cdots & z_{cn} & \end{array}\right) \qquad \mathbf{f} = \begin{pmatrix} f_1 \\ f_2 \\ \vdots \\ f_n \end{pmatrix} \qquad \mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix}$$

where:

z_{ij} = sector *i* sales to sector *j*

f_j = sector *j* sales to final demand

x_j = total sector *j* sales

The *c*-th row represents compensation of employees (ie. payments for labour), and the *c*-th column is household consumption.

The relationship between the elements of these matrices is:

$$x_i = z_{i1} + z_{i2} + \ldots + z_{in} + f_i \qquad (1)$$

The technical coefficients (or direct input coefficients) of sector *j* are written:

$$a_{ij} = z_{ij} / x_j \qquad (2)$$

which in matrix form is:

$$\mathbf{A} = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{in} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix}$$

[20] In the Inter-industry Study 1996, which forms the basis of the multiplier analysis contained in this report, n = 126.

Thus a_{ij} is the proportion of sector *j*'s total output (the value of which is equivalent to the value of sector *j*'s total input) and is made up of inputs from other sectors (*i).*

Given equation *(1),* sector *i*'s sales can be rewritten and expressed in terms of technical coefficients as:

$$x_i = a_{i1}x_1 + a_{i2}x_2 + \ldots + a_{in}x_n + f_i \qquad (3)$$

Equations (1) and (3) respectively can be written in matrix form as:

$$\mathbf{x = Zi + f} \qquad (4)$$

$$\mathbf{x = Ax + f} \qquad (5)$$

where **i** is an *n*-element column vector of 1s.

Recall that equations *(1)* and *(3)*, and hence *(6)* and *(7)*, are equivalent.

Using an *n*x*n* identity matrix and rearranging equation *(5)* yields:

$$\mathbf{Ix - Ax = f}$$

$$\Rightarrow \quad \mathbf{(I - A)x = f} \qquad (8)$$

From this we can derive the change in output, $\mathbf{x}^*$, arising from a change in final demand, $\mathbf{f}^*$:

$$\mathbf{x}^* = \mathbf{(I - A)}^{-1}\mathbf{f}^* \qquad (9)$$

$\mathbf{(I - A)}^{-1}$ is the Leontief Inverse, or the total (initial, direct and indirect) requirements matrix. This can be represented by **B** so that:

$$\mathbf{x}^* = \mathbf{Bf}^* \qquad (10)$$

A.1.1 Output multipliers

Re-expressing equation *(10)* in expanded format gives:

$$\mathbf{x}^* = \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & \vdots & & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{pmatrix} \begin{pmatrix} f_1^* \\ f_2^* \\ \vdots \\ f_n^* \end{pmatrix}$$

From this it can be seen that the economy-wide impact of f_j^* is:

$$\mathbf{x}^{*} = \sum_{i=1}^{n} b_{ij} f_j^{*} \qquad (11)$$

For $f_j^{*} = 1$, $\mathbf{x}^{*}$ reduces to:

$$\mathbf{x}^{*} = \sum_{i=1}^{n} b_{ij} \qquad (12)$$

$\mathbf{x}^{*}$ is the (Type I) *output multiplier*: that is, how much does economy-wide output have to increase to meet a $1 increase in final demand for the output of sector *j*.

A.1.2 Income multipliers

In principle these are calculated in the same way as for output multipliers; the distinction is that changes in sectoral output arising from a change in final demand are scaled by each sector's labour input coefficient (ie the value of payments for labour – income).

The labour input coefficients are calculated using the compensation of employees row of the input-output table. We shall denote the elements in this row as z_{cj}. In a manner similar to that used to derive the direct input coefficients in equation *(2)*, the labour input coefficients are:

$$a_{cj} = z_{cj} / x_j \qquad (13)$$

By using this to scale the impact of changes in output we have:

$$H_j = \sum_{i=1}^{n} a_{ci} b_{ij} / a_{cj} \qquad (14)$$

This is the (Type I) *income multiplier*. Its interpretation is: how much will economy-wide income increase, above the initial increase in sector *j*'s income payments, given an increase in final demand of sector *j*'s output of $1.

A.1.3 Employment multipliers

These are calculated as for the income multipliers, but rather than use compensation of employees to scale the output effects we have used the ratio of full time equivalent (FTE) jobs to output by sector. This employment ratio is:

$$e_j = FTE_j / x_j \qquad (15)$$

Using this in our multiplier calculation gives:

$$E_j = \sum_{i=1}^{n} e_i b_{ij} / e_j \qquad (16)$$

A.2 Derivation of Type II multipliers

In the calculations above, the matrix elements are restricted to those within the *n*x*n* confines of the transactions matrix of the 1996 Inter-industry tables. However, this effectively excludes the impact of changes in household income arising from additional final demand, since household income and consumption is outside of the *n*x*n* matrix. Type II multipliers address this issue by expanding the *n*x*n* matrix to include household consumption and compensation of employees. Households are effectively treated as another production sector in Type II multiplier analysis, producing labour services and demanding consumption goods and services.

The technical coefficients for the household row and column are:

$$a_{cj} = z_{cj} / x_j \qquad (17)$$

$$a_{ic} = z_{ic} / x_c \qquad (18)$$

where:

a_{cj} = the labour coefficient for sector *j*

a_{ic} = the 'household consumption' coefficient.

In equation *(18)*, x_C represents household disposable income. For the analysis contained in this report we calculated household disposable income as the sum of:

- compensation of employees (from the input-output tables)
- self-employed earnings (derived from SNZ's *Institutional Sector Accounts*)
- dividend earnings (derived from SNZ's *Institutional Sector Accounts*)

and then subtracted tax from that sum using an average personal income tax rate derived from the *Institutional Sector Accounts*.

Appendix B : List of regional multipliers

Sector	Output_I	Output_II	Income_I	Income_II	Employ_I	Employ_II
Other horticulture	1.56	2.84	1.58	2.56	1.21	1.50
Apple and pear growing	1.77	3.48	1.57	2.54	1.27	1.62
Kiwifruit growing	1.73	3.01	1.88	3.04	1.75	2.48
Other fruit growing	1.68	2.96	1.79	2.90	1.21	1.43
Mixed livestock and cropping	1.83	2.94	2.55	4.13	1.68	2.20
Sheep and beef cattle farming	1.91	2.99	2.76	4.47	1.64	2.02
Dairy cattle farming	1.65	2.83	1.74	2.82	1.54	2.10
Other farming	1.71	2.80	2.21	3.58	1.30	1.57
Services to agriculture, hunting and trapping	1.74	3.21	1.69	2.75	1.51	2.03
Forestry	1.79	3.05	2.24	3.62	5.24	8.66
Services to forestry	1.52	3.27	1.34	2.17	1.35	2.01
Logging	1.49	3.08	1.35	2.19	1.31	1.86
Fishing	1.55	2.44	1.93	3.13	1.71	2.45
Coal mining	1.80	3.14	1.88	3.04	2.27	4.14
Services to mining	1.40	3.42	1.21	1.97	1.28	2.14
Other mining and quarrying	1.72	2.97	1.82	2.95	2.06	3.41
Oil & gas extraction	1.56	2.61	1.68	2.72	6.31	14.42
Oil & gas exploration	2.01	2.83	21.69	35.17	5.35	8.16
Meat processing	2.31	3.66	2.62	4.25	4.27	5.79
Poultry processing	1.69	2.81	1.92	3.11	2.47	3.83
Bacon, ham and smallgood manufacturing	1.89	3.12	2.16	3.50	2.02	2.88
Dairy product manufacturing	1.63	2.29	3.23	5.23	4.48	6.52
Fruit and vegetable, oil and fat, cereal manufacturing	1.94	3.10	2.47	4.01	2.75	4.09
Bakery, sugar and confectionery manufacturing	1.87	3.06	2.14	3.48	2.08	3.13
Seafood processing	1.90	3.04	2.27	3.68	2.95	4.61
Other food manufacturing	1.61	2.66	1.83	2.97	1.87	2.89
Soft drink, cordial and syrup manufacturing	1.53	2.51	1.82	2.94	3.01	5.33
Beer, wine, spirit and tobacco manufacturing	1.76	2.86	2.29	3.71	3.29	5.32
Textile manufacturing	1.64	2.79	1.77	2.87	1.64	2.35
Clothing manufacture	1.43	2.70	1.40	2.28	1.24	1.64
Footwear manufacture	1.41	2.72	1.33	2.16	1.31	1.93
Other leather product manufacturing	1.56	2.49	1.73	2.81	1.61	2.25
Log sawmilling and timber dressing	2.08	3.46	2.35	3.81	2.13	3.30
Other wood product manufacturing	1.66	2.81	1.79	2.91	1.61	2.36
Paper & paper product manufacturing	1.68	2.84	1.80	2.91	2.33	4.24
Printing and services to printing	1.58	2.88	1.53	2.48	1.43	2.17
Publishing, recorded media manufacturing	1.56	2.98	1.47	2.38	1.51	2.44
Petroleum refining	1.30	1.54	3.38	5.49	2.76	4.93
Petroleum and coal product manufacturing	1.72	2.75	2.31	3.75	1.70	2.37
Fertiliser manufacturing	1.85	2.64	3.08	4.99	3.87	6.33
Other industrial chemical manufacturing	1.66	2.61	2.11	3.41	2.40	3.97
Medicinal, detergent and cosmetic manufacturing	1.65	2.76	1.85	3.00	2.08	3.37
Other chemical product manufacturing	1.64	2.69	1.88	3.05	2.18	3.63
Rubber manufacturing	1.40	2.58	1.40	2.27	1.54	2.56
Plastic product manufacturing	1.41	2.46	1.43	2.32	1.48	2.40
Glass and glass product and ceramic manufacturing	1.48	2.70	1.47	2.39	1.41	2.13
Other non-metallic mineral product manufacturing	1.71	3.01	1.79	2.90	2.22	3.87
Basic metal manufacturing	1.59	2.60	1.81	2.94	1.97	3.26
Structural, sheet and fabricated metal product manufacturing	1.80	3.20	1.80	2.91	1.71	2.60
Motor vehicle and part manufacturing	1.75	2.71	2.47	4.01	2.36	3.48
Ship and boat building	1.51	2.81	1.48	2.40	1.39	1.96
Other transport equipment manufacturing	1.28	2.54	1.26	2.05	1.36	2.37
Photographic and scientific equipment manufacturing	1.49	2.76	1.49	2.42	1.50	2.29
Electronic equipment and appliance manufacturing	1.71	2.99	1.81	2.94	1.82	2.80
Agricultural machinery manufacturing	1.69	3.07	1.69	2.73	1.55	2.28
Other industrial machinery & equipment manufacturing	1.68	3.10	1.63	2.65	1.52	2.23
Prefabricated building manufacturing	1.53	2.54	1.74	2.83	1.45	2.04
Furniture manufacturing	1.61	2.81	1.67	2.71	1.40	1.92
Other manufacturing	1.47	2.67	1.47	2.38	1.25	1.66
Electricity generation	1.53	2.66	1.79	2.90	3.30	6.73
Electricity transmission	1.40	2.65	1.48	2.40	3.42	7.23
Electricity supply	2.26	3.66	2.85	4.62	4.10	8.37
Gas supply	1.49	2.42	1.76	2.85	2.89	5.72
Water supply	1.94	3.22	2.03	3.30	2.19	3.89

Residential building construction	1.96	3.11	2.85	4.62	2.05	2.79
Owner builders	2.43	3.53	44.86	72.75	2.91	3.62
Non residential building construction	2.14	3.38	3.32	5.39	3.68	5.33
Non building construction	2.00	3.44	2.19	3.55	2.35	3.70
Site preparation services	1.81	3.16	1.88	3.05	1.96	2.92
Building structure services	1.75	3.07	1.83	2.97	1.46	1.94
Plumbing services	1.75	3.05	1.91	3.10	1.56	2.09
Installation trade services	1.67	2.96	1.77	2.87	1.53	2.13
Building completion services	1.73	3.10	1.74	2.83	1.39	1.80
Other construction services	1.69	3.06	1.70	2.76	1.44	1.96
Wholesale trade	1.54	2.85	1.55	2.51	1.60	2.50
Retail trade	1.59	3.13	1.49	2.41	1.27	1.68
Accommodation	1.67	3.03	1.60	2.59	1.23	1.55
Bars, clubs, cafes and restaurants	1.73	2.99	1.78	2.88	1.26	1.56
Road freight transport	1.77	3.20	1.90	3.08	1.89	2.76
Road passenger transport	1.58	3.17	1.48	2.40	1.28	1.69
Water and rail transport	1.53	3.17	1.44	2.33	1.71	3.20
Air transport, services to transport and storage	1.48	2.66	1.53	2.48	1.63	2.61
Communication services	1.37	2.67	1.35	2.19	1.52	2.70
Finance	1.45	3.06	1.39	2.25	1.56	2.71
Life insurance	1.92	3.41	2.37	3.84	2.61	4.02
Superannuation fund operation	2.21	3.43	14.73	23.89	4.00	5.72
Health insurance	1.81	3.55	1.79	2.91	1.63	2.40
General insurance	1.49	2.88	1.49	2.41	1.71	2.84
Services to finance and insurance	1.61	3.08	1.62	2.63	1.61	2.41
Residential property operators	1.49	2.24	2.06	3.34	24.19	42.01
Commercial property operators	1.31	2.45	1.35	2.18	1.46	2.49
Real estate agents	2.02	3.56	2.13	3.45	1.90	2.51
Ownership of owner-occupied dwellings	1.35	4.15	1.13	1.84	12.72	65.70
Investors in other property	2.11	3.19	18.38	29.81	4.44	6.17
Vehicle and equipment hire	1.54	2.57	1.84	2.98	1.86	2.80
Scientific research	1.45	3.46	1.27	2.07	1.32	2.03
Technical services	1.54	3.19	1.45	2.34	1.43	2.15
Computer services	1.47	3.02	1.40	2.27	1.51	2.45
Legal services	1.37	3.05	1.28	2.08	1.28	1.90
Accounting services	1.39	3.20	1.28	2.07	1.28	1.88
Advertising and marketing services	1.63	2.97	1.71	2.78	1.79	2.88
Business administrative and management services	1.45	2.86	1.44	2.34	1.30	1.80
Employment, security and investigative services	1.46	3.30	1.35	2.18	1.32	1.96
Pest control and cleaning services	1.37	3.34	1.24	2.01	1.20	1.66
Other business services	1.70	3.15	1.80	2.92	1.46	1.97
Central government administration	1.74	3.53	1.59	2.58	1.57	2.30
Defence	1.35	3.25	1.20	1.94	1.24	1.92
Public order and safety services	1.25	3.56	1.11	1.80	1.14	1.76
Local government administration services and civil defence	1.82	3.35	1.87	3.04	2.30	3.63
Pre-school education	1.40	3.67	1.22	1.97	1.17	1.55
Primary and secondary education	1.26	3.53	1.12	1.82	1.11	1.55
Post school education	1.41	3.60	1.19	1.93	1.25	1.97
Other education	1.57	3.38	1.44	2.34	1.27	1.64
Hospitals and nursing homes	1.32	3.48	1.16	1.88	1.24	1.99
Medical, dental and other health service	1.44	3.02	1.37	2.22	1.31	1.81
Veterinary services	1.42	3.07	1.31	2.13	1.26	1.75
Child care services	1.43	3.58	1.28	2.07	1.13	1.33
Accommodation for the aged	1.53	3.52	1.35	2.20	1.22	1.56
Other community care services	1.62	3.66	1.45	2.34	1.38	1.88
Motion picture, radio and TV services	1.52	2.90	1.54	2.50	1.71	2.79
Libraries, museums and the arts	1.76	3.52	1.69	2.74	1.35	1.73
Horse and dog racing	1.93	3.21	2.52	4.08	1.77	2.33
Lotteries, casinos and other gambling	1.36	2.57	1.36	2.21	1.56	2.74
Other sport and recreational services	1.87	3.24	2.26	3.66	1.69	2.29
Personal and other community services	1.59	3.33	1.47	2.38	1.21	1.51
Waste disposal, sewerage and drainage services	1.74	3.17	1.77	2.88	1.64	2.22
Household sector	0.00	3.87	0.00	0.00	0.00	0.00

Appendix C : Source of students

Table 5 Students by last known secondary school
EFTS loads, 2005

Local body of last known Secondary school	Full time	% of total	Part time	% of total
Auckland	15406	63.7	2663.5	44.9
Bay of Plenty	444	1.8	104	1.8
Canterbury	260	1.1	108	1.8
Correspondence school	42	0.2	14	0.2
Gisborne	41	0.2	29	0.4
Hawkes bay	160	0.7	68	1.2
Manawatu-Wanganui	182	0.8	72	1.2
Marlborough	6	0.0	4	0.1
Nelson	32	0.1	12	0.2
Northland	477	2.0	138	2.3
Otago	86	0.4	36	0.6
Southland	27	0.1	23	0.4
Taranaki	125	0.5	49	0.8
Tasman	13	0.1	8	0.1
Waikato	666	2.8	198	3.3
Wellington	272	1.1	113	1.9
West Coast	7.7	0.0	5.4	0.1
Other	5924	24.5	2294	38.7
Total	24170	100.0	5931	100.0

Source: University of Auckland