Financial Aid and Academic Performance at Simon Fraser University: The Effects of Merit-Based versus Need-Based Aid

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EXECUTIVE SUMMARY:

The office of Analytical Studies conducted a study for the Senate Policy Committee on Scholarships, Awards & Bursaries in order to address the following research question:

> ***Which type of financial aid, merit-based or need-based, is more successful in improving student performance?***

Students were separated into three groups based on which type of financial aid they received: merit-based (scholarships and entrance scholarships), need-based (bursaries and work-studies), or none. Regression models were fit for nine academic performance measures. These models controlled for baseline student GPA, sex, international student status, coming from a lower mainland high school, and entry faculty.

Financial aid was found to significantly improve many of the academic performance measures that we examined (for students admitted to SFU directly from BC secondary schools between spring 1996 to fall 2005.)

Compared to equivalent students who received no financial aid, **both merit-based and need-based aid recipients achieved the following academic benefits**:

- higher CGPA at 60 credits
- higher graduation GPA
- higher persistence rates (measured at 30 and 60 credits)
- greater number of credits completed (among need-based aid recipients only)
- higher degree completion rates
- lower rates of unsatisfactory academic standing (OAP, RTW[1])

A number of differences in academic performance between merit-based and need-based aid recipients were found:

- **merit-based aid recipients achieved higher GPA outcomes**:
  - higher CGPA at 60 credits
  - higher graduation GPA
  - lower OAP rates
- **need-based aid recipients achieved better retention outcomes**:
  - higher persistence rates
  - higher degree completion rates

Cautions and implications of the results are briefly discussed, and further recommendations are offered. It is suggested that the Committee pursue the development of access and performance indicators that can be tracked yearly to assess the impact of the financial aid program.

[1] OAP stands for "On Academic Probation" within two years. RTW stands for "Required to Withdraw" within two years.

BACKGROUND INFORMATION:

Introduction and Study Objectives:

This report was prepared by the Office of Analytical Studies at the request of the Senate Policy Committee on Scholarships, Awards & Bursaries (SPCSAB) at Simon Fraser University. It outlines the results of a study that examines the relationship between financial aid and student performance. The **research question** is:

> ***Which type of financial aid, merit-based or need-based, is more successful in improving student performance?***

In this report, we present the results of formal statistical tests for differences in performance measures between students receiving different types of financial aid. The analyses control for baseline factors that might influence the relationship between academic performance and financial aid. Definitions of statistical terms can be found in Appendix D.

Study Methodology:

The dataset used in this study is comprised of all students admitted to SFU directly from grade 12 at a British Columbia high school, from spring 1996 to fall 2005. For the purposes of this study, students were separated into **three groups** based on the type of financial aid they received from SFU:

1. Students receiving **merit-based financial aid** only, which includes:
   - scholarships
   - entrance scholarships
2. Students receiving **need-based financial aid** only, which includes:
   - bursaries
   - work studies
3. Students receiving **no financial aid**

Students who received other types of financial aid or more than one type of aid were excluded from the analyses, in order to avoid results that are complicated by students who received an extra financial advantage from SFU.

Nine student **academic performance measures** were analyzed in this study:

GPA:

1. Graduating GPA
2. CGPA at 60 credits

Retention:

3. Successful Completion of 30 credits
4. Successful Completion of 60 credits

5. Degree Completed
6. Number of Credit Hours Completed at SFU

Other Performance Measures:

7. Number of Terms Required to Graduate
8. On Academic Probation (OAP) within Two Years of admission to SFU
9. Required to Withdraw (RTW) within Two Years of admission to SFU

A regression model was fit for each performance measure. Logistic Regression Models were fit for binary performance outcome variables (such as degree completion), and Analysis of Variance Models were fit for continuous outcomes (such as GPA). The models include indicator variables that identify the type of financial aid received by students. These indicator variables allow us to compare the performance of students receiving each type of financial aid against a common control group of students receiving none. Full regression models control for the following baseline student characteristics: sex, entry faculty, coming from a lower mainland high school, being designated as an international student, and admission GPA or CGPA at 30 credits. These student characteristics could influence the relationship between financial aid and performance, and they are included in the models to control for this possible confounding effect. The amount of aid received and the timing of the aid were not considered in this study. Raw comparisons of performance among the three groups can be found in Appendix B.

Analyses involving some of the outcome variables excluded some students. For example, when we looked at graduation rates, we excluded students who were admitted after fall 1999, so that students in the analysis would have had adequate time to complete their degrees (6 years). Table 1 outlines the criteria for which students were included in each of the analyses. In addition, students with missing data for any of the variables were excluded from associated analyses.

Table 1: Criteria for Including Students in the Analyses by Performance Outcome

Performance Measure	Inclusion Criteria	Sample Size		
		merit	need	none
Graduating GPA	successful graduation	600	591	4044
CGPA at 60 credits	successful completion of 60 credits	1387	1051	7557
Completed 30 credits	admitted at least 2 years ago	1658	1176	11059
Completed 60 credits	admitted at least 3 years ago	1147	1064	9690
Degree Completion	admitted at least 6 years ago	581	536	5213
# Credit Hrs Completed	admitted at least 6 years ago; separated at completion of 90 credits (see Appendix A for details)	581	536	5213
# Terms to Graduate	successful graduation	629	622	4281
OAP within 2 Yrs	admitted at least 2 years ago	1658	1176	11059
RTW within 2 Yrs	admitted at least 2 years ago	1658	1176	11059

Comparisons within any given model between students receiving merit-based and need-based aid were Bonferroni corrected to avoid errors associated with multiple comparisons. However, Bonferroni corrections were not applied between models, and the results of these analyses should be treated as exploratory and hypothesis-generating, rather than definitive.

RESULTS:

Table 2 summarizes the results of the regression models, which test for a predictive relationship between financial aid and academic performance, while controlling for other variables that might affect this relationship. Note that model effect sizes can be found in Appendix C.

Table 2: Summary of Regression Model Results

Performance Measure	merit vs. none	need vs. none	Best: merit vs. need	Signif. Control Variables: Baseline GPA	Sex (F)	Lower Mainland HS Graduate	International	Entry faculty
Graduating GPA	+	+	merit	+	+	-	-	*
CGPA at 60 credits	+	+	merit	+	+		-	*
Completed 30 credits	+	+	need	+	+	+	-	*
Completed 60 credits	+	+	need	+	+	+		*
Degree Completion	+	+	need	+	+	+		*
# Credit Hrs (<90)		+	=	+		+		*
# Credit Hrs (>=90)		+	=	+	-		-	*
# Terms to Graduate	-		=	+	+		+	*
OAP within 2 Yrs	+	+	merit	+	+	+	-	*
RTW within 2 Yrs	+	+	=	+	+		-	*

*, + - Indicate the presence of a statistically significant relationship, where the presence or size of the variable contributes to improved (+) or decreased (-) performance

= Indicates no difference in performance between merit-based and need-based aid students

In general, improved performance implies an increase in the performance measure. Exceptions to this are "# Terms to Graduate", "OAP", and "RTW", for which a decrease in the measure corresponds to improved performance.

Academic Benefits of Financial Aid:

The models indicate that when we control for important baseline student attributes, students receiving financial aid outperform those receiving none in most performance measures**. Both merit-based and need-based aid improve:**

- graduating GPA,
- 60 credit CGPA,
- 30 credit survival,
- 60 credit survival,
- degree completion, and
- academic standing (lower OAP and RTW rates)

In addition, **students with need-based aid complete more credits at SFU than students receiving no aid**. It should be noted that students must be enrolled in at least nine credits per term to be eligible for need-based aid, as well as most types of merit-based aid.

Only in the number of terms required to graduate does financial aid fail to improve performance: among students who graduated, **those receiving merit-based aid took significantly longer to complete their degrees than those receiving no financial aid.** Of course this does not necessarily imply that giving financial aid results in longer completion times. This result may be attributable to students being in co-op programs, in honours programs, or in other degree programs that require more time or credits to complete.

Relative Benefit of Merit-Based versus Need-Based Aid:

Among the performance measures that are improved by both types of aid, the relative value of merit-based versus need-based aid is not consistent. Students who receive merit-based financial aid outperform those receiving need-based aid in CGPA at 60 credits and graduating GPA, even when we control for earlier GPA and other baseline covariates. This means that, in general, **students with the same 30-credit CGPA, sex, entry faculty, lower mainland and international status, will have a better 60 credit and graduating GPAs if they receive merit-based aid than if they receive need-based aid.**

On the other hand, Students receiving need-based aid outperform those receiving merit-based aid in many of the retention-related performance measures: completion of 30 credits, completion of 60 credits, and degree completion. In essence, **a student who receives need-based aid is more likely to stay at SFU for longer than an equivalent student (equivalent in terms of the control variables) receiving merit-based aid.**

Finally, **students receiving merit-based aid are less likely to be on academic probation within two years of admission than those receiving need-based aid.**

For the remaining performance measures that we considered, there is no statistically significant difference in the benefit of merit-based aid versus need based aid. Performance measures that fall into this group include the number of credit hours completed, the number of terms required to graduate, and being required to withdraw within two years of admission to SFU.

Influence of Other Variables on Academic Performance:

The baseline control variables are important in all of the models, regardless of a student's financial aid status:

- having a higher early GPA improves performance in all models,
- females often have improved performance over males,
- students from the Lower Mainland tend to have improved performance over those who graduated from secondary school elsewhere,
- International students tend to perform worse overall than non-international students, although they require fewer terms to graduate. This may be because, among graduates, international students took more credits per term than non-international students.
- Entry faculty is a significant predictor of performance in all models.

Financial Aid Benefits Separated by Faculty among Degree Completers:

In order to further examine the role of faculty in the relationship between financial aid and student performance, a secondary analysis focusing on graduating students was undertaken. This analysis fit regression models (controlling for baseline student characteristics) for graduating GPA and the number of terms required to graduate, separately by graduating faculty[2]. (Graduating faculty was used in this analysis due to the fairly loose match between entering and graduating faculties.) Because of sample size restrictions, this analysis was limited to four faculties: Applied Science, Arts and Social Sciences, Business Administration, and Science. The results are summarized in Table 3.

Among degree completers, no differences in the length of time to graduation were found between the financial aid groups in any faculty. However, we did find that higher graduation GPA's were achieved among:

- merit-based aid recipients in all four faculties (versus no aid),
- need-based aid recipients in Applied Sciences (versus no aid), and
- merit-based aid recipients in Arts and Social Sciences (versus need-based).

[2] Analyses were separated by faculty in order to determine whether the benefit of financial aid differs for students in different areas of study.

Table 3: Summary of Regression Models Separated by Graduating Faculty

Graduating Faculty	Performance Measure	merit vs. none	need vs. none	Best: merit vs. need
Applied Science (n = 1147)	Graduating GPA	+	+	=
	# Terms to Graduate			=
Arts and Social Sciences (n = 2111)	Graduating GPA	+		merit
	# Terms to Graduate			=
Business Administration (n = 936)	Graduating GPA	+		=
	# Terms to Graduate			=
Science (n = 840)	Graduating GPA	+		=
	# Terms to Graduate			=

+ Indicates a statistically significant relationship in which the presence or size of the variable contributes to improved performance

= Indicates no difference in performance between merit-based and need-based aid students

Improved performance implies an increase in "Graduating GPA", or a decrease in "# Terms to Graduate".

CAUTIONS:

There are a few key points to keep in mind when interpreting these results. First of all, we are only considering whether or not a student received financial aid, and we are not looking at the timing of this aid. This means that in some cases, the financial aid may have been awarded after the outcome of interest. For example, when we consider CGPA at 60 credits, we may be labeling some students as having received aid, when in fact they did not receive any aid until after 60 credits. In such cases, we cannot argue that the financial aid was a causal factor in the outcome (CGPA at 60 credits.)

We have also made a number of other simplifications. We have not included students who received other types of aid from SFU. We are also not considering financial aid that students may be receiving from external sources. Such aid could certainly affect student performance, and if it is also associated with whether or not students receive internal aid, it could be a confounding factor in the models.

Finally, several of the models exhibit low predictive power and poor fit to the data. This means that we are sometimes missing some key predictor variables. These may be variables that we are unable to capture, such as personal motivation, parental pressure, employment status, *etc*. However, prediction is not our primary reason for modeling, and it is still valid to say that we have controlled for particular baseline student attributes, and found financial aid to be a significant factor in student performance. Even so, it is important to remember that these analyses are exploratory, and the results cannot be reported as definitive.

CONCLUSIONS AND RECOMMENDATIONS:

The analyses conducted thus far suggest that **both merit-based and need-based aid improve most student performance measures**. Students receiving merit-based aid are more likely to have high GPA and less likely to be on academic probation than equivalent students receiving need-based aid. Conversely, students who receive need-based aid are more likely to remain at SFU longer and complete their degrees than equivalent students who receive merit-based aid. Only in the number of terms required to graduate do students receiving financial aid (merit-based aid) perform worse than students receiving none, although this result may simply reflect the fact that some programs that take longer to complete.

The results presented herein can be used to loosely predict the effects of making certain types of changes to the University's financial aid disbursement practices. Based on the SPCSAB's goals for the financial aid program, these results can help to prioritize the allocation of scholarship versus bursary budgets: increasing merit-based aid may lead to higher student GPAs, while increasing need-based aid may result in greater student retention.

It has recently been suggested in a draft report by the Sub-Committee on Access Issues that a series of indicators be developed to "track access and the impacts of funding levels so that the consequences of policy decisions with respect to tuition levels and scholarship and bursary funding can be assessed." We recommend that the SPCSAB pursue the development of access and performance indicators that can be easily quantified on a yearly basis, so that trends over time can be investigated. Examples of such indicators might include:

General Indicators

- Expenditures on Scholarship & Bursaries ÷ Total Tuition Revenue
- Percentage of graduating students who received financial aid from SFU
- Average amount of financial aid received from SFU by graduating students

Indicators to be Compared between Financial Aid Recipients and Non-Recipients

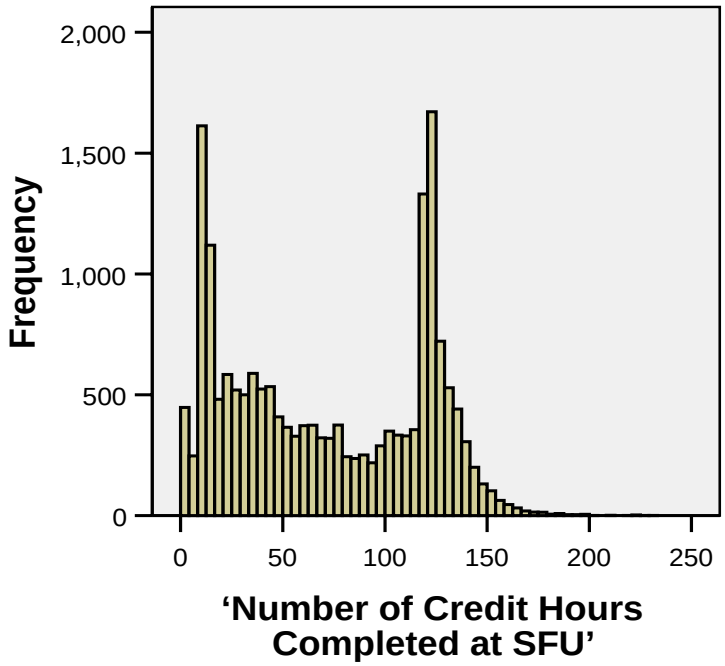
- Graduating GPA
- Number of terms required to graduate
- 30 or 60 credit survival
- Degree completion rate
- OAP rates
- RTW rates

The Office of Analytical Studies would be happy to discuss and clarify these suggestions with the Committee. As shown in this study, it is important to control for other baseline characteristics in the development and reporting of many of these proposed indicators.

APPENDIX A: NUMBER OF CREDIT HOURS COMPLETED

Analyses of performance measure #6, "Number of Credit Hours Completed at SFU", were conducted slightly differently than the analyses of the other continuous performance variables. The reason for this difference lies in the distribution of the variable. Figure 1 shows a histogram of the number of credits completed. The height of each bar represents the number of students completing a certain number (or range) of credit hours.

Figure 1: Distribution of "Number of Credit Hours Completed at SFU"



When distributions show this sort of bimodal shape, it suggests that there are two distinct populations within the dataset. Parametric statistical tests and models are designed to work on single populations. Ideally, this problem would be handled by determining the underlying factor that distinguishes the two populations, and separating the data into two groups based on this factor. However, in this case, we do not know what the underlying factor is. As an imperfect solution to this problem, the data were divided into two groups based on the number of credit hours completed. Analyses were conducted separately for students who completed fewer than 90 credits and those completing 90 or more credits. This cut-off value was selected because it is the low point between the two peaks in the distribution displayed in Figure 1. In addition, when raw performance values were compared among the three financial aid groups (see Table 4, in Appendix B), a non-parametric test (the Mann-Whitney Test) was used for this performance measure. This test is more appropriate for bimodal distributions than the corresponding parametric tests, and was used only when the data were not divided into two groups at the 90-credit cut-off point.

APPENDIX B: RAW PERFORMANCE COMPARISONS

In this section, raw comparisons of the performance measures among the three students groups (merit-based aid, need-based aid, and no financial aid) are presented. These comparisons do not control for underlying students characteristics. As such, the results can be incorrect or misleading. The reason for including these analyses is that they provide interesting context. These are the relationships between financial aid and performance, as they appear on the surface, without considering the impact of confounding variables.

Table 4 outlines the raw performance comparisons. The "Sig. > None" columns indicate whether the performance of students receiving aid is significantly better than the performance of students receiving no aid. The "Best" column indicates whether students with merit-based aid or those with need-based aid have the greater improvement over students with no aid.

Table 4: Raw Differences in Academic Performance between Students Receiving Merit-Based Aid, Need-Based Aid, and No Financial Aid from SFU

Performance Measure	Sample Size			Mean or %			Sig. > None		Best:
	merit	need	none	merit	need	none	merit	need	merit vs. need
Graduating GPA	600	591	4044	3.49	2.98	2.90	+	+	merit
CGPA at 60 credits	1387	1051	7557	3.39	2.83	2.74	+	+	merit
Completed 30 credits	1658	1176	11059	95.1%	96.9%	83.6%	+	+	=
Completed 60 credits	1147	1064	9690	89.1%	93.0%	73.3%	+	+	=
Degree Completion	581	536	5213	81.4%	82.6%	63.0%	+	+	=
# Credit Hours:									
All Students†	581	536	5213	117.4	120.4	96.4	+	+	=
< 90 Credits	76	50	1660	40.2	48.7	33.4	+	+	=
>= 90 Credits	505	486	3553	129.1	127.8	125.8	+	+	=
# Terms to Graduate	629	622	4281	15.9	16.0	15.9			=
OAP within 2 Yrs	1658	1176	11059	5.5%	22.7%	36.4%	+	+	merit
RTW within 2 Yrs	1658	1176	11059	1.6%	4.1%	15.4%	+	+	merit

+ Indicates a statistically significant improvement in mean or odds over students with no financial aid, ($p < 0.05$)
= Indicates no difference in performance between merit-based and need-based aid students
† p-values for this outcome are based on non-parametric Mann-Whitney Tests. See Appendix A for details.

As Table 4 indicates, when we do not control for underlying student characteristics, every performance measure except "The Number of Terms Required to Graduate" is significantly improved among students who receive financial aid from SFU. For performance measures related to retention, students receiving either type of aid have equivalent performance improvement over those receiving no aid. Students receiving

merit-based aid have greater performance improvement than those receiving need-based aid for GPA, OAP, and RTW performance measures.

When interpreting these results, it is important to remember that we have not yet controlled for any baseline student attributes which may influence the relationships between financial aid and student performance.

APPENDIX C: MODEL EFFECT SIZES

This section contains the effect sizes from the regression models. Table 5 contains the effect sizes (displayed as odds ratios) for the binary performance outcomes (such as degree completion.) An odds ratio of 1 implies that there is no difference in performance between recipients and non-recipients of financial aid. A statistically significant odds ratio that is greater than 1 implies that the odds of the outcome is increased for recipients of financial aid. For example, students who received need-based aid have three times the odds of completing their degree over students with no financial aid.

Table 6 displays the effect sizes for the continuous performance measures (such as GPA.) In this case, the effect size is simply a difference. So for example, after controlling for baseline characteristics, students who received merit-based aid graduated with a GPA that was on average 0.10 higher than the GPA of students without aid. (Note that if you control for admission GPA rather than 30-credit GPA, the difference between the two groups increases to 0.38. See Table 7 and the next paragraph for an explanation of methods.) An effect size of '---' does not statistically differ from zero.

Wherever possible, the models controlled for 30-credit GPA rather than admission GPA, because doing so greatly improved the fit of the models. Thirty-credit GPA was therefore used in the models for all performance outcomes that were restricted to students who had persisted at SFU for at least 30 credits: 'Graduating GPA', 'GPA at 60 Credits', Number of Credit Hours Completed (among student completing at least 90 credit hours)', and 'Number of Terms Required to Graduate'. Since admission GPA may be a more appropriate control variable for financial aid purposes, Table 7 contains the effect sizes for these four variables when controlling for admission GPA rather than 30-credit GPA.

Note that **when models have poor fit, their effect sizes are very unstable**, and adding new variables to the models could substantially change the effect sizes. In this study, the purpose of modelling was not prediction. **These effect sizes should serve only as guides, and should be used for prediction with caution**.

Table 5: Model Effect Sizes (Odds Ratios) for the Binary Performance Measures

Performance Measure	Odds Ratio		Significant Difference		Best:
	merit vs. none	need vs. none	merit vs. none	need vs. none	merit vs need
Completed 30 credits	2.2	6.9	*	*	need
Completed 60 credits	1.7	5.5	*	*	need
Degree Completion	1.5	3.0	*	*	need
OAP within 2 Yrs	0.28	0.51	*	*	merit
RTW within 2 Yrs	0.23	0.25	*	*	=

* Indicates a statistically significant difference at the 0.05 level of significance
Note: An Odds Ratio of 1 implies no difference between the two groups.
Note: These models controlled for Admission GPA, not 30-Credit GPA.

Table 6: Model Effect Sizes (Differences) for the Continuous Performance Measures (Controlling for 30-Credit GPA Where Possible)

Performance Measure	Effect Size: merit vs. none	Effect Size: need vs. none	Significant Difference: merit vs. none	Significant Difference: need vs. none	Best: merit vs need
Graduating GPA	0.10	0.03	*	*	merit
GPA at 60 credits	0.05	0.01	*	*	merit
# Credit Hrs (<90) †	---	15.2		*	=
# Credit Hrs (>=90)	---	1.8		*	=
# Terms to Graduate	0.4	---	*		=

* Indicates a statistically significant difference at the 0.05 level of significance

Note: An Effect Size of 0 implies no difference between the two groups. Effect Sizes of '---' do not differ statistically from 0.

† The model for this performance measure controlled for Admission GPA, not 30-Credit GPA.

Table 7: Model Effect Sizes (Differences) for the Continuous Performance Measures (Controlling for Admission GPA, NOT 30-Credit GPA)

Performance Measure	Effect Size: merit vs. none	Effect Size: need vs. none	Significant Difference: merit vs. none	Significant Difference: need vs. none	Best: merit vs need
Graduating GPA	0.38	0.07	*	*	merit
GPA at 60 credits	0.39	0.07	*	*	merit
# Credit Hrs (<90)	---	15.2		*	=
# Credit Hrs (>=90)	---	2.2		*	=
# Terms to Graduate	---	---			=

* Indicates a statistically significant difference at the 0.05 level of significance

Note: An Effect Size of 0 implies no difference between the two groups. Effect Sizes of '---' do not differ statistically from 0.

APPENDIX D: STATISTICAL TERMS AND DEFINITIONS

Regression Models

"Regression analysis" is used to model relationships between random variables, and to determine the magnitude of the relationship between these variables. In essence, we want to estimate the value of an "outcome" or "response" variable (ex: student GPA, or other performance variable), based on the value of an "explanatory" variable (ex: whether a student has been given financial aid.) Regression models allow us to have multiple explanatory variables. One advantage of this approach is that we can control for baseline variables that might be confounding the relationship of interest (the relationship between financial aid and academic performance.)

Full Regression Models

The "full regression model" is the model with all explanatory variables included. This is distinguished from the "reduced regression model", in which non-significant variables are removed from the model.

Logistic Regression Models

"Logistic regression models" are regression models in which the outcome or response variable is binary (having two levels only). An example of a binary outcome variable is "Degree Completion", for which each student can have one of only two possible values: "yes" or "no".

Analysis of Variance Models

"Analysis of Variance" models are a type of "linear" regression model. Linear regression models compare the means (averages) of continuous "outcome" or "response" variables, such as GPA. In "Analysis of Variance" models, the primary "explanatory" variable of interest is categorical, rather than continuous. This categorical variable splits the dataset into different populations of interest. In this project, our primary "explanatory" variable is a three level categorical variable, indicating which type of financial aid a student received: "merit-based", "need-based", or "none".

Indicator Variables

Using "indicator variables" is a method for coding categorical variables that is often employed in regression models. Each category becomes a unique variable, which is assigned a "1" if the original observation (student) fell into that category, and a "0" otherwise. In this way, the variables "indicate" which category the observation is in. The observations in the control group (students with no financial aid) are assigned a "0" for all indicator variables, so that each variable represents one category being compared to the control group.

Statistically Significant Difference

In statistics, a result is "significant" if it is unlikely to have occurred by chance. For example, if there are two populations with the same average GPA, natural variability in samples from the populations may make it appear as though the averages differ. For any such comparison, we can calculate the probability that our results would occur by chance if the populations truly have the same average. In general, the convention has been to declare a difference to be "statistically significant" if the probability that it would occur by chance is less than 5%.

Bonferroni Corrections

Whenever a statistical test or comparison is undertaken, there is a chance that we will declare a difference to be "statistically significant" when in fact no true difference exists (see definition of "statistically significant difference".) When multiple comparisons are made, the chance of making such an error increases. With "Bonferroni corrections", we can ensure that the probability of making such an error is less than 5% in total, even when making multiple comparisons. This is achieved by having stricter requirements for declaring statistical significance in any individual test or comparison.

Histogram

A histogram shows the shape of a variable's distribution by graphically displaying frequencies. It is similar to a bar-chart, and the height of a bar shows the number of observations (students) that have a particular value or range of values for the variable being assessed.

Bimodal Distribution

"Bimodal Distributions" are distributions with two distinct peaks. Such a shape generally suggests that the dataset is comprised of two distinct populations.

Parametric Statistical Tests

"Parametric statistical tests" are tests which assume that the variables being assessed belong to specific known families of probability distributions. Many such tests work under the assumption that the data follow the "Normal" or "Gaussian" Distribution. "Non-parametric" tests do not depend on distributional assumptions, but they are generally much less powerful (less likely to detect existing differences in the data.)

Mann-Whitney Test

The "Mann-Whitney test" is a non-parametric test for the difference between two distributions. It is based on the ranking of values, rather than the values themselves. As such, it does not have any distributional requirements, and is essentially testing for a difference in the median (middle value) of two populations.