**Identifying variables affecting Students' Academic Performance among Engineering Students**

by

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Department of Computer Science

Lakehead University

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## ABSTRACT

An essential consideration for campus administrators and faculty members is that students complete their degree with good academic grades. Being able to predict factors affecting students performance is necessary to help ensure the supply of quality students. The purpose of this study is to determine the factors affecting transfer students' academic performance (AP) who are taking Baccalaureate degree in the university. The sample used in this study includes 996 students (934 males and 62 females). The data was filtered by removing students whose *cohort year* is greater than the *first term registered*, students who deceased while studying, and students with a degree other than Baccalaureate degree. The data were analysed using descriptive statistics and structural equation modelling (SEM) approaches (like Path analysis and Confirmatory Factor Analysis (CFA)).

Results revealed that (i) *male* students older than 25 to be a strong predictor of students' *academic performance*, (ii) *females* and the students *younger* than 21 significantly complete their studies *on-time*, (iii) students who are on a *Permanent resident immigration status*, have *French* as their native language or are from *India*, *Pakistan* or *other_countries* perform better, (iv) students from *Institute N* (anonymised institute) significantly complete their studies *on-time*, (v) students' *past grades* from *Institute L* and *J* shows significant positive effect on their *current grades* at the university. Furthermore, students with fewer *bridging courses* or are from *group 3* perform better at the university. These findings will help institutional planning for future students.

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First and foremost, I thank Dr. Vijay Mago for his unwavering support, encouragement and patience throughout this project. I appreciate all the help he provided me, the experience he have helped me gain, and the precious time he spent making sure my thesis is always on track.

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Furthermore, I owe so much to my whole family for their undying support, their unwavering belief that I can achieve so much. Unfortunately, I cannot thank everyone by name because it would take a lifetime but, I want you all to know that you count so much. Had it not been for all your prayers and benedictions; were it not for their sincere love and help, I would never have completed this thesis.

## DEDICATION

I am dedicating this thesis to my family and friends who have meant and continued to mean so much to me. My parents who raised me loved me and taught me to speak. I also want to thank my brother Samad who helped me out in every phase of life.

*May you all find peace in this world and happiness in Paradise*

# Chapter 1

# Introduction

Within the current Ontario post-secondary context, there is an increasing number of transfer students who are transitioning between a variety of credentials due to career shifts, employment contexts, credential dilution [37]. Statistics show that 11.4 percent of applicants apply for a university transfer, 6.1 percent of which get enrolled in universities. Due to an increase in transfer students, universities and colleges in Ontario, and worldwide, are increasingly in search of the factors that assist in supporting a new generation of students who tend to come from more varied backgrounds and life situations [9] than the traditional first-year post-secondary student.

Transferring between any post-secondary institution can be considered a significant life transition that is multi-faceted and highly variable between individual students [13] and can be related to changes in the academic, social and physical environment [34]. There are both qualitative [13] [16] studies seeking to understand the experience of transition for transfer students and quantitative studies that attempt to determine the factors responsible for transfer student success and also indicate predictions of strong *academic performance* [47] [7] [23] [14] [15] [35]. Many studies indicate a need to understand the variables predictive of success so that institutional planning and analysis departments can analyse measures to advise potential changes in student support service delivery, academic advising, and curriculum delivery.

Many studies focus on various interpretations of the concept of *academic performance*, a latent variable, which is predicted by a multitude of observed variables that shift based on the institutional context. *Academic performance* has been evaluated by counting the amount of time a student has to re-take exams [14], cumulative GPA [35] and test scores [39]. Students' success is measured by different independent variables: Amuda et al. used [7] marital status, age, gender, parents education; Jacobs and King [26] used ethnicity, employment, the origin of birth and full-time/part-time status; and Sulaiman et al. [50] used undergraduate GPA and undergraduate discipline to predict students' AP.

This study specifically tries to:

- Understand how demographic variables influence measures of student success;
- Understand how sending institution and previous GPA influences measures of student success;
- Understand how the amount of curriculum and content contained with transfer-required bridging courses influences student success;

The importance of *academic performance* has raised significant questions for institutional planning. The problems include what factors predict students' *academic performance* among transfer students? How students' demographic characteristics affect performance? How past education effect on students' present education at the university? These questions are considered, as the issue of poor *academic performance* is a serious concern for the university, faculty members, the student, their parents, and employers.

# Hypothesis

The present study focused on testing the following hypotheses and rejecting the null hypotheses. Fig. 1.1 shows the visual representation of the hypothesis with independent and dependent variables.

$H_1$ : There is no relationship between students' *academic performance* and age, gender and marital status.

$H_{1A}$ : Marital status, age and gender do affect on students' *academic performance*.

$H_2$ : Time to complete the studies is not related to the marital status, gender, and age of the student.

$H_{2A}$ : Marital status, gender, and age of the students affects completing their studies.

$H_3$ : Citizenship, immigration status and primary language does not effect the student getting excellent marks.

$H_{3A}$ : Citizenship, immigration status and primary language of the student does affect getting good marks.

$H_4$ : Time to complete graduation is not dependent on the sending institution of the student.

$H_{4A}$ : Sending institution of the student affects time of graduation.

$H_5$ : Students' college grades does not affect their present *academic performance.*

$H_{5A}$ : There is an effect of students' college grades on their present *academic performance.*

$H_6$ : Bridging courses does not effect students' *academic performance.*

$H_{6A}$ : Bridging courses do effect students' *academic performance.*

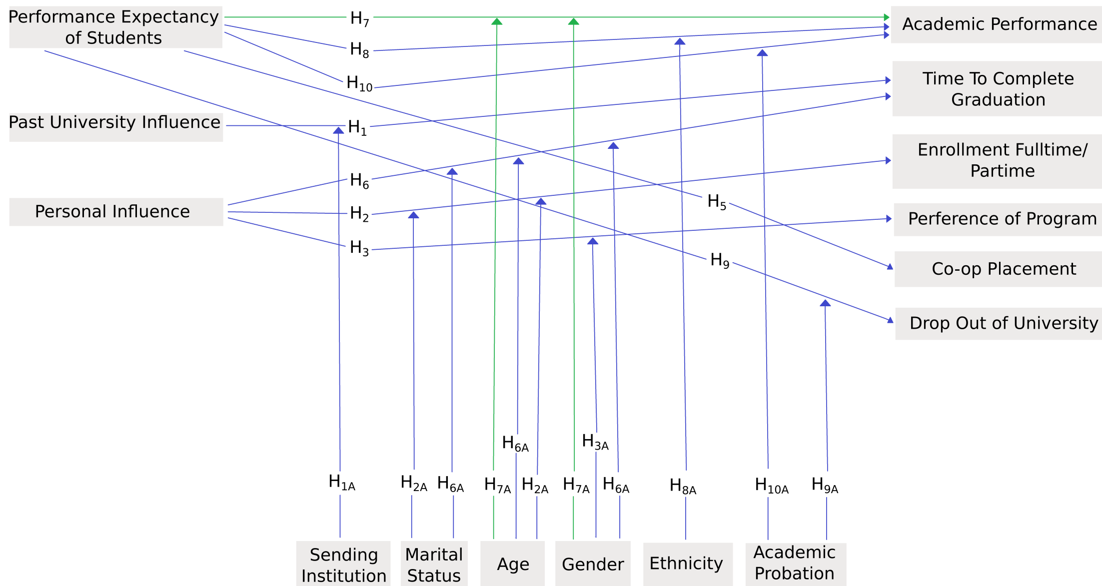


Figure 1.1: Visualisation of different hypotheses

## 1.1 Overview

Research questions were analysed using descriptive statistics (frequencies, histograms and boxplots) to find out the number of students in each group and their performance according to their grades during each term in the university. Later, the correlation between variables is shown through a correlation heat map. Finally, the impact of manifest or exogenous variables (such as age, gender and marital status) on dependent or latent variables (success) is computed using path analysis or confirmatory factor analysis, which are Structural Equation Modelling (SEM) techniques. The overall results show the positive or negative effects of variables on another variable.

## 1.2 Descriptive Analysis

The present data were analysed using descriptive statistics. Descriptive statistics are used to describe the basic features of the data. Different visualisations such as histograms, boxplots, Gantt charts and timelines are used to summarize the data. To remove the outliers, two different techniques were used - Mahalanobis Distance (MD) algorithm and interquartile range using boxplots. As our dataset contains students with extreme values (very few students performing above or below average), according to the outlier techniques, these types of data are considered as outliers and should be removed. In our analysis, we require this type of data to compare the students with the average student. This data is replaced with the averages to keep the data closer to the linear regression line.

| Characteristics | Number of students | Percentage(%) | Grade(Mean) |
|---|---|---|---|
| **Age** | | | |
| Young (18-20) | 95 | 8.42 | 66.59 |
| Mid-young (21-25) | 793 | 70.36 | 68.22 |
| Mature (26-50) | 239 | 21.20 | 68.68 |
| **Citizenship** | | | |
| Canada | 1030 | 91.39 | 68.21 |
| China | 11 | 0.97 | 75.24 |
| India | 18 | 1.59 | 66.83 |
| Pakistan | 7 | 0.62 | 67.2 |
| Lebanon | 6 | 0.53 | 68.97 |
| other_countries | 55 | 4.88 | 67.04 |
| **Primary Language** | | | |
| English | 899 | 79.76 | 68.19 |
| French | 28 | 2.48 | 71.72 |
| Other | 200 | 17.74 | 67.45 |
| **Immigration status** | | | |
| Canadian | 1030 | 91.39 | 68.21 |
| Permanent Resident | 77 | 6.83 | 69.05 |
| Student Visa | 20 | 1.77 | 67.48 |
| **Gender** | | | |
| Male | 1060 | 94.05 | 68.23 |
| Female | 67 | 5.94 | 67.52 |
| **Marital Status** | | | |
| Married | 69 | 6.12 | 71.15 |
| Single | 1058 | 93.87 | 67.98 |

1. Students whose entering *cohort year* is greater than their *first term registered* are removed.
2. All other visa types/categories were combined to student visa.
3. Students who deceased while enrolled are removed.

Table 1.1: Frequency distribution of students with transfer credit enrolling into STEM based Baccalaureate degrees at an Ontario university between the years of 2007 and 2012

Table 1.1 shows the demographic characteristics with cumulative marks of 1127 students. The median age of the student in the university is 23. Students above the age of 26 years perform well compared to other students in the university. Out of 1127 students in the Baccalaureate degree 94.05% are males, whereas very few of them are females (approximately 7%). Although the majority of the students are from Canada and have Canadian citizenship, a smaller proportion (0.97% out of 1127 students) from China perform better when compared with the grades during each term. No significant difference is noted between the cumulative-marks according to their gender. Also, it was observed that married students perform well in the university compared to the students that are single.

## 1.3 Structural Equation Modelling (SEM) - A brief Introduction

SEM is a vast field and widely used by many applied researchers in the social and behavioural science [42]. It is a multivariate statistical analysis technique used to analyse structural relationships. SEM can be thought of as path analysis using latent variables. Path analysis is the diagrammatic representation of a theoretical model using standardised notation. Latent variables are not directly observed but are implied from other observed variables. The data was analysed using Confirmatory Factor Analysis (which is similar to structural equation modelling except for that covariance or correlation, not the prediction, between latent variables is assumed) and Structural Equation Modelling (in which prediction of latent variables or unobserved variables is hypothesised). These techniques were used because each construct of interest is measured by multiple indicator variables. The process involves using confirmatory factor analysis to develop an acceptable measurement model (a measurement model is a CFA model in which you identify latent constructs of interest and indicate which observed variables measure each latent construct). SEM follows the conceptual sequence known as model specification, identification, estimation, testing, and modification. Once a measurement model is selected with the acceptable fit, the next step is to perform SEM to determine whether the combined measurement and SEM provide an acceptable fit. To check if the model is acceptable there are few ways such as Chi-square value $\chi^2$, the degree of freedom (df), Root Mean Square Error of Approximation (RMSEA), Standardised Root Mean Residual (SRMR), Comparative Fit Index (CFI) and Akaike Information Criterion (AIC).

A lot of the concepts are not directly observable such as the intelligence of a person, success, reputation, social capital. All these unobserved variables can be measured with the help of latent variables using observable indicators. In general terms, latent variables (hidden variables) are something that we are not able to measure directly.

### 1.3.1 SEM Programming Environment

*Lavaan* package is used in R programming language to run the SEM models and predict the latent variables [43]. The SEM software packages are easy to use in R-Studio which is an integrated development environment (IDE) for R programming. The *Lavaan* R package has been developed to provide researchers, and statisticians, a free, fully open-source, but "commercial-quality package" for modelling latent variables [43].

There are other SEM software packages available that run in the R environment. We are using lavaan because it provides intuitive and rich software modelling features, complete easy-to-use program, and is open source for statisticians to implement new methodological ideas [42].

### 1.3.2 Path Analysis

Path analysis is used to test the directional relationships of theoretical models among some observed variables. It determines whether the model successfully fits the actual relationships between observed variables in the sample data. Path analyses only deals with models in which the variables are observed or manifest variables. In general terms, a given manifest outcome variable may be influenced by a variety of other observed variables (for example, an employee working in an organisation). In this scenario, motivation, the workplace norms and supervisory support is an independent or antecedent variable to predict the effect on the work performed. This relationship can be seen with the help of path analysis. A Path diagram is a schematic diagram that represents a concise overview of the model the researchers aim to fit. In path analysis, a straight single-headed arrow is used to represent a unidirectional path. The arrow originates at the variable exerting the influence (independent or manifest), and pointing towards the variable being predicted (dependent variable).

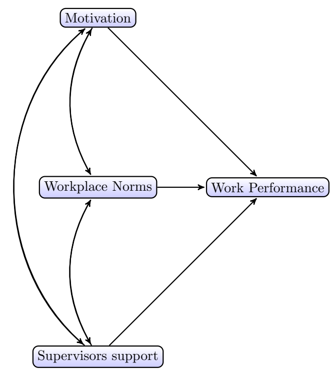


Figure 1.2: Path Diagram

The straight single-headed arrow from Motivation, Workplace Norms and Supervisors Support to Work Performance represents that Work Performance predicted by Motivation, Workplace Norms and Supervisors Support as shown in Fig. 1.2

### 1.3.3 Confirmatory Factor Analysis (CFA)

CFA is a type of SEM that only deals with the relationships between observed (indicators) and latent variables (such as success and intelligence). A latent variable is an unobserved variable that receives influences from more than one observed variables. Explanatory factor analysis, Principal component analysis and structural equation modelling are very similar to CFA, but there are some significant distinctions between them [42]. CFA model is a type of model that falls under the SEM family. CFA only focuses on the relationship between the observed and latent variables, but SEM focuses on the whole structure and causal path between the latent variables. For example, intelligence or success is a latent variable, which can be measured with the help of observed variables such as grades, ranking, employment designation among others.

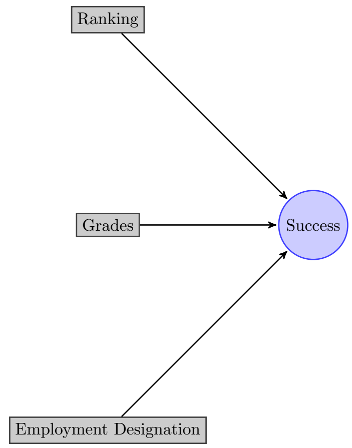


Figure 1.3: CFA Diagram

A latent variable is shown in a circle and the observed variables in a rectangle. The straight single-headed arrow from *grades*, *ranking* and *employment designation* to success shown in Fig. 1.3 represents that success can be predicted from grades, ranking and employment designation of a person.

## 1.4 Project Objective

*"This project investigates the significant factors affecting transfer students' academic performance for a better future of universities."*

There are six hypothesis to be tested, as well as null hypotheses to be rejected in this study. Each hypothesis uses different techniques and ways to predict transfer students' AP. The AP is measured by students' on-time degree completion or the grades during each term.

# Chapter 2

# Related Work

## 2.1 Effect of Marital Status and Age on students' Academic Performance

Earlier findings have shown that marital status and age influence the *academic performance* among female students [53], and explores the influence of gender and marital status on the cumulative GPA for university students in the UAE. The data (N = 3676) collected on a random sampling basis for all current students. The observed variables used to predict *academic performance* are students' gender, age and marital status. Their findings show that female students significantly perform better than male students (p-value = 0.001), mature students have higher scores than young students, and students who are married significantly perform better (p-value of 0.02).

Alshammari et al. did a study to find the factors affecting the *academic performance* of 201 nursing students from nursing college at the University of Hail [5]. Alshammari used content validation and reliability test to predict AP. They used students' age, gender, year level, marital status, socio-economic status and past school to find out the impact on students' *academic performance*. Only students' age showed significant effect on students' AP (t-value = 3.591), whereas no significant effect was seen by other variables such as students' past school (p = 0.398); year level (p = 0.589); socioeconomic status (p = 0.970).

Research was done by Abdullah Al-Mutairi who proposed to investigate buisness students' AP [3] in Arab Open University- Kuwait branch. In his finding, 7 hypothesis were tested for a higher level at .05 margin of error. The sample size for the study was 556 graduate students, of which 353 were female, and 213 were male, for academic session 2009-10. Abdullah Al-Mutairi used Ordinary Least Square (OLS) multiple regression technique to find out the factors affecting students' performance. The performance was measured by GPA and observed by nationality, age and high school grades. The study also indicated that the results were better for younger students compared to mature students, international students compared to national students, married students compared to non-married students, and female students compared to male students.

Anne Marie Goff did a descriptive correlational study using Gazella's Student-Life Stress Inventory (SSI) and Rosenbaum's Self Control Scale (SCS) to find out the AP for 53 bachelors nursing students [20]. The study used personal and academic stressors, ethnicity, age and gender of the students to predict AP. The finding indicated that a high level of personal and academic stressors shows no significant effect (p-value = 0.90), whereas age was a significant indicator of *academic performance* (p-value = 0.01). The finding also suggests that male African American/black students' performance was higher than female and white students.

Amuda et al.used marital status and age as predictors of students' *academic performance* [7] in the North-Eastern states of Nigeria. The scope of the study was to find the level of *academic performance* of Nigeria Certificate in Education (NCE) students. In the North-Eastern States of Nigeria, the key determinant, and significant predictors, were marital status and age. A random and stratified technique was used to collect a sample of 13,529 (8422 males and 5107 females). To predict students' AP, they used descriptive statistics and multilinear regression analysis. The result indicated that marital status and age did not significantly affect students' AP.

## 2.2 Effect of Marital Status, Gender, and Age on students in completing the studies on time

With the increasing number of students attending colleges and universities, the completion of a degree on time is a growing concern. Undergraduate enrolment in degreegranting postsecondary institutions increased by 30 percent (from 13.2 million to 17.0 million according to the National Center for Education Statistics (NCES)) [36]. Female students made up 56 percent of total undergraduate enrolment, and male students made up 44 percent. Enrollment for both males and females showed similar patterns of change: female enrolment increased by 29 percent and male enrollment increased by 30 percent (NCES, 2017 (Fig 2.1)). Between 2000 and 2015, Hispanic enrollment more than doubled (from 1.4 million to 3.0 million students) in contrast with other racial/ethnic groups (NCES, 2017 (Fig 2.2)). Enrollment for both full-time and part-time students increased mainly between 2000 and 2010 when full-time enrollment increased by 45 percent and part-time enrollment increased by 27 percent (2017 (Fig 2.3)). This increase in the number of enrollment is of vital importance to administrators and faculty.

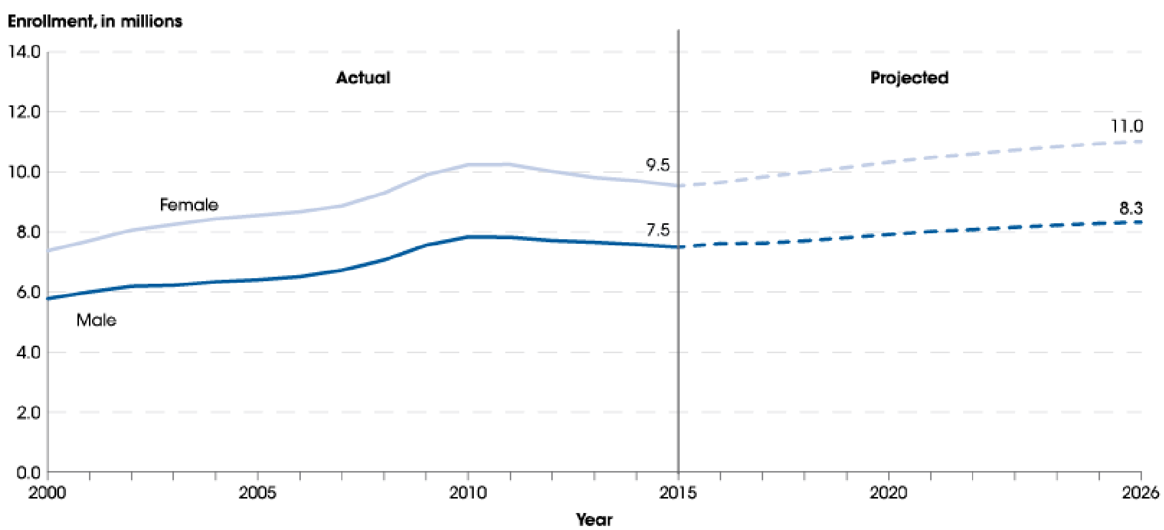


Figure 2.1: Enrolment of students based on their Gender [36]

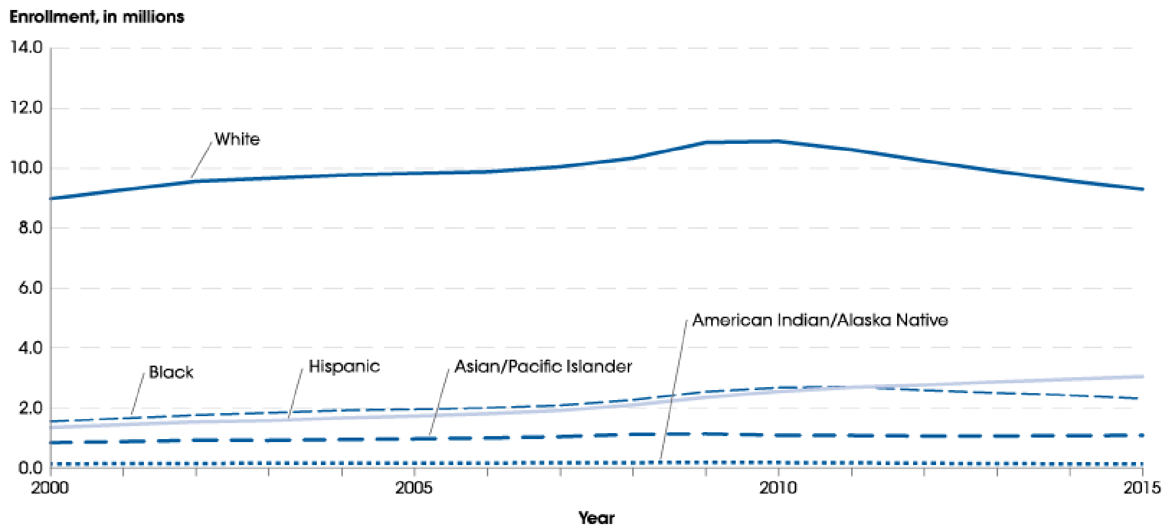


Figure 2.2: Enrolment of students based on their Ethnicity [36]

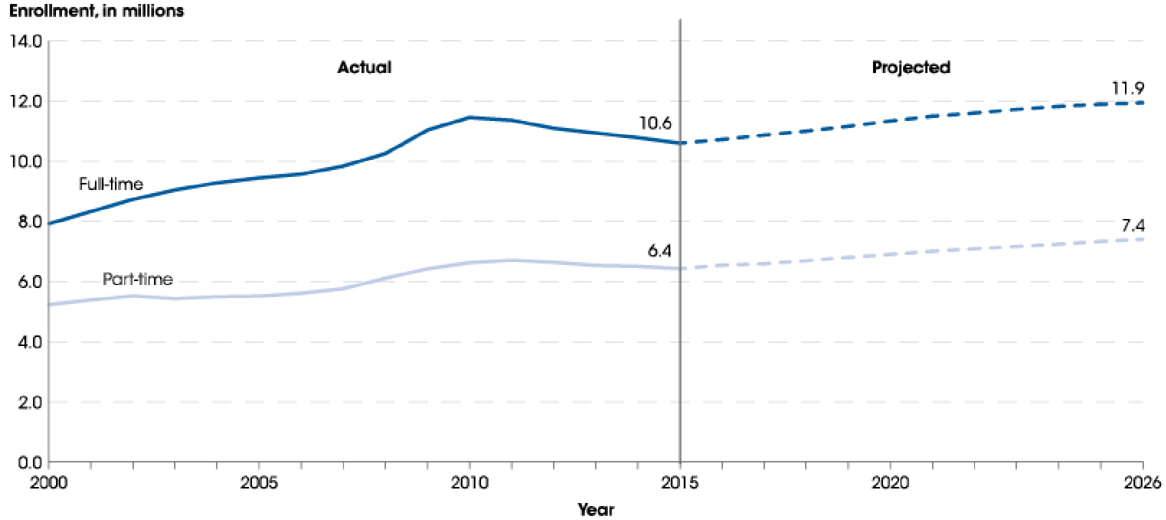


Figure 2.3: Enrolment of students based on their registration status [36]

Taniguchi and Kaufman indicated concerns on nontraditional students low completion rates [51]. They studied the impact of student characteristics on the success rate of course completion with event history models. The data used for the analysis was from the National Longitudinal Survey of Youth, a national probability sample of men and women. They used the time to complete a four-year undergraduate program to measure students' AP. One of the key predictors was the registration status (part-time/full-time) of the student. They also used students' past work experience, age, gender and marital status as predictors of AP. The findings show that young students who have previous work experience and students with young kids affect completing the studies on-time. Also, students' gender does not affect time to complete.

A significant proportion of students who enrolled in U.S colleges and universities are over age 25 [26]. Jacob et al. examined the time to completion of obtaining a bachelor's degree from the time of enrolment and to analyse the chances of completing a degree in different age groups. The observed variables used in this study are students' age, marital status, registration status and the presence of young kids. From the data set, the researchers concluded that higher enrolments led to the greater acquisition of the degree. There is a higher chance of getting a degree before the age of 23, and it declines thereafter. Older age saw higher enrolments in part-time and other intervening courses but it also indicated a lower completion rate. Another factor is the gender of the student, female students over the age of 25 show negative impact on time to complete the degree, as most likely they are registered part-time.

Another research in the field was done by Abedi and Benkin on doctoral programs [4]. The aim was to understand the proportion of students who completed their degree and the time taken to complete it. The later is an important point for a doctorate as it helps the administrators and faculty members understand the historical trends to a higher degree. National Research Council's Doctorate Records files and reports from UCLA to study the personal, academic and financial independent variables to predict AP. A regression method was deployed to analyse the most significant predictor of time to complete the degree. The most important variable in predicting the total time to a doctorate was the *source of support*, i.e. own earnings during graduation.

Similar research was done by Seagram et al. on factors affecting doctoral studies completion [46]. The main aim was to understand the nature and extent to which female and male students experience their doctoral training distinctly. They also wanted to see the relationship between any differences in time taken to complete doctoral programs. A sample of 154 graduates from Natural Science, Social Science, and Humanities enrolled in doctoral programs at York University was analysed. The variable used to analyse students' AP are their gender, discipline of their degree, characteristics of the supervisory relationship, students' financial situation and registration status. Multiple regression technique was used to explore the predictors of time for a doctoral program. Average completion time in Natural Science studies was approximately six years. No large disparity was observed in course completion between male and female students. The satisfaction level was higher in male students compared to females. Slow completion was associated with receiving larger financial assistance, Natural Sciences, ease in topic selection, full time enrolment, and keeping the same supervisor throughout the discipline. Some of the other factors include material submitted to supervisory committees, collaborating with the supervisor on papers and articles, and fewer years of teaching assistant support. The results are closely linked with those reported in the literature.

## 2.3 Effect of Immigration status and Ethnicity of the student on Graduation GPA

The rise in the volume and diversity of immigrants to Canada since 2006 has increased concerns about whether assimilation benefits educational achievements. Recent trends in international migration also contributed to the ethnic diversification of the school-aged population. The foreign-born students reached approximately 350,000 in 2006 (Census Canada). According to the 2016 Census [2], 7.5 million foreign-born people came to Canada through the immigration process. A majority of the people are from the Philippines (188,805), and countries such as India (147,190), China (129,020), Iran (42,070), and Pakistan (41,480) also contributed significantly to the increase in the population.

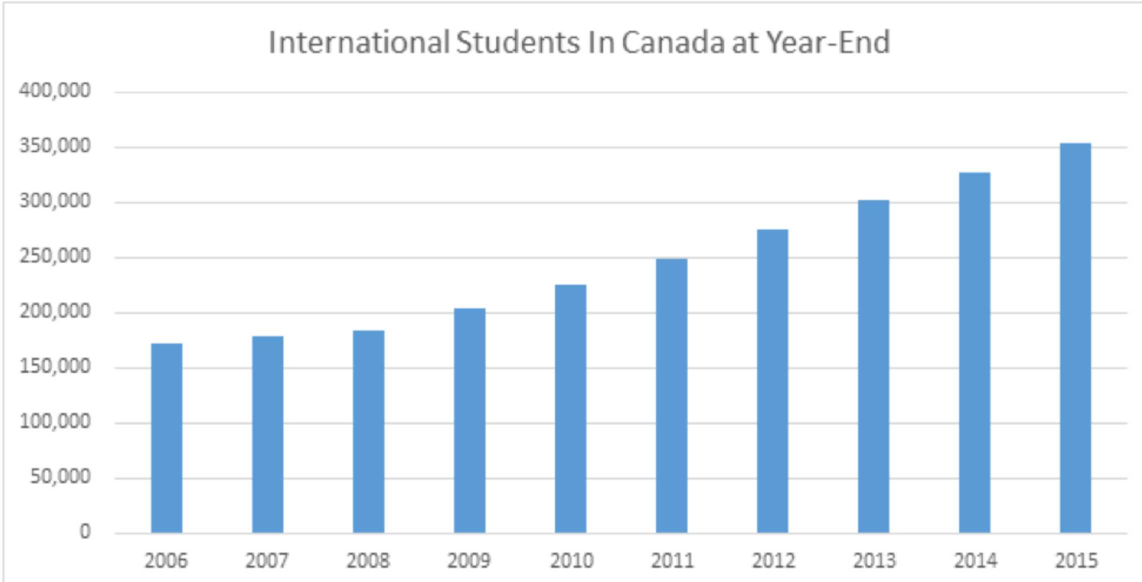


Figure 2.4: Immigrants enrolling in Canadian Universities [2]

Ka and Tienda highlighted the issue of scholastic performance by measuring students' grades and test scores [28]. They proposed straight-line assimilation, accommodation without assimilation, and immigrant optimism to predict AP. The data used in this study was from the National Education Longitudinal Study (NELS, 1988). The main objective was to find out the impact of generation status on student performance. Immigration status and parents nativity are the essential components in understanding the AP of immigrated students versus the native youth. The study highlights the effect of generation status on the academic outcome which is linked to race and ethnic group such as parental nativity. They found out that behavioural differences between immigrant and native parents are key indicators to predict the *academic performance*. Moreover, students, *academic performance* is also dependent on students' race and ethnicity.

Andrew J. Fuligni indicated an increase in immigration in the United States in the last 30 years [17]. The research describes the relative effect of the family background, parental attitudes, peer support and adolescents own attitude and behaviour on the academic achievement of students from immigrant families. The sample included 1,100 students from East Asian, Latino, Filipino and European backgrounds groups. A sequence of Multiple regression were conducted to analyse the academic achievement of the students from different immigrant families. The results concluded that the students of immigrant families performed better than a student from native-born parents in both areas of Mathematics and English.

A similar study by Hao and Bruns also mentioned the growing population in the United States since the enactment of the Immigration Act in 1965 [21]. As per the population index of 1990, the immigration constituted to 10.9 percent of the United States population. The researcher's argument was on the parent's and children's educational expectation which spurred between family and social capital. They used exploratory factor analysis (EFA), and a two-stage least squares (TSLS) method to estimate the effects of variables and a hierarchical linear model (HLM), which deals with student level and school level factors in a multilevel manner. The analyses from four immigration groups (Chinese, Filipino, Korean, and Mexican) and three native groups (Mexican, black, and white) indicate that high levels of parent-child interactions increase academic achievements.

Students' ethnicity, immigration and socioeconomic status have the most significant impact on high-school completion. Amy Lutz examines high-school completion among the Latino immigration group in the USA [17], with a particular focus on the effects of ethnicity, generation, language proficiencies, family structure, and socioeconomic status. The issue of poverty among Mexicans, who make up the most significant proportion of the immigrant population and whose levels of high-school completion are significantly lower than those of other groups. The results also show the effect of Spanish speaking students on high-school completion and indicate that high- level proficiency in both Spanish and English is associated with a higher likelihood to complete high school than white students. Padilla and Gonzalez also examined generation differences in achievement among 2167 high school students of US-born or outside of the US [38]. The analyses based on students' grade point average (GPA), shows that immigrant students in general score higher grades than other students.

## 2.4 Effect of students' college grades on their Academic Performance

Students' grades play a vital role in a students' life. They give information of students' achievement, an instrument of selection to next education or industry and they increase students' motivation to learn [30]. Sulaiman et al. found that a students' undergraduate grades are the best predictors of their master's *academic performance* [50]. The objective of the study was to identify the factors affecting graduate students' academic achievement. They used age, gender, ethnicity, years of industry experience, and undergraduate grades to predict the *academic performance* of MBA students. The analysis was done, and the hypothesis was answered using the simple correlation between dependant variables against both independent and other dependant variables.

Similarly, Cherdsak did a study to find out the impact of high school grades on medical students' grades [25]. They studied demographic and entrance exams scores for the analyses. High school grades are a significant predictor of *academic performance* in medical students. Past undergraduate grades are a prerequisite for medical school application in North America. Cherdsak used multiple linear regression to predict the effect of independent variables such as age, entrance exam scores on medical students' performance. He found out that students with high scores in the entrance exams significantly perform better ($t = 4.42$, $p = 0.05$), whereas age ($t = -4.37$, $p = 0.05$) and high school grades ($t = -2.64$, $p = 0.05$) have significant negative impact on medical students' performance. There are various studies focused on previous school/college grades to predict students' future *academic performance*:

1. Thiele et al. measure students' *academic performance* by examining the effect of past school grades, school type, school performance, socioeconomic status, neighbourhood participation and students' sex [52]. The sample data used was from a British university, collected from a central student database of the university of students registered from the years 2004-2010. They used two different approaches to find out the relationship between independent and dependent variables. The first approach used univariable logistic regression to see the impact of background characteristics on students' AP. The other approach used was the multivariable logistic regression to determine the effect of individual

variables on students' AP. Results show that students' background characteristics significantly affect *academic performance*, i.e. school type, school performance, neighbourhood participation, sex and ethnicity do effect students' *academic performance*.

2. The decision to admit students in universities is based on many factors, but high school grades is one of the significant factors [12]. Cyrenne and Chan researched to determine the impact of previous high school performance on students' current performance. The sample data was collected from the University of Winnipeg. The main objective was to find out the impact of high school on students' university performance over the years 1997-2002. Least Squares Dummy Variable (LSDV) and Hierarchical Linear Model (HLM) techniques were used to predict students' AP. Results from both the techniques are similar. They conducted that high school GPA is a strong predictor of their university *academic performance*, but other factors play a significant role as well.

3. Another study to address the impact of high school on students' university performance was done by Brett and Morell [6]. A sample of 5000 undergraduates at the University of California, San Diego, used in this study. They find a significant effect of high school on students' undergraduate *academic performance*, along with a substantial impact on students' personal background. Moreover, the experience of the high school teachers has a positive but small effect on their university GPA.

4. Cohn et al. [10] measured the *academic performance* by college GPA of students enrolled at the University of South Carolina. The objective was to determine the effect of SAT scores, high school GPA and class rank on students' college performance. They found out that SAT scores do affect student success in college. Also, student achievement is dependent on other factors such as race and gender.

Earlier studies show that type of school and school leaving examination do predict students' *academic performance*. Kumwenda et al. also discuss the relationship between school type and *academic performance* at medical school [29]. They used data from 33 UK graduate who graduated in 2012 and 2013. The data was statistically analysed using IBM SPSS V.23.0 and STATA. They found out that students from state-funded schools perform better compared to independent school. Furthermore, there is an influence of ethnicity, gender, and age on the difference in medical programmes. Serge Herzog also did a case study on the effect of high school on academic preparation and retention of first-year college students [22]. The findings show that students' *academic performance* is highly correlated with student curricular choices, effort, and focus on college preparation.

## 2.5 The effect of bridging courses on students' academic performance

According to Malcolm Ransom, bridging courses are university preparation course with an academic syllabus offered to students for preparing for the intellectual challenges of university education [40]. Students have to complete the bridging courses to receive admission in the university. Students with no post-secondary school record need a minimum grade of B or better in the approved bridging course as the base of admission to undergraduate schools. Students with a post-secondary education may be considered with successful completion of bridging courses at the time of application. The faculty department of the university approves the bridging courses that meet the requirements set out in the regulations. Bridging courses, often called transition programs, allow students to meet academic standing and complete missing courses for university requirements [44].

Transition programs often help students to acclimate to the new environment that they will encounter after the transition [24]. Better insight into the effect of transition programs on the retention rates could lead to reducing the negative consequences associated with students who do not complete high school. Wickert did a case study on the effectiveness of the transition program for ninth grade students [55]. Students transitioning to a higher level of education concerns the transition to the physical, social, and academic environment. A sample of 400 archival 9th grader students from Delaware school was analysed using t-test. The findings from the study show that transition programs help students improve their *academic performance* in higher grades.

# Chapter 3

# Does Marital Status, Gender and Age affect the students' Academic Performance?



---

**Summary**

With the increasing diversity of students attending universities [11] [36], there is a necessity to analyse the factors affecting students' academic performance. The objective of this chapter is to investigate whether *marital status*, *gender* and *age* are significant predictors of *academic performance*

(AP), specifically focusing on transfer students. Three hypothesis questions were answered and tested in this chapter. A sample of 1127 (1060 males and 67 females) was analysed using descriptive statistics and confirmatory factor analysis techniques. Results revealed that (a) *Marital status* of the student is not a significant predictor of AP (b) The AP of *male* students is significantly higher than *female* students and (c) *Mature*(26-50) students significantly perform better when compared to *young*(18-20) and *mid-young*(21-25) students. The findings of this study can be used to target services towards specific demographic groups to assist in maximising *academic performance* across the increasingly diverse post-secondary context.

## 3.1 Introduction

The desire to maintain high *academic performance* influences all post-secondary stakeholders, including students, faculty members, upper administration and institutional support services [18]. The main aim of any institution is to help students achieve their desired *academic performance* objectives, generally maintaining an appropriate grade average and graduating from their credential in the desired time frame. Performance is significant as the level of success students achieve in school has implications for their personal and professional lives such as career choice, personal income and level of success [18]. Several studies have been done to identify the factors affecting students' *academic performance* and to improve it [47] [7]. Michael and Amuda et al. did a study to find out the predictors of Academic Performance. The studies used descriptive statistics (percentages, frequency counts, mean and standard deviation) for the analyses of undergraduate students.

In this chapter the following demographic variables are examined as predictors of *academic performance* in a sample of transfer students:

- Age
- Gender
- Marital Status

### 3.1.1 Objectives

The objectives of this question are to determine:

- If *Marital status* is a significant predictor of AP.
- If *Gender* is a significant predictor of AP.
- If *Age* is a significant predictor of AP.

### 3.1.2 Hypotheses

The study analysed these null hypotheses:
$H_0$ : *Marital status* is not a significant predictor of AP.
$H_0$ : *Gender* is not a significant predictor of AP.
$H_0$ : *Age* is not a significant predictor of AP.

## 3.2 Method

### 3.2.1 Data

The sample consists of 1127 undergraduate college to university transfer students enrolled in STEM based Baccalaureate degrees at an Ontario university between the 2007 to 2012 academic years. The sample size and time span were selected from a larger dataset and contained the most consistent data with no missing values available at the time of this research. Previous research in this area has included sample sizes ranging from 134 university students [47] to 1200 students from six colleges [7].

The nature of the variables collected constitutes to both qualitative and quantitative data. Furthermore, there are discrete variables such as cohort year, students' unique id, and continuous variables such as grades, age, etc.

### 3.2.2 Method of Data Analysis

Descriptive statistics (percentages, frequencies, mean values, histograms and boxplots) were used to determine the number of students in each group and evaluate their degree level *academic performance* using grades similar to Amuda et al [7] and

Michael Sheard [47]. Correlation of variables is presented in the form of a heat map. Additionally, structural equation modelling techniques were applied through confirmatory factor analysis to examine the relationship between latent variables and measured or observed variables. In this study, *academic performance* is a latent variable and *marital status*, *gender* and *age* are observed variables.

Students' grades, sub-divided into each individual course grade, are segmented by semester and presented using the following key:

- 2007A = Spring Semester and/or Summer Transition Courses of 2007
- 2007S = Summer Semester of 2007
- 2007F = Fall Semester of 2007
- 2007W = Winter Semester of 2007

The *age*, *gender* and *marital status* of the student reflects the demographic recorded at the time the student registered at the receiving university. Parents education include two variables, *X_Fathers_schooling* and *X_Mothers_schooling*. Both variables have nine levels: such as attended university without earning a degree, completed a bachelor's degree, completed a doctoral degree, completed a master's degree, did not finish high school, graduated from high school, some or completed college, opted out and not available.

### 3.2.3 Descriptive Analysis

| Characteristics | Number of students | Percentage(%) | Term Grade Mean |
|---|---|---|---|
| **Age** | | | |
| $Young(18-20)$ | 95 | 8.42 | 66.59 |
| $Mid-young(21-25)$ | 793 | 70.36 | 68.22 |
| $Mature(26-50)$ | 239 | 21.20 | 68.68 |
| **Gender** | | | |
| Male | 1060 | 94.05 | 68.23 |
| Female | 67 | 5.94 | 67.52 |
| **Marital Status** | | | |
| Married | 69 | 6.12 | 71.15 |
| Single | 1058 | 93.87 | 67.98 |

1. Students whose entering *cohort year* is greater than the *first term registered* are removed.
2. Students who deceased while enrolled are removed.

Table 3.1: Frequency distribution of the variables

Table 3.1 shows the demographic characteristics and grades at each term for the sample of 1127 STEM based college to university transfer students. A sizeable 94% of the sample is *male* with a small portion of the students identifying as *female*. The median *age* is 23 for the dataset and, notably, students above the *age* of 26 years have higher grades when compared to younger students. The majority of the students were recorded as being *single*, with the small *married* proportion (6.12% out of 1127 students) performing better, with respect to grades, when compared to the grades of *single* students at each term. Also, it was observed that *male* students perform slightly better than *female* students.

**Histogram of Grades of the students each term.**

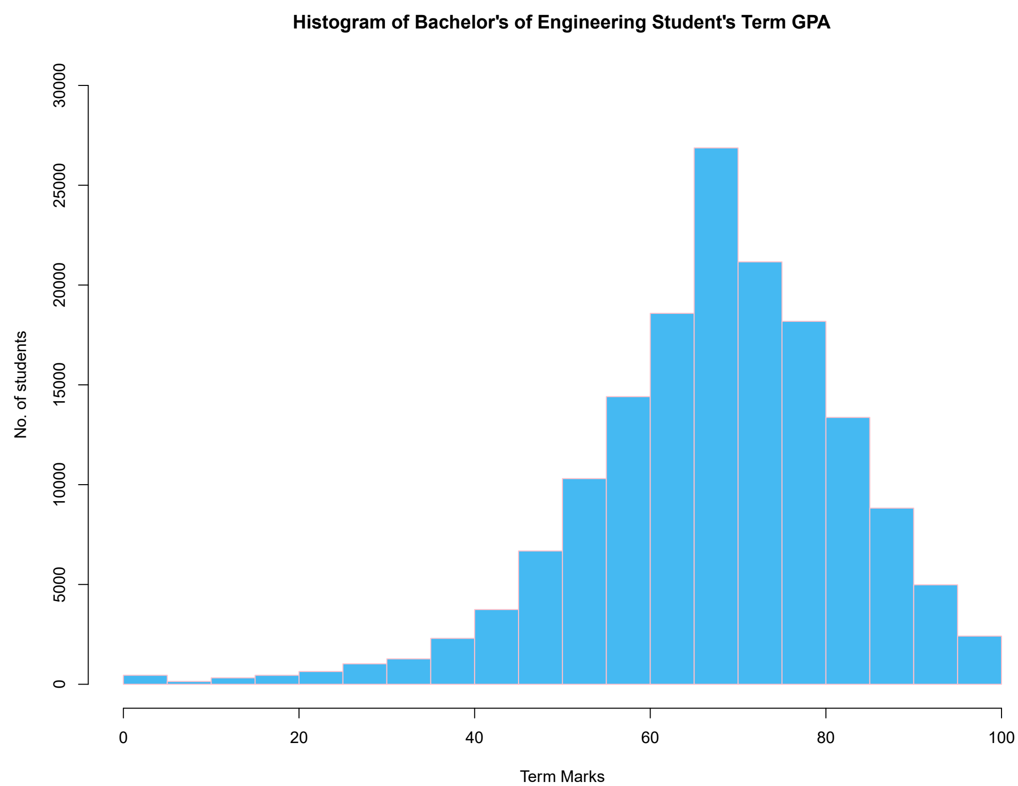


Figure 3.1: Histogram of Grades of the student

Figure 3.1 shows the average term marks of students in the university. The x-axis shows the term marks and the y-axis shows the overall number of students for the year 2007 to 2012. It is a bell-shaped and binomial type distribution. The graph shows that the majority of the students score between 60% to 80% in each term.

**Relationship between Marital status and Grades of the student**

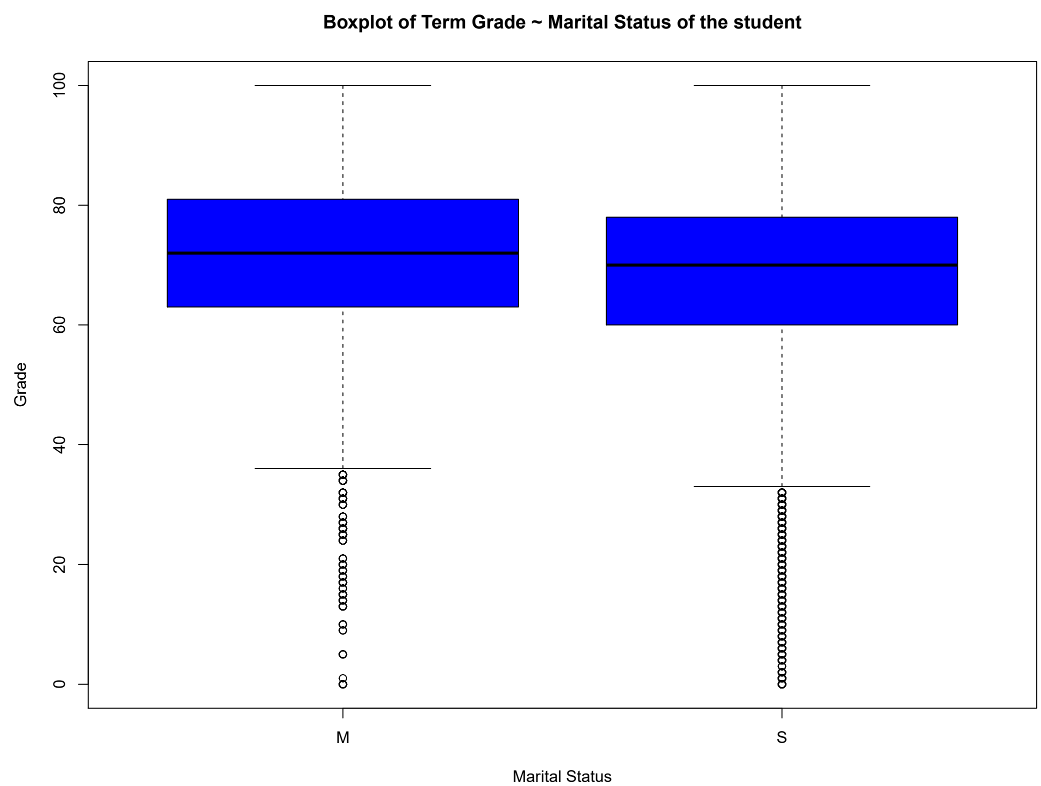


Figure 3.2: Box-plot of Grades and Marital status of the students

Figure 3.2 shows that *married* students perform better compared to the students who are *single*. The x-axis shows the *marital status* of the student and the y-axis shows the term grades of the students in percentage. The diagram shows that the average marks of all the students are between 60% to 80%. Students who are *single* (1058 out of 1127) have outliers because it has a significant amount of data.

**Relationship between Gender and Grades of the student**

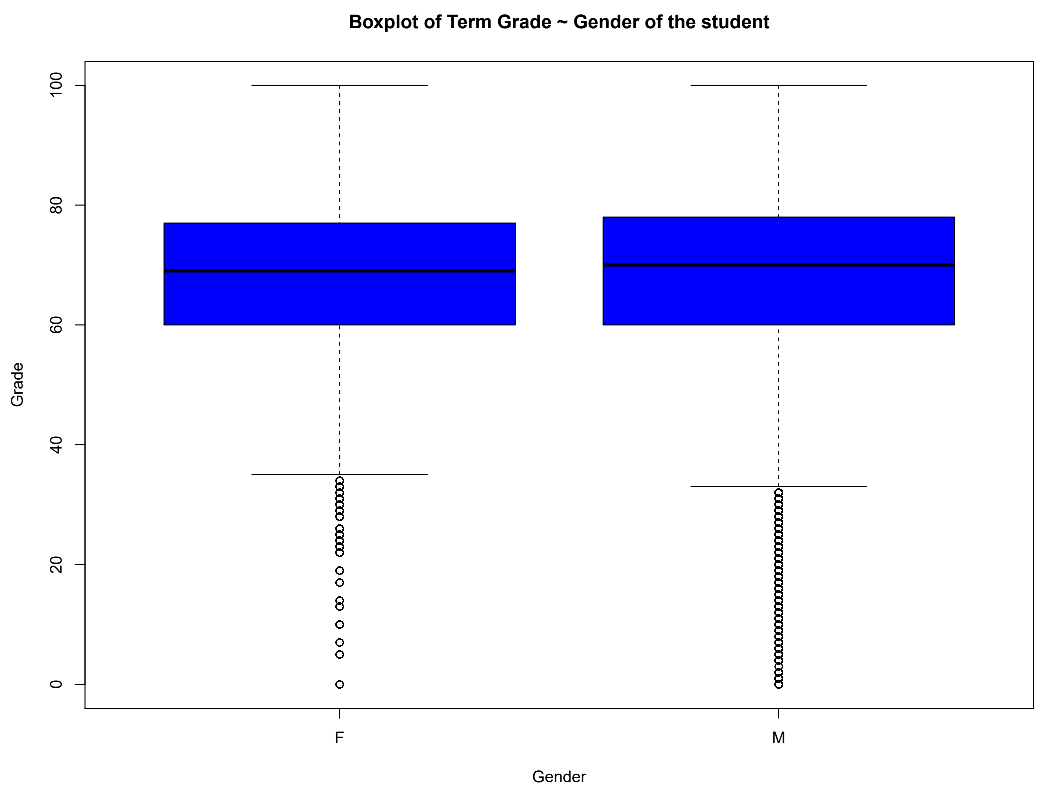


Figure 3.3: Box-plot of Grades and Gender of the students

*Male* students slightly outperform their counterpart *female* students as shown in Fig. 3.3. The x-axis shows the gender of the student and the y-axis shows the term grades in percentage. The diagram shows that the average marks of all the students are between 60% to 80%.

**Relationship between Age at first term and Grades of the student**

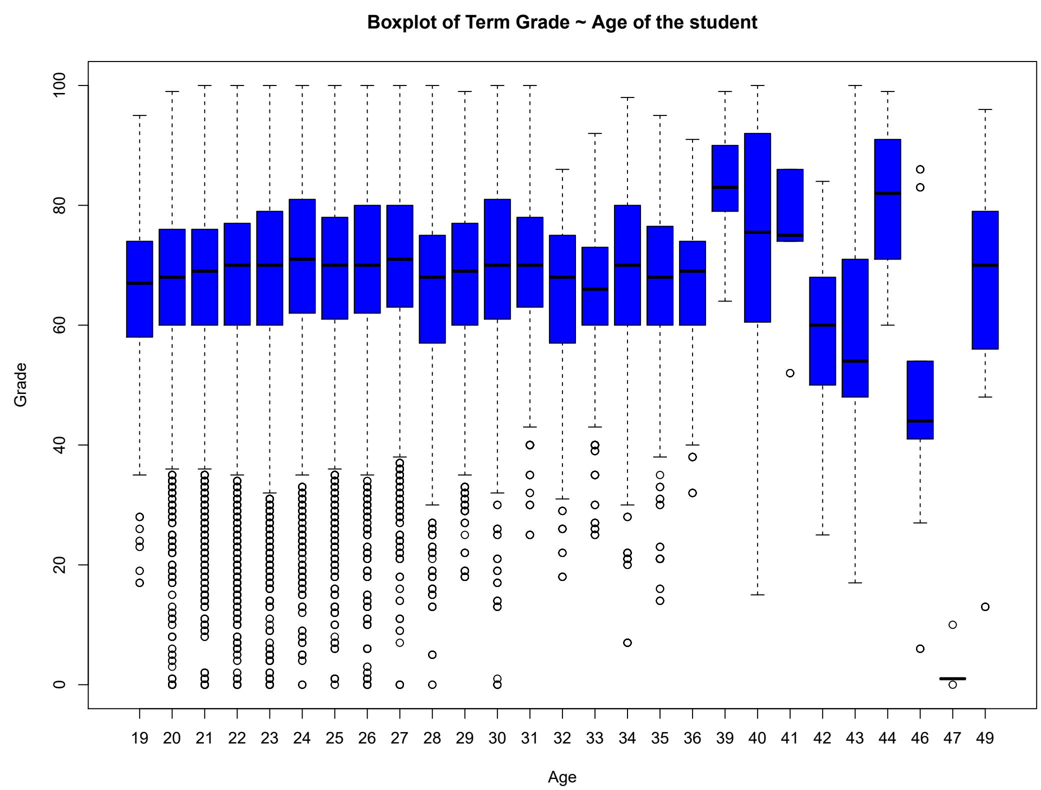


Figure 3.4: Box-plot of Grades and Age of the students

Figure 3.4 shows that students from age 19 to 36 have similar average grades compared to the students from age 36 to 50 whose average grade is better. There is no consistency in the data of the students above 40, as a majority of them are mid-young (21-25). There are a limited number of students who register after the age of 26. The x-axis shows the age of the student and the y-axis shows the term grades in percentage. The diagram shows that the average marks of most of the students are between 60 to 80.

## Correlation

To provide insight into the relationships between variables, correlations were computed on the following variables: *gender*, *age*, *marital status*, and grade, cumulative

GPA, Completion.

Figure 3.5 shows a correlation heat map of different variables. Grade and Cumulative GPA has a high positive relationship of 57.6%. The variables from *marital status* (the students who are single and married) show a similar effect on variables that were selected to measure *academic performance*. Similar correlation show no effect in SEM model.


Figure 3.5: Correlation Matrix

### 3.2.4 Confirmatory Factor Analysis

A two-step structural equation modelling (SEM) process was used to examine the structural relations between students' demographic variables and *academic performance* as per the aforementioned hypothesis. The first step is to identify the exogenous/independent variables and the endogenous/dependent variable that, in this case, is also a latent variable.

*Gender_Male, Gender_Female, Married, Single, young, mid-young, mature, X_Father Schooling, X_Mother_Schooling, Grade, Completion, and Cum_GPA*, are all **exogenous variables** (also known as independent variables, which are not affected by other variables).
*Academic Performance* is an **endogenous variable** (also known as dependant variables, which have values that are determined by other variables). It is also a latent variable whose value is predicted by other independent variables.

The next step involves assessing the hypothesised relations among the latent variables. We are predicting that there is a relationship between *academic performance* and the students' *marital status*, *age* and *gender*.

**# To create model for the hypotheses:**

```
modelcfa1 = '
Academic_Performance =~
Gender_Male + Gender_Female + Married + Single + young + mid-young +
mature + X_Father_Schooling + X_Mother_Schooling + Grade + Completion
+ Cum_GPA
'
```

The final step is model fitting the overall sample data, based on the relationship model created.

**# To fit the model:**

```
cfafit = sem(modelcfa1, data = data, std.lv = TRUE)
```

The summary of the model fit can be viewed with the help of the **fit-measures** command, which is used to see the model fit indices of the model.

**# Summary of the model:**

```
summary(cfafit, standardized = TRUE, fit.measures = TRUE, rsquare =
TRUE)
fitmeasures(cfafit)
```

Table 3.2: Summary of the model

| | Estimate($\beta$) | Std.Err | Std.lv | Std.all |
|---|---|---|---|---|
| **Latent Variables:** | | | | |
| Academic Performance =~ | | | | |
| Gender_Male | 0.000 | NA | 0.000 | 0.001 |
| Gender_Female | -0.000 | NA | -0.000 | -0.000 |
| Married | 0.003 | NA | 0.003 | 0.012 |
| Single | 0.003 | NA | 0.003 | 0.013 |
| young | 0.024 | NA | 0.024 | 0.075 |
| mid-young | -12.248 | NA | -12.248 | -6.163 |
| mature | 0.790 | NA | 0.790 | 0.109 |
| X_Fathr_Schlng | 0.015 | NA | 0.015 | 0.005 |
| X_Mothr_Schlng | -0.000 | NA | -0.000 | -0.000 |
| Grade | 13.180 | NA | 13.180 | 0.677 |
| Completion | -0.000 | NA | -0.000 | -0.001 |
| Cum_GPA | -1.454 | NA | -1.454 | -0.006 |
| **R-Square:** | | | | |
| Gender_Male | 0.000 | | | |
| Gender_Female | 0.000 | | | |
| Married | 0.000 | | | |
| Single | 0.000 | | | |
| young | 0.006 | | | |
| mid-young | 0.000 | | | |
| mature | 0.012 | | | |
| X_Fathr_Schlng | 0.000 | | | |
| X_Mothr_Schlng | 0.000 | | | |
| Grade | -48.850 | | | |
| Completion | 0.000 | | | |
| Cum_GPA | 0.000 | | | |

1. **Std.Err:** Standard Error
2. **Std.lv:** Standard Lavaan
3. **Std.all:** Standard all the variables.

Table 3.3: Model Fit Indices

| df | p-value | RMSEA | SRMR | CFI | GFI | AGFI |
|---|---|---|---|---|---|---|
| 46.000 | 0.000 | 0.623 | 0.221 | 0.074 | 0.674 | 0.447 |

The Table 3.3 shows the model fit indices of the fitted model. We can see that our our model has 46 degrees of freedom. We can proceed to estimate statistical power using the formula from MacCallum et al. [31], in which n = 1127 and df = 46, the model is estimated to have power greater than 0.99 which means that we can proceed to interpret goodness of fit with more confidence.

The major indicators to accept the model are its standard RMSEA (SRMR), RMSEA, and CFI values which are estimated to be >= 0 and >= 0.90 for a good model fit [49]. For further explanation please see Appendix B. As we can see from the Table 3.3, the model is an exact fit and therefore we can reject the null hypotheses. Another important index is the p value. The overall model is significantly acceptable (p-value = 0.000).

```
# Specifying the variable names for each node

lbls = c("Male", "Female", "Married", "Single", "young", "mid-young",
"mature", "Father Schooling", "Mother Schooling", "Grade", "Completion",
"Cum GPA", "Academic Performance")

# To plot the model as shown in Fig 9.1 you can choose from
different types of layout such as tree, circle, spring, tree2, circle2:

semPaths(cfafit, whatLabels = "std", layout = "spring", nodeLabels = lbls,
sizeMan = 10, sizeLat = 10, edge.label.cex = 1.5)
text(0,1.4, labels = "Effect of variables on Academic Performance")
```

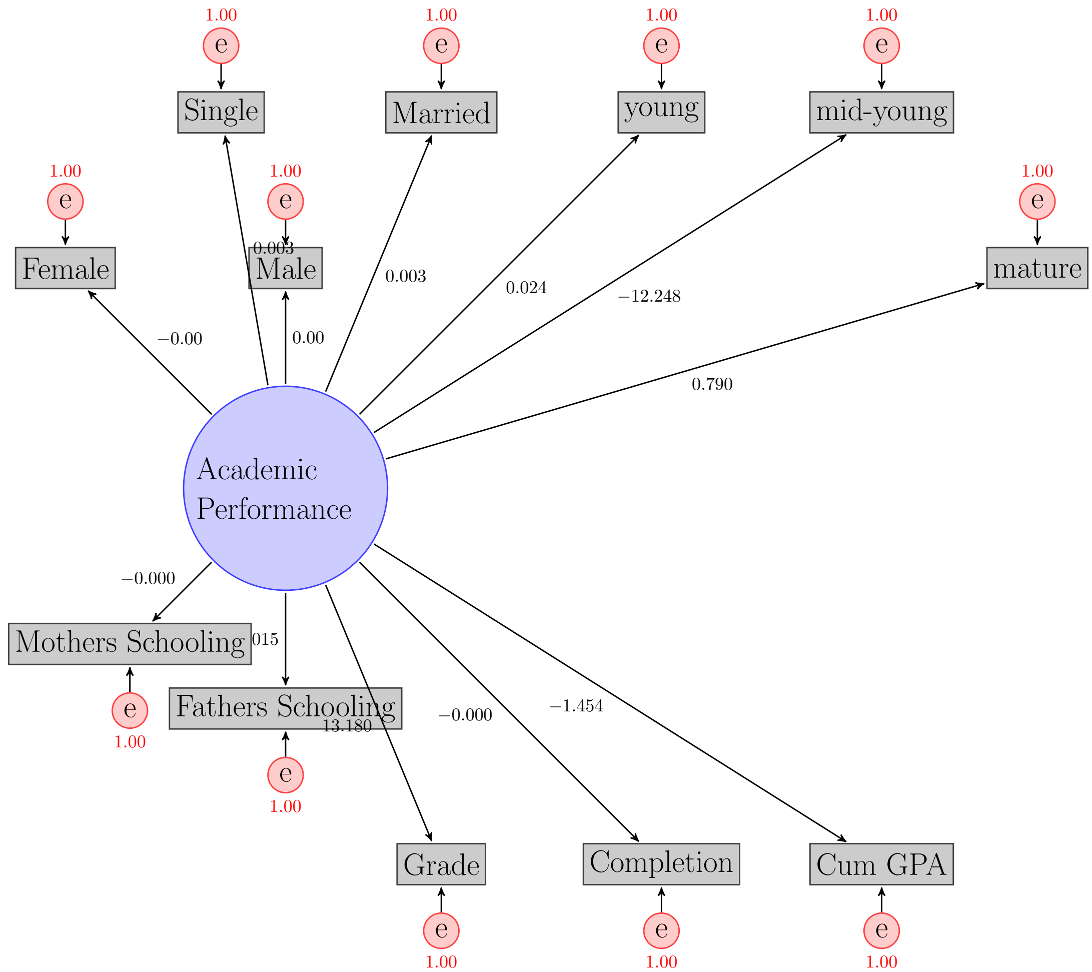


Figure 3.6: SEM path diagram of the CFA model

## 3.3 Results

- **Effect of Marital Status of the student:** The results indicated that *marital status* is not a significant predictor of AP. Student *married* or *single* doesn't show any effect on students' AP. Both *married* and *single* students show a similar effect on students AP ($\beta = 0.013$). Furthermore, the correlation Table 3.5 shows the same effect on the grade of the student. Because of similar correlation, we observe no impact of students' *marital status* on their AP.

- **Effect of Gender of the student:** *Gender male* was found to be a strong and positive predictor of *academic performance*. The results showed that students who are *male* are performing better in overall AP when compared to students who are *female*. The number of *male* students are 1060 whereas only 67 of the students are *female* with no missing values. *Male* students positively affect students' AP ($\beta = 2.4\times10^{\ 5}$), compared to *female* students that show a negative effect on student AP ($\beta = -2.4 \times 10^{\ 5}$).

- **Effect of Age of student:** *Mature* students show significant positive effect on students' AP. The results showed that the students who are *mature* (26-50) and *young* (18-20) positively affected *academic performance*. For the *mid-young* (21-25) students, however, the results were negative. *Mature* students positively affected students' AP ($\beta = 0.790$), but *mid-young* students negatively affected their AP ($\beta = -12.248$).

## 3.4 Discussion and Conclusion

Based on the findings of this study, it is concluded that "for the first hypothesis, null hypothesis is not rejected", as *marital status* show no significant effect on students' AP, which is consistent with earlier published results of Amuda et al [7]. For the second and third hypothesis, we reject the null hypothesis and accept the alternative, as both *gender* and *age* affect students' AP. Earlier studies [53] [5] [3] show similar results that *gender* of the student does effect their *academic performance*. With respect to age of the student, the results are consistent with previous research as well (Amuda et al [7])that states *young* students perform better compared to *mature* students.

The findings provide empirical support for the conclusion that *gender* and *age* of the student do effect on students' AP. This conclusion is more clearly evident when considering the number of students and their frequency distribution. In particular, the *gender* that the students provided at the time of enrolment shows that there are 1060 *male* students and only 67 *female* students. Therefore, it may be beneficial to conclude the results based on students' frequency table.

# Chapter 4

# Do marital status, gender, and age affect the student in completing their studies on-time



---

**Summary**

This chapter focuses on *marital status*, *gender* and *age* as predictors of students' on-time university completion. The effect of demographic variables is examined using *marital status* (married or single), *gender* (male or female) and *age* (19-50) for Baccalaureate degree. Descriptive analysis and path analysis are used to find out the frequency distribution and relationship between variables. *Female* students complete their studies *on-time* more than *male*. *Marital status* does not affect students' on-time completion. Results show that as *age* increases the amount of time taken to complete a credential increases as well. The implications of these results can be applied to systems, communications and policy development for future students and policies.

## 4.1 Introduction

As time to complete is one of the primary indicators of *academic performance* [26] it is important to understand the factors that affect the time frame in which students' complete their studies. Within the increasingly diverse context of post-secondary enrollment, factors influencing the time to degree completion can inform the development of accommodation plans and unique semester structures to support future generations of credential seekers.

There are a lot of factors that affect students in completing their studies *on-time*. *Mid-young* students represent a significant proportion of university enrolment. Approximately, 73% of the students who enrolled in Baccalaureate degree are 23 year-old single males.

The enrolment of full-time students has grown more rapidly from the year 2000 to present compared to part-time by 4.2%. The students who are enrolled part-time are more likely to take more time to complete as they are only allowed to take three courses each term compared to the students who are enrolled full-time.

The methodology is guided by Jacobs and King who primarily focused on student *age* as a predictor of credential completion time [26].In this chapter; we extend their work and focus on additional variables (*marital status*, *gender*, and *age*) as predictors influencing credential completion.

### 4.1.1 Objective

The objective of this question is to determine:

- If the *Marital Status* of the student affects time taken until program completion.
- If the *Gender* of the student affects on-time program completion.
- If the *Age* of the student affects on-time program completion.

### 4.1.2 Hypotheses

The study analysed these null hypotheses:
$H_0$ : *Marital Status* does not affect students' on-time program completion.
$H_0$ : *Gender* does not affect students' on-time program completion.
$H_0$ : *Age* does not affect students' on-time program completion.

## 4.2 Method

### 4.2.1 Data

To pursue the objective of the study, a sample of 1127 bachelor of engineering students from 2007-2012 cohort year was taken. To assess the *on-time* program completion of students, expected completion times were provided by the office of Institutional Analysis and Planning. Transfer Students starting in Spring term are expected to complete their credential in 2 to 4 years, and transfer students beginning in Fall term are scheduled to complete their credential in 3 to 5 years. The completion variable contains three different levels: *On-time* completion, *not on-time* completion and *not completed*. There was no missing data. The variables used for the analysis are : *Marital status*, *gender*, *age*, *citizenship*, *native language*, *registration status* and *parents education* of the student during their first term.

### 4.2.2 Data Analysis

Two new variables were created to see students' *on-time* program completion. The variable *Time_to_Complete* is created by subtracting the *COHORTYEAR* from *First Reunion Class* and variable *Completion* is created using *Time_To_Complete* based on the guidelines provided by the Office of Institutional Analysis and Planning. There are about 882 students who completed the degree *on-time* compared to 11 *not-on-time* and 234 *not-completed*. We censored the students who are still enrolled (have not completed or dropped out), a similar technique used by Jacobs and King Jacobs [26]. This approach helped them to examine the behaviour of those whose education was completed, as well as those who have not yet completed the school or dropped out .

The hypotheses questions were answered using descriptive statistics and path analysis. Descriptive analyses were done to find out the relationship between *marital status*, *gender*, the *age*, the *registration status* of the student and *time to complete*. A correlation matrix was generated to show the correlations between variables. Later, a SEM based path analysis was applied to provide estimates of the magnitude and significance of hypothesised causal connections between sets of variables. This approach helps to see the effect of different variables such as *Marital status*, *Age*, *Gender*, and *Registration status* on variable *completion*.

Table 4.1: Frequency distribution of the variables used

| Characteristics | Number of students | Percentage(%) | Grade(Mean) |
|---|---|---|---|
| **Completion** | | | |
| On_Time | 882 | 78.26 | 69.73 |
| Not_on_Time | 11 | 0.97 | 58.68 |
| Not_Completed | 234 | 20.76 | 53.5 |
| **Age** | | | |
| $Young(18-20)$ | 95 | 8.42 | 66.59 |
| $Mid-young(21-25)$ | 793 | 70.36 | 68.22 |
| $Mature(26-50)$ | 239 | 21.20 | 68.68 |
| **Gender** | | | |
| Male | 1060 | 94.05 | 68.23 |
| Female | 67 | 5.94 | 67.52 |
| **Marital Status** | | | |
| Married | 69 | 6.12 | 71.15 |
| Single | 1058 | 93.87 | 67.98 |
| **Citizenship** | | | |
| Canada | 1030 | 91.39 | 68.21 |
| India | 18 | 1.59 | 66.83 |
| China | 11 | 0.97 | 75.24 |
| Pakistan | 7 | 0.62 | 67.2 |
| Lebanon | 6 | 0.53 | 68.97 |
| Othercities | 55 | 4.88 | 67.04 |
| **Native Language** | | | |
| English | 899 | 79.76 | 68.19 |
| French | 28 | 2.48 | 71.72 |
| Other | 200 | 17.74 | 67.45 |
| **Registration status** | | | |
| Full-Time | 1007 | 89.35 | 68.42 |
| Part-time | 120 | 10.64 | 64.99 |

1. Students whose entering *cohort year* is greater than their *first term registered* are removed.
2. Students who deceased while enrolled are removed.

### 4.2.3 Descriptive Analysis

**Relationship between Marital status of the student and Time to complete the studies.**

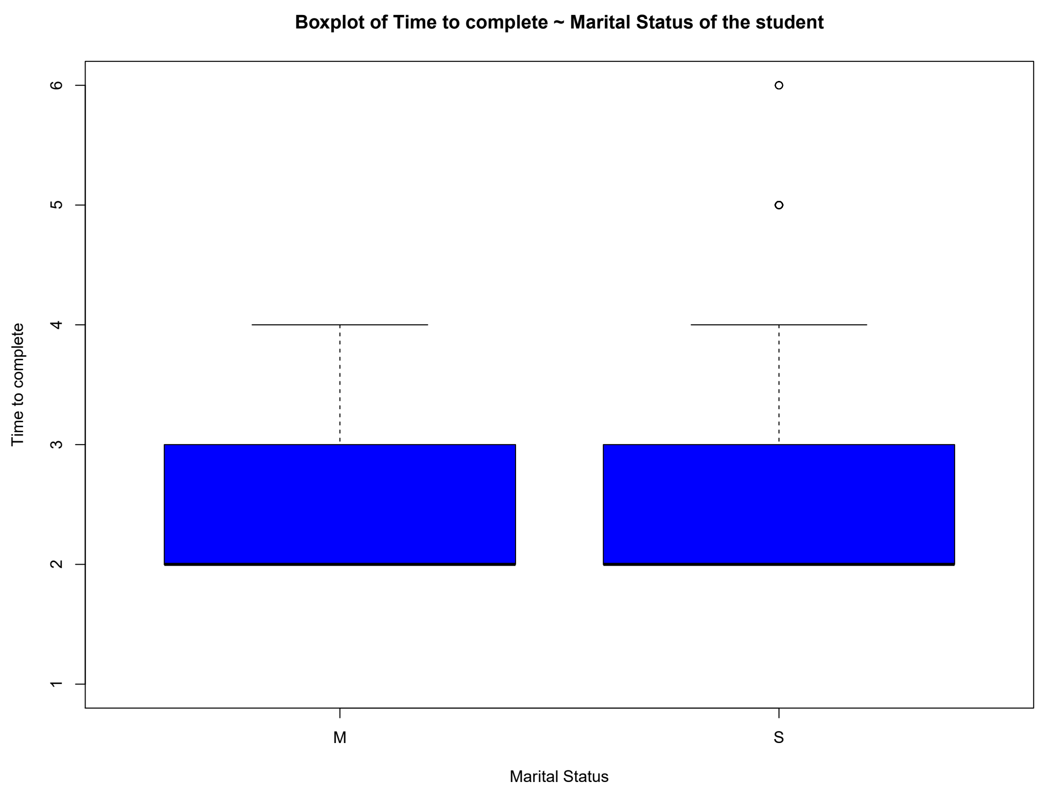


Figure 4.1: Box-plot of Time to complete and Marital status of the students

Fig. 4.1 shows that the average students complete their studies in 2 years. There is no difference in the *marital status* in completing the studies. The x-axis shows the *marital status* of the student and the y-axis shows time to complete the degree.

**Relationship between Gender of the student and Time to complete the studies.**

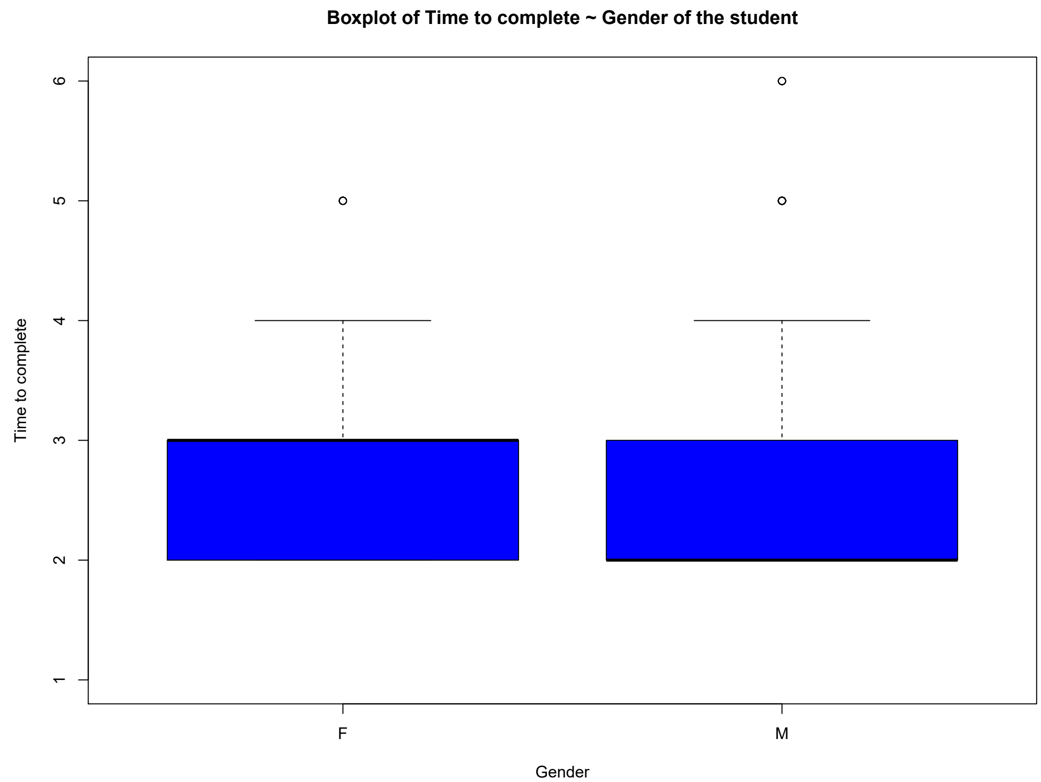


Figure 4.2: Box-plot of Time to complete and Gender of the students

Fig. 4.2 shows the completion of degree of *female* and *male* students in years. The x-axis shows the gender of the student, and the y-axis shows time to complete the degree. The average *female* students complete their degree in 3 years, compared to *male* students who complete in 2 years.

**Relationship between Age of the student and Time to complete the studies.**

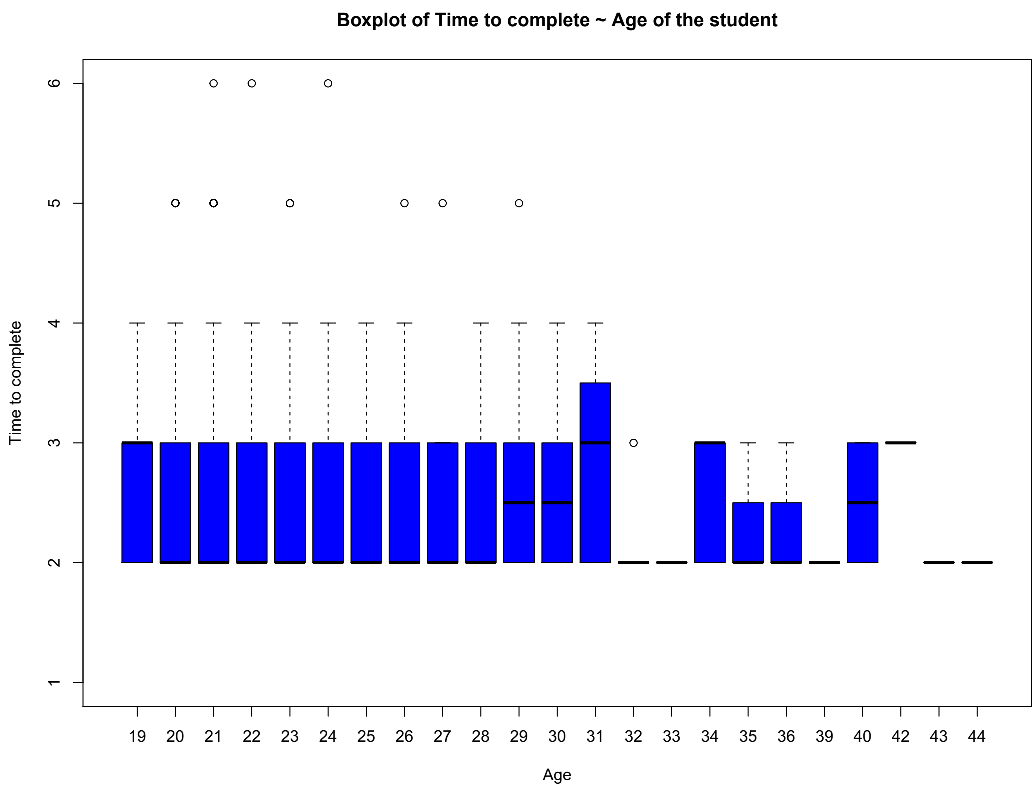


Figure 4.3: Box-plot of Time to complete and Age of the students

Figure 4.3 shows that a significant number of students complete their studies in 2 years, but there are few students of age 29-31, 34, 40 and 42 whose average time to complete is 2.5 and 3 years. The x-axis shows the *age* of the student at first term registered, and the y-axis shows time to complete the degree.

**Relationship between Registration status of the student and Time to complete the studies.**

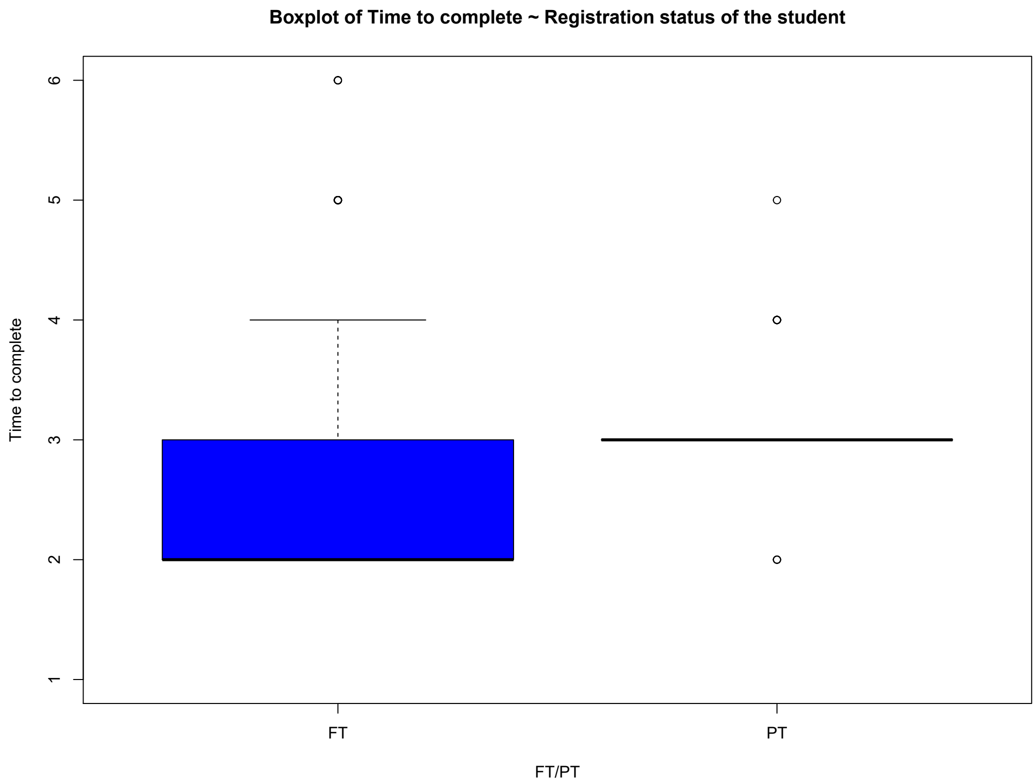


Figure 4.4: Box-plot of Time to complete and Registration Status of the students

There are only 120 part-time students enrolled in Baccalaureate degree out of 1127 students. Fig.4.4 shows the full-time and part-time status on the x-axis and time to complete the degree on the y-axis. The average full-time students complete their studies in 2 years, compared to part-time students who complete in 3 years.

## Correlation

To see the correlations between variables a correlation heat map was created. The relationship between *on-time* program completion and students' *marital status*, *age*, *gender*, *registration status*, *citizenship* and *native language* is shown in Fig 4.5. Darker shades of red indicate higher correlations. Similar correlation such as -0.002 in married and single show no effect in SEM model.

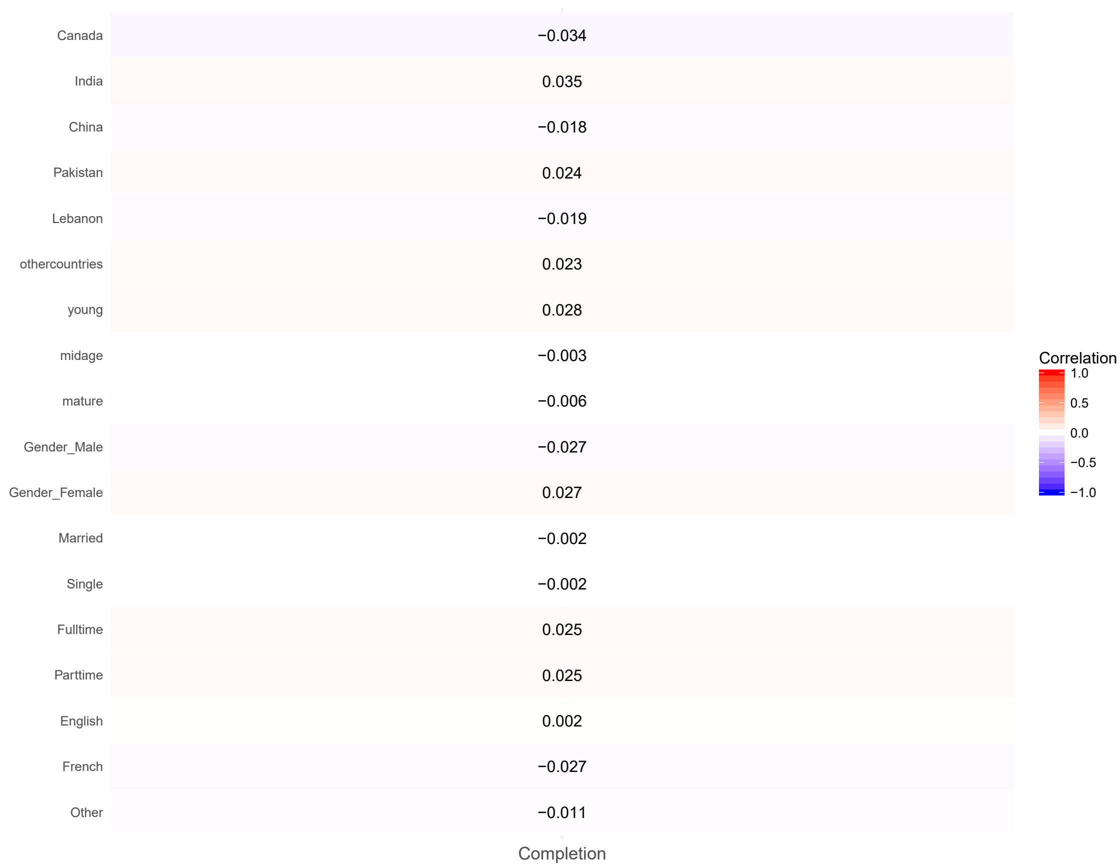


Figure 4.5: Correlation Matrix

### 4.2.4 Path Analysis

Path analysis is used to describe the directed dependencies among a set of variables. It is an extension of a regression model, in which two or more casual models are compared. This approach is used to find out the relationship between the demographic characteristics of the student and *on-time* degree completion. A step by step path analysis is used to evaluate the null hypothesised model. First, we need to find out the variables that are used to see the dependencies of different variables on one variable. Satisfactory data in the first step suggests the measured or observed variables and independent variables.

- Gender_Male, Gender_Female, Married, Single, young, mid-young, mature, X Father Schooling, X_Mother_Schooling, Canda, India, China, Pakistan, Lebanon, othercities, Full-time, Part-time, English, French, and Other are all exogenous variables (or independent variable, which is a variable not affected by other variables).
- On-time is an endogenous variable (or dependent variable have values that are determined by other variables).

The next step involves creating the model for assessing the hypothesised relations among the observed variables.

```
# To create model for the hypotheses:

modelPath1 = '
On_Time ~
Gender_Male + Gender_Female + Married + Single + young + mid-young
+ mature + X_Father_Schooling + X_Mother_Schooling + Canada + India +
China + Pakistan + Lebanon + othecities + Fulltime + Parttime + English
+ French + Other
'
```

The final step involves model fitting with the sample data. The model applied to the sample data evaluate the effect of Gender, *Marital status* and *Age* on *On_Time* degree completion.

```
# To fit the model:

path = sem(modelPath1, data = data)
```

The summary of the model can be viewed with the following command.

```
# Summary of the model:

summary(path, standardized = TRUE, rsquare = TRUE)
```

Table 4.2: Summary of the model

| | Estimate($\beta$) | Std.Err | z-value | p-value | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regressions:** | | | | | | |
| On_Time ~ | | | | | | |
| Gender_Male | -0.048 | 0.006 | -8.251 | 0.000 | -0.048 | -0.021 |
| Gender_Female | 0.070 | 0.003 | 21.806 | 0.000 | 0.070 | 0.055 |
| Married | -0.005 | 0.003 | -1.687 | 0.092 | -0.005 | -0.004 |
| Single | -0.005 | 0.003 | -1.687 | 0.092 | -0.005 | -0.004 |
| young | 0.049 | 0.003 | 15.527 | 0.000 | 0.049 | 0.050 |
| mid-young | 0.008 | 0.000 | 6.437 | 0.000 | 0.008 | 0.050 |
| mature | 0.001 | 0.000 | 8.720 | 0.000 | 0.001 | 0.034 |
| X_Fathr_Schlng | -0.003 | 0.000 | -8.886 | 0.000 | -0.003 | -0.024 |
| X_Mothr_Schlng | 0.002 | 0.000 | 6.437 | 0.000 | 0.002 | 0.018 |
| Canada | -0.051 | 0.004 | -13.209 | 0.000 | -0.051 | -0.047 |
| India | 0.109 | 0.006 | 16.977 | 0.000 | 0.109 | 0.051 |
| China | -0.091 | 0.009 | -10.199 | 0.000 | -0.091 | -0.028 |
| Pakistan | 0.155 | 0.011 | 13.999 | 0.000 | 0.155 | 0.037 |
| Lebanon | -0.139 | 0.013 | -10.575 | 0.000 | -0.139 | -0.028 |
| othercities | 0.003 | 0.000 | 11.994 | 0.000 | 0.008 | 0.050 |
| Full-time | 0.056 | 0.006 | 10.44 | 0.000 | 0.032 | 0.027 |
| Part-time | 0.032 | 0.003 | 10.547 | 0.000 | 0.032 | 0.027 |
| English | 0.047 | 0.004 | 11.479 | 0.000 | 0.047 | 0.064 |
| French | -0.047 | 0.004 | -11.479 | 0.000 | -0.047 | -0.029 |
| Other | -0.037 | 0.004 | -8.237 | 0.000 | -0.037 | -0.048 |
| **R-Square:** | | | | | | |
| On_Time | 0.016 | | | | | |

1. **Std.Err:** Standard Error
2. **Std.lv:** Standard Lavaan
3. **Std.all:** Standard all the variables.

Later, to view the model and see the residuals and effect of the variables, we can plot the model. The following commands will plot a model with labelled nodes.

**# Specifying the variable names for each node**

lbls = c("Male", "Female", "Married", "Single", "young", "mid-young", "mature", "Father Schooling", "Mother Schooling", "Canada", "India", "China", "Pakistan", "Lebanon", "othercities", "Full time", "Part time", "English", "French", "Other", "On_Time")

**# To plot the model you can choose from different types of layout such as tree, circle, spring, tree2, circle2:**

semPaths(path, whatLabels = "std", layout = "spring", nodeLabels = lbls, sizeMan = 10, sizeLat = 10, edge.label.cex = 1.5) text(0,1.4, labels = "Effect of Gender, Marital status and Age on on-time completion.)

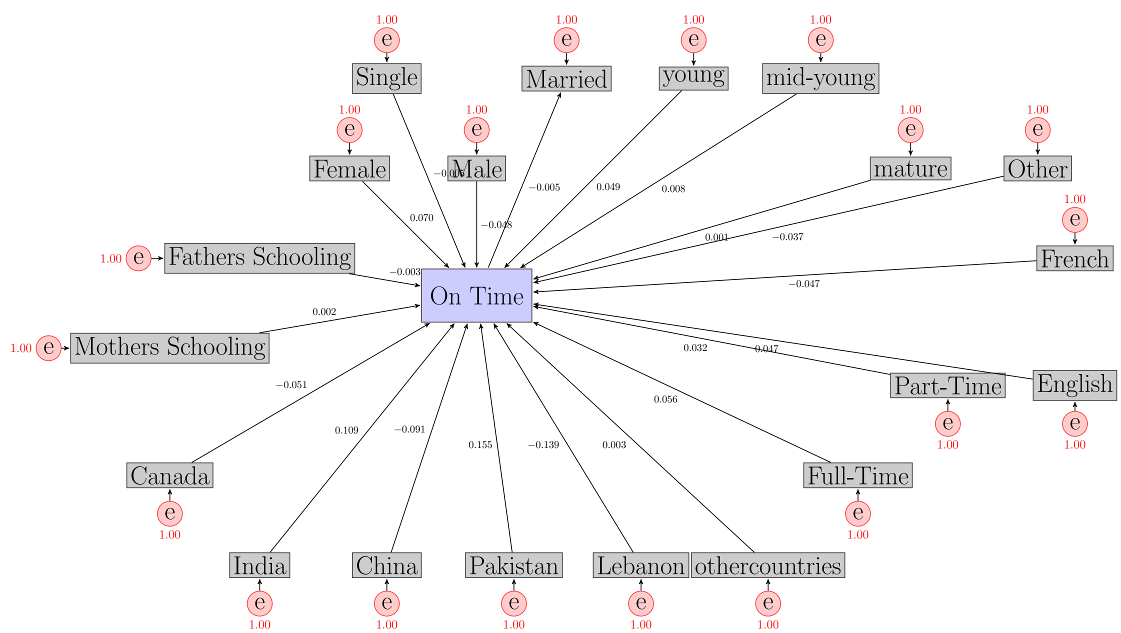


Figure 4.6: SEM path diagram of the path model

## 4.3 Results

- **Effect of Gender of the student:** The results of the analysis show *male* students don't complete their studies *on-time*. *Male* students emerged as a negative factor in predicting students' *on-time* degree completion variable compared to *Female* students. *Gender Female* positively affected students' *on-time* degree completion variable ($\beta = 0.070, p = 0.000$), whereas *Gender Male* negatively affected students' *on-time* degree completion ($\beta = -0.048, p = 0.000$).

- **Effect of Marital Status of the student:** The overall *marital status* shows a negative effect on student *on-time* degree completion. The correlation heat map shows a similar effect on students' *on-time* degree completion variable. Students' *marital status* show no impact on students' *on-time* variable ($\beta = -0.005, p = 0.092$). In conclusion, *marital status* of the student doesn't show any effect on student's *on-time* degree completion.

- **Effect of Age of student:** *Young* students (18- 20) emerged as a high positive factor in predicting students' *on-time* degree completion compared to *mid-young* (21-25) and *mature* students (26-50). Low estimate value of *mature* students shows that they take more time to complete their degree as "they might be married and have kids or other responsibilities" compared to *mid-young* or *young* students whose main priority is school. The greater estimate value of *young* students ($\beta = 0.049, p = 0.000$) shows that *young* students complete their degree *on-time* as compared to *mid-young* ($\beta = 0.0080, p = 0.000$) and *mature* students ($\beta = 0.001, p = 0.000$).

## 4.4 Discussion and Conclusion

Several conclusions seem appropriate based upon the results of this study. First, *male* transfer students are more likely to take longer to complete their studies on time ($\beta = -0.048$), given sufficient time to complete degree requirements. *Female* Students are more likely to complete their studies *on-time* based on the high significance of the correlation between the *female* and completion time variables. The null hypothesis is rejected, as there is a significant effect of student *gender* on *on-time* degree completion, given sufficient time to complete degree requirements. The second conclusion from this study is that student married or single doesn't affect students' *on-time* degree completion. A final conclusion is that the older students are at the time of registration, the more likely it is that they will take more time to complete the degree. Only 11 students in this study did not complete their degree *on-time*, given sufficient time to complete, however, 234 students did not complete their degree. We analysed the effect of all transfer students on *on-time* variable. The students who are taking longer or not completing shows negative impact on *on-time* completion variable. Results seems to validate Jacob's [26] theory that *female* students and *young* students complete their studies *on-time* compared to *male* and *mature* students.

# Chapter 5

# The effect of citizenship, immigration status, and native language on Grades.



---

**Summary**

The purpose of this study is to explore how factors related to *ethnicity* and *citizenship* influence overall *academic performance*. We included students who enrolled in Baccalaureate degrees at an Ontario university between the years of 2007 and 2012. We considered *citizenship* (Canada, China, India, Pakistan, Lebanon and Other), *immigration status* (Canadian Citizen, Permanent Resident, Student Visa) and *native languages* (English, French, Other) in a Structural Equation Modelling analysis. The sample primarily consisted of students residing in Canada with Canadian citizenship (92%). Our analysis revealed that (a) students who are from different ethnic groups (such as India and Pakistan) tend to complete their studies on-time, when compared to students with other citizenships; (b) Students whose *native language* is French complete their studies on-time in relation to others; and (c) students whose immigration status is Permanent Resident complete their studies on-time compared to students who have Canadian citizenship or student visa. These findings will help institutional planning and student support services to develop strategies for supporting an ethnically diverse student body.

## 5.1 Introduction

Students' *citizenship* plays an important role in student *academic performance*. Recently there have been increasing number of children from Asian backgrounds arriving in Canada while a majority are from the Philippines [2]. This study examines the ethnic differences in university education attainment in the children of immigrant families. Determining the ethnic differences in educational attainment among the immigrants is vital for understanding why some groups achieve more success than others.

Research has shown that ethnicity is associated with academic achievement. In other countries such as the United States of America (USA), Asian-American students are outperforming Caucasians, as there are cultural differences and immigration status [23]. Chinese and Korean families have a higher expectation, which is beneficial for children scholastic achievement compared to children of Mexican background [21]. The Chinese and Koreans [59], and South Asians [56], show excellent academic success while others exhibit signs of a poor academic success. Possible explanations for the variation between groups include factors such as financial and human capital, family structure, community resources, cultural relocations, as well as external factors such as racial difference and economic opportunities [58].

High *academic performance* is not observed among all the children of immigrants.

Children who immigrate in early childhood have higher educational outcomes than those who arrive late [27]. Student immigration status can be of three type (Canadian citizen, permanent resident and student visa). In this study, *ethnicity* is defined as the *citizenship* of the student. The primary aim of this study is to explain the performance of students according to their *citizenship*.

### 5.1.1 Objectives

The objectives of this study are to determine:

- If *Citizenship* affects student Grades at each term.
- If *Immigration Status* affects student Grades at each term.
- If *Native Language* affects student Grades at each term.

### 5.1.2 Hypothses

The study analysed the following null hypotheses:
$H_0$ : *Citizenship* of the student does not affect on students' Grades at each term.
$H_0$ : *Immigration Status* of the student does not affect on students' Grades at each term.
$H_0$ : *Native Language* of the student does not affect on students' Grades at each term.

## 5.2 Method

### 5.2.1 Data

This research uses data from the students with transfer credit who enrolled into STEM based Baccalaureate degrees at an Ontario university between the years of 2007 and 2012. It is a non-denominational and provincially supported public university. Student *citizenship*, *immigration status* and *native language* entered during the time of enrolment were used to address the hypotheses. In addition, students' gender also used for the analyses. Variables were subdivided further, for example *citizenship* of the students is subdivided into Canada, China, India, Pakistan, Lebanon and other countries based on the total number of student enrolled per country. Overall, there are 1127 students without any missing data.

### 5.2.2 Method of Data Analysis

The sample for our analysis consisted of three *immigration statuses*, three *native languages*, and six *citizenships*. These variables were used to represent ethnicity, as the variable ethnicity was not present in the data set. The *citizenship* variable included more countries, but only countries with more than five students were used and the rest combined into an "other_countries" variable. In the immigration status variable, there are more visa categories, but all different visa type/categories were combined to student visa. The analysis was done using descriptive statistics (frequencies, histogram and boxplot) and path analysis (to see the effect of an observed variable on another observer variable) which is an SEM technique.

The majority of the students have English as their native language, have Canadian citizenship and are from Canada. There are minor groups of students from different categories as shown in Table 5.1.

Table 5.1: Frequency distribution of the variables used

| Characteristics | Number of students | Percentage(%) | Grade(Mean) |
|---|---|---|---|
| **Citizenship** | | | |
| Canada | 1030 | 91.39 | 68.21 |
| China | 11 | 0.97 | 75.24 |
| India | 18 | 1.59 | 66.83 |
| Pakistan | 7 | 0.62 | 67.2 |
| Labanon | 6 | 0.53 | 68.97 |
| othercities | 55 | 4.88 | 67.04 |
| **Gender** | | | |
| Male | 1060 | 94.05 | 68.23 |
| Female | 67 | 5.94 | 67.52 |
| **Immigration status** | | | |
| Candian | 1030 | 91.39 | 68.21 |
| Permanent Resident | 77 | 6.83 | 69.05 |
| Student Visa | 20 | 1.77 | 67.48 |
| **Primary Language** | | | |
| Englsih | 899 | 79.76 | 68.19 |
| French | 28 | 2.48 | 71.72 |
| Other | 200 | 17.74 | 67.45 |

1. Students whose entering *cohort year* is greater than their *first term registered* are removed.
2. All other visa types/categories were combined to student visa.
3. Students who deceased while enrolled are removed.

### 5.2.3 Descriptive Analysis

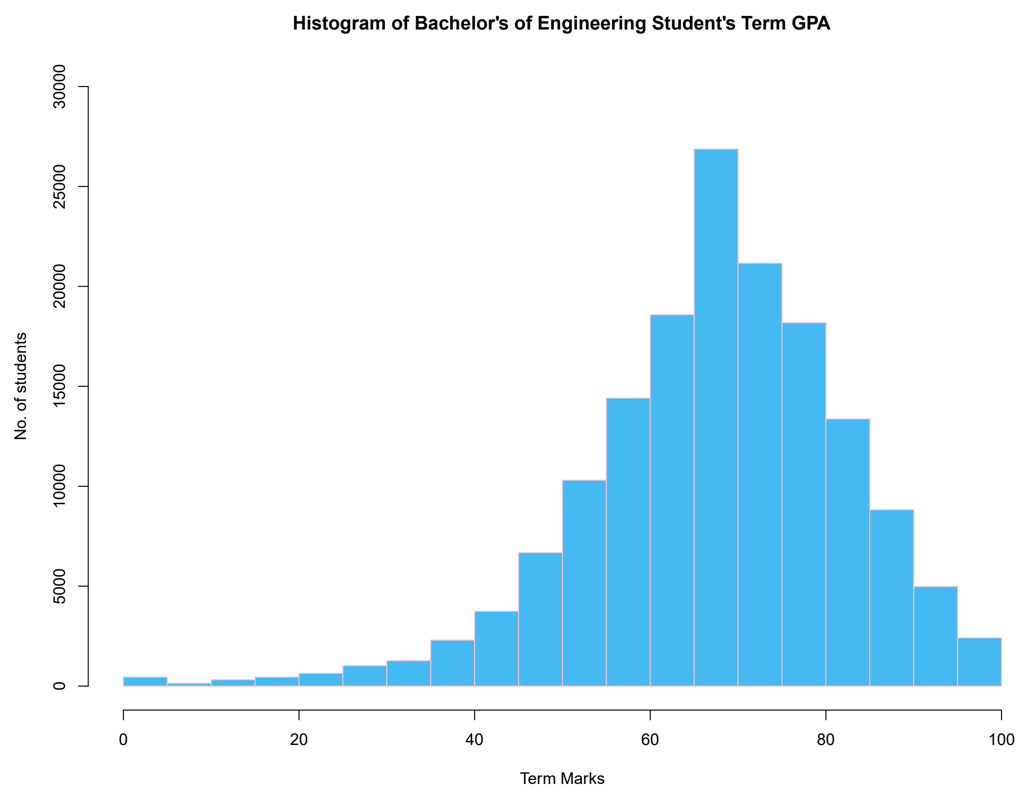


Figure 5.1: Histogram of Grades

Figure 5.1 shows the median marks of students in the university. The x-axis shows the term marks and the y-axis shows the overall number of students for the year 2007 to 2012. It is a bell-shaped and binomial type distribution. The graph shows that majority of the students' score between 60% to 80% in each term.

**Relationship between Immigration status and Grades of the student**

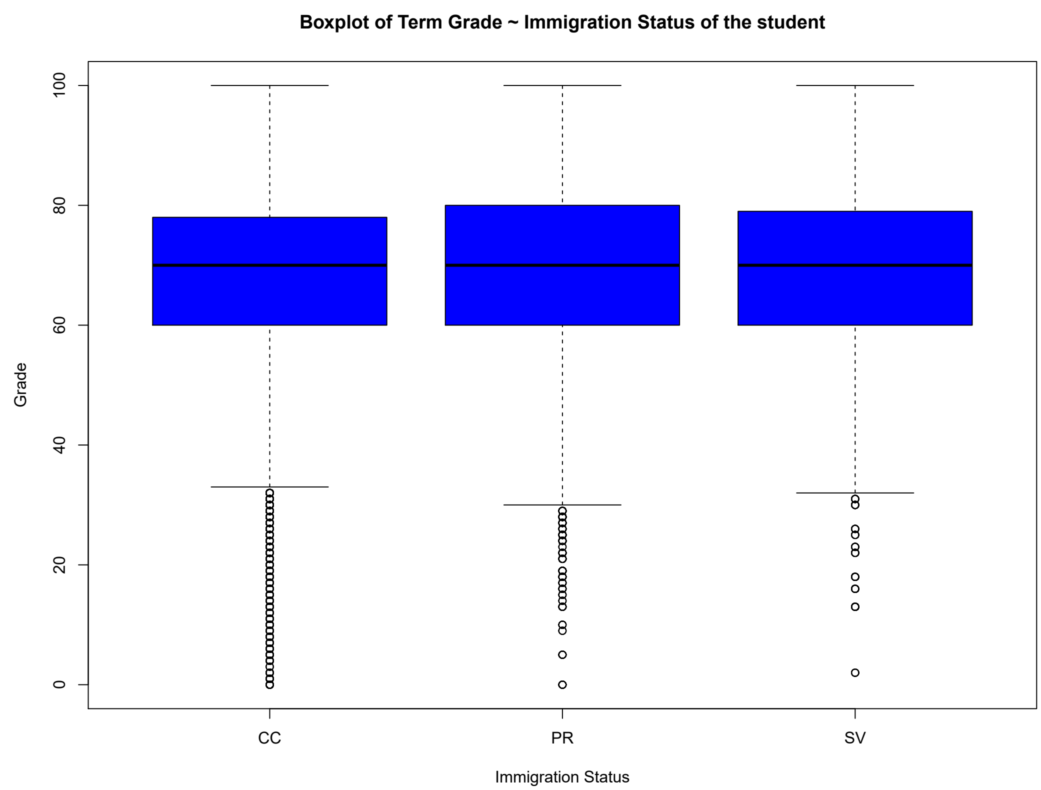


Figure 5.2: Boxplot of Term grade and immigration status of the student

Figure 5.2 shows that average marks of students are between 60 to 80 percent. The x-axis shows the immigration status of the student and the y-axis shows the term grades in percentage. Students from all three categories show similar average term grades.

**Relationship between Citizenship and Grades of the student**

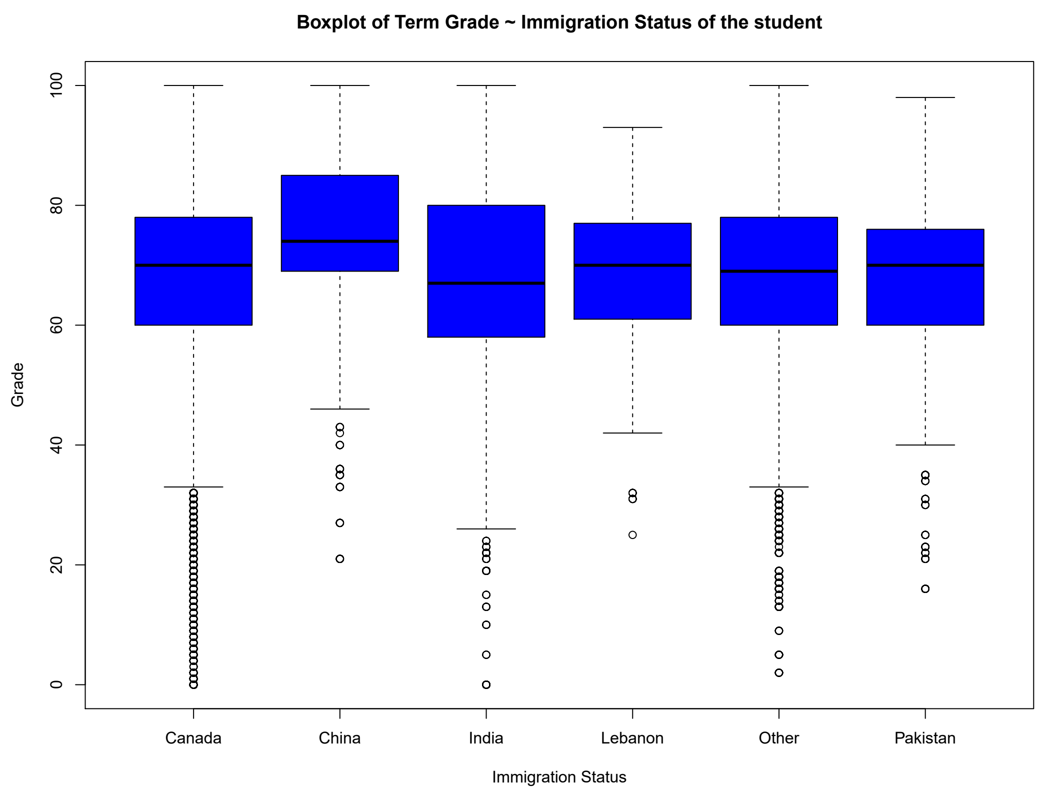


Figure 5.3: Boxplot of Term grade and Citizenship of the student

Figure 5.3 shows that the average marks of all the students are between 60 to 80 percent. The x-axis shows the citizenship of the student and the y-axis shows the term grades in percentage. The average marks of students from China is significantly higher compared to the students from other countries. Students from India, Pakistan, Lebanon and other countries show similar grades.

**Relationship between Native Language and Grades of the student**

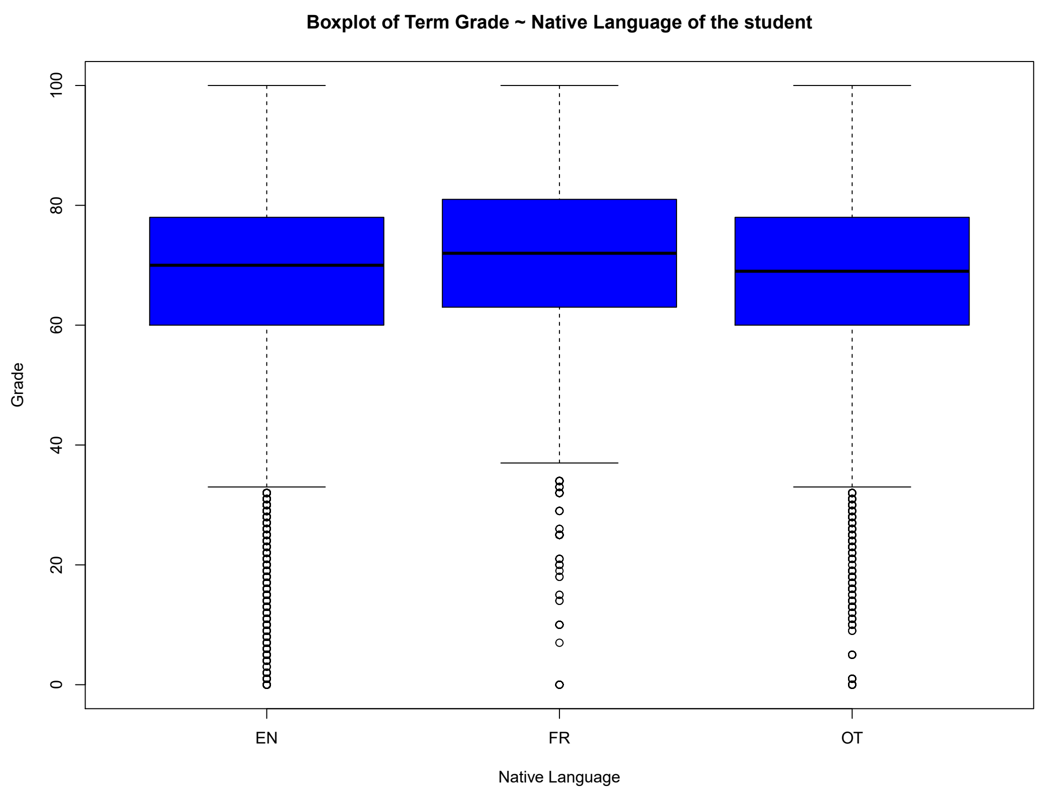


Figure 5.4: Boxplot of Term grade and Native language of the student

Figure 5.4 shows that the average marks of all the students are between 60 to 80 percent. The x-axis shows the Native language of the student registered at the time of registration in the university and the y-axis shows the term grades in percentage. The students whose native language is French outperforms the students whose native language is English or Other.

**Relationship between Gender and Grades of the student**

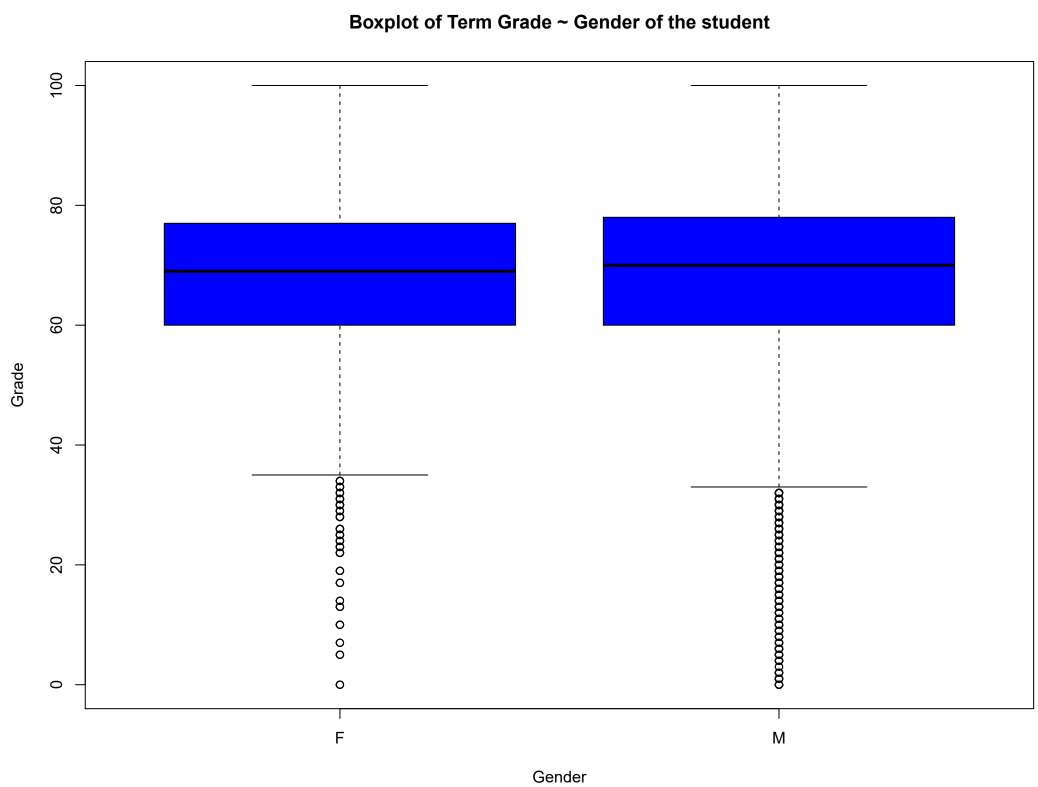


Figure 5.5: Boxplot of Term grade and Gender of the student

Both gender male and female show similar average grades in Figure 5.5. The x-axis shows the gender of the student and the y-axis shows the term grades in percentage. The diagram shows that the average marks of all the students are between 60 to 80 percent.

# Correlation

Figure 5.6 shows the correlations between exogenous variables (independent variables) and endogenous variable (dependent variable) taken to answer the hypotheses. Registration status (Full-time; Part-time) and marital status (Married; Single) show a similar relationship with the variable grade.

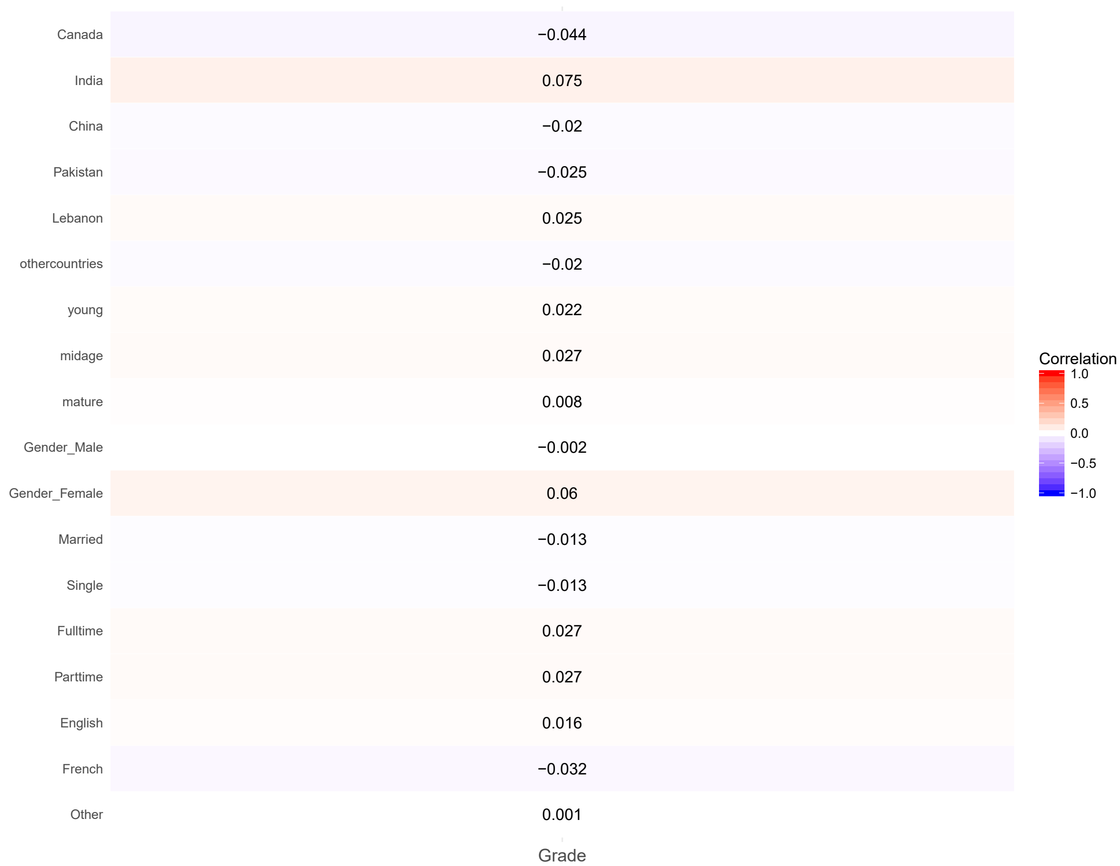


Figure 5.6: Correlation Matrix

### 5.2.4 Path Analysis

Path analysis indicates whether the model fits the data, as well as significance tests for specified directional paths. Path analyses follows the following steps to assess the hypothesis and accept the alternative hypothesis. The first step is to find out the variables required to answer the hypotheses.

- Canada, India, China, Pakistan, Lebanon, othercountries, X_Father_Schooling, X Mother Schooling, English, French, Other, Canadian, Permanent_resident, student_visa, Gender_Male, Gender_Female are all exogenous variables (or independent variables is a variable that is not affected by other variables).

- Grade is an endogenous variable (or dependent variables have values that are determined by other variables).

The next step involves creating the model for assessing the hypothesised relations among the variables mentioned above.

```
# To create model for the hypotheses:

modelPath2 = '
Grade ~
Canada + India + China + Pakistan + Lebanon + othecities +
X_Father_Schooling + X_Mother_Schooling + English + French + Other
+ Canadian + Permanent_resident + Student_visa + Gender_Male + Gender_Female
'
```

The last step involves model fitting with the sample data of 1127 transfer students. The model applied to the sample data evaluate the effect of *citizenship*, *native language*, *immigration status* and *gender* on students' term grades.

```
# To fit the model:

path = sem(modelPath2, data = data)
```

Table 5.2 shows the summary of the model fitted, which can be viewed with the help of the following command.

```
# Summary of the model:

summary(path, standardized = TRUE, rsquare = TRUE)
```

Table 5.2: Summary of the model

| | Estimate($\beta$) | Std.Err | z-value | p-value | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regressions:** | | | | | | |
| Grade ~ | | | | | | |
| Canada | -0.597 | 0.295 | -2.024 | 0.043 | -0.597 | -0.011 |
| India | 0.301 | 0.311 | 0.970 | 0.332 | 0.301 | 0.003 |
| China | -8.149 | 0.433 | -18.840 | 0.000 | -8.149 | -0.052 |
| Pakistan | 0.109 | 0.535 | 0.204 | 0.838 | 0.109 | 0.001 |
| Lebanon | -1.580 | 0.635 | -2.486 | 0.013 | -1.580 | -0.007 |
| othercities | 0.032 | 0.016 | 1.948 | 0.051 | 0.032 | 0.005 |
| X_Fathr_Schlng | 0.111 | 0.015 | 7.301 | 0.000 | 0.111 | 0.020 |
| X_Mothr_Schlng | -045 | 0.018 | -2.488 | 0.013 | -0.045 | -0.007 |
| English | 0.079 | 0.096 | 0.822 | 0.411 | 0.079 | 0.002 |
| French | 1.087 | 0.206 | 5.273 | 0.000 | 1.087 | 0.011 |
| Other | -0.742 | 0.099 | -7.516 | 0.000 | -0.742 | -0.020 |
| Canadian | -1.040 | 0.185 | -5.622 | 0.000 | -1.040 | -0.020 |
| Permannt_rsdnt | 0.472 | 0.321 | 1.470 | 0.141 | 0.472 | 0.008 |
| Student_visa | -0.418 | 0.291 | -1.437 | 0.151 | -0.418 | -0.004 |
| Gender_Male | -0.690 | 0.156 | -4.432 | 0.000 | -0.690 | -0.011 |
| Gender_Female | 0.562 | 0.156 | 3.614 | 0.000 | 0.562 | 0.009 |
| **R-Square:** | | | | | | |
| Grade | 0.003 | | | | | |

1. **Std.Err:** Standard Error
2. **Std.lv:** Standard Lavaan
3. **Std.all:** Standard all the variables.

Figure 5.7 shows the path diagram of the model. The model can be viewed to see the residual terms for endogenous variables, variances, covariances among exogenous variables and covariance among endogenous variables.

**# Specifying the variable names for each node**

lbls = c( “Canada”, “India”, “China”, “Pakistan”, “Lebanon”, “othercountries”, “Father Schooling”, “Mother Schooling”, “English”, “French”, “Other”, “Canadian”, “Permanent_resident”, “Student_visa”, “Male”, “Female”, “Grade”)

**# To plot the model you can choose from different types of layout such as tree, circle, spring, tree2, circle2:**

semPaths(path, whatLabels = “std”, layout = “spring”, nodeLabels = lbls, sizeMan = 10, sizeLat = 10, edge.label.cex = 1.5) text(0,1.4, labels = “Effect of citizenship, immigration status, and native language on Grades”)

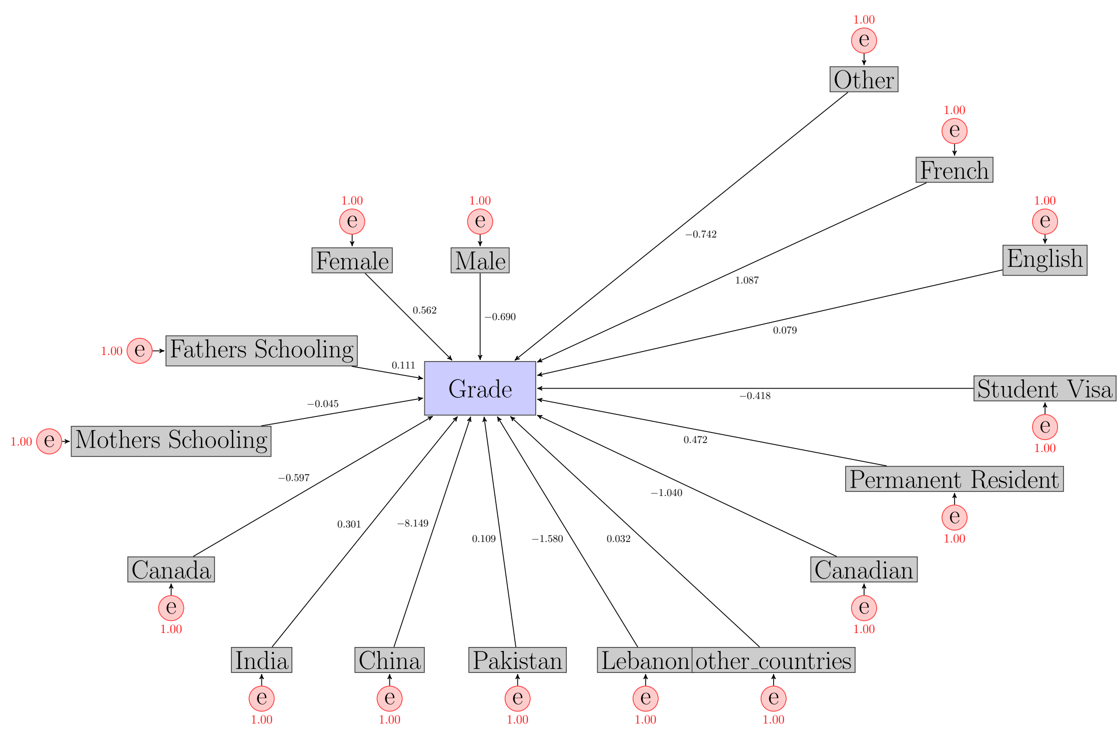


Figure 5.7: SEM path diagram of the path model

## 5.3 Results

- **Effect of immigration status of the student:** Permanent resident status had a significant positive effect on grades. Students who have permanent resident ($\beta = 0.472, p = 0.141$) as their *immigration status* tend to perform better compared to students with Canadian ($\beta = -1.040, p = 0.000$) and student visa ($\beta = -0.418, p = 0.151$) as their *immigration status* as seen in summary Table 5.2.

- **Effect of native language of the student:** Students who have French as their native language outperform the students with English and other as their native language. French student shows a significant positive effect on Grade ($\beta = 1.087, p = 0.000$), compared to English ($\beta = 0.079, p = 0.411$) and other ($\beta = -0.742, p = 0.000$).

- **Effect of Citizenship of the student:** Students coming from India, other countries and Pakistan show a positive effect on grades, whereas students coming from Canada, China, Lebanon shows a negative effect on grades. The results may be skewed because of the number of students from different countries such as 91% of the students are from Canada and only 9% are from different countries. The results indicated that students from India ($\beta = 0.301, p = 0.332$), Pakistan ($\beta = 0.109, p = 0.838$) and other countries ($\beta = 0.032, p = 0.051$) had positive and significant effect on students' term grades.

## 5.4 Discussion and Conclusion

Several hypotheses answered in this question about the effect of *immigration status*, native language and citizenship of the student on their term grades. In conclusion, students who have a permanent resident as their *immigration status*, have French as their native language or are from India, Pakistan or other countries perform better compared to other students. The results are consistent as Ka and Tienda [28] and Andrew J. Fuligni [17] also found out that *immigration status* and parents nativity are the key predictors to predict students' *academic performance*. Similarly, Amy Lutz [17] found out that students who speak "non-english" as their *native language* have high level of proficiency than the students who speak English as their *native language*. There may be other factors that affect students' grades, but our focus was on these available variables. These finding will help institutional planning for the future students.

# Chapter 6

# Is the likelihood of graduating on-time dependent on the sending institution of the student?



---

**Summary**

The primary aim of this study is to look at the *sending institution* of transfer students and to determine if there is a relationship between their demographic characteristics and completing the studies *on-time*. Data was collected from students with transfer credits who are enrolling into

STEM-based Baccalaureate degrees at an Ontario university between the years of 2007 and 2012. A sample of 1127 students were used in this study. Information from fourteen major institutes, which sent more than or equal to 30 students to Lakehead, were used in this study. Descriptive statistics and path analysis were the primary statistical techniques used. The study indicated the following conclusions: students coming from institute N ($\beta = 0.217$) are significantly completing the studies *on-time* compared to other institutes, whereas students from institute F and H are not completing the studies *on-time*. Furthermore, students whose native language is English and Other are completing the studies *on-time*, whereas students whose native language is French are not. It appears that *sending* or *past institutions* have a massive effect on a students' future institute.

## 6.1 Introduction

Approximately 53% of Canadians above the age of 15 have completed some level of postsecondary education at either a university or college [1]. The college system in Canada provides technical training and diplomas [45]. Colleges typically focus on specific employment skills, career training and trades. Contrarily, universities are institutions that can grant degrees. Universities in Canada are academic institutions that are regulated by provincial legislation. They typically focus on analytical skills, academic, and professional programs [45].

Research shows that there is a difference in the academic preparation of college students compared to students from universities [57]. College graduates tend to be less academically prepared compared to university graduates [57]. Priorities differ when students are in college compared to university. For example, for most university students, the university education is their primary focus with other responsibilities being secondary [19]. This difference in educational standards can affect transfer students who venture from college to university. Another aspect of the transfer that may affect student's performance is the type of course completed at the previous institute. Traditionally, students transfer to a university in a similar program they were taking in the previous institute. However, with increased flexibility from institutions and higher acceptance rates, more students may now transfer from different programs. Glass Jr. and E. Bunn did a similar study to find out the length of time required to graduate for community college students transferring to senior institutions [19].

The significance of this study is its attempt to examine transfer student success, as measured by *on-time* degree completion, depending on the *sending institution* of the student. The study focused on the students' *past/sending institution*, *gender*, *native language*, *age*, and *parent education*. There are many other factors affecting transfer students' *on-time* degree completion, such as the social and academic framework of institutions etc. The question that guided the current hypothesis are to find out is there a relationship between students' *past/sending college* and their academic success in university?

### 6.1.1 Objective

The objective of this study is to find out the effect of the *sending institution* on student completing his/her studies *on-time*.

### 6.1.2 Hypotheses

The current study analysed the following null hypotheses:
$H_0$ : *Sending institution* of the student does not affect whether they complete the graduation *on-time*.

## 6.2 Method

### 6.2.1 Data

The data collected for this study consisted of students with transfer credits who are enrolling into STEM-based Baccalaureate degrees at an Ontario university between the years of 2007 and 2012. Data was collected from 45 institutes overall, but only 14 major *sending institutes* were used in the analysis. The rest of the institutes were combined into a single variable and named as other_inst. Students who were doing degree that was not a Baccalaureate degree were removed from the data. The time to complete degree variable was used to create the *on-time* variable. Students starting in Spring term are supposed to complete the degree in 2 to 3 years, but an additional year is given to sufficiently complete the degree. Students beginning in Fall term are supposed to complete in 3 to 4 years, but an additional year is provided to complete the degree. In short, students starting in Spring term can complete the degree within 4 years and students who are starting in Fall term can finish in 5 years. The variables used in the study are *on-time* degree completion, *sending institutes* (subdivided into individual institutes whose number of student count >= 30), *gender* (male and female), *native language* (English, French, Other), *parents schooling* (father's schooling and mother's schooling), and *age* of the student (young, mid-young, mature).

### 6.2.2 Data Analysis

The current study focuses on the effect of every *sending institution* on the individual student completing their degree *on-time* at their current program, given sufficient time to complete. The students coming from different institutes taken and their impact on *on-time* completion variable are seen in this analysis.

The analysis for the study used descriptive statistics and path analysis to see the frequency and impact of one variable on another. We used path analysis which is an SEM technique to determine the relationship between the dependent and independent variables and we also used level of significance to test the hypotheses as <= 0.05. The path analysis technique was selected because it considered the impact of multiple variables (i.e., individual *sending institutes*, *gender*, *age* and *native language* of the student) on one variable(i.e. *on-time* degree completion).

Table 6.1: Frequency distribution of the variables used

| Characteristics | Number of students | Percentage(%) | Grade(Mean) |
|---|---|---|---|
| **Completion** | | | |
| On_Time | 882 | 78.26 | 69.73 |
| Not_on_Time | 11 | 0.97 | 58.68 |
| Not_Completed | 234 | 20.76 | 53.5 |
| **Sending Institutions** | | | |
| A (1.026) | 109 | 9.67 | 63.77 |
| B (1.060) | 85 | 7.54 | 68.12 |
| C (1.057) | 82 | 7.27 | 69.3 |
| D (1.039) | 74 | 6.56 | 67.21 |
| E (1.001) | 63 | 5.59 | 67.85 |
| F (1.043) | 64 | 5.67 | 68.19 |
| G (1.02) | 62 | 5.50 | 68.48 |
| H (1.052) | 57 | 5.05 | 72.28 |
| I (1.003) | 53 | 4.70 | 71.17 |
| J (1.007) | 46 | 4.08 | 69.83 |
| K (1.049) | 36 | 3.19 | 66.01 |
| L (1.01) | 31 | 2.75 | 66.19 |
| M (1.011) | 30 | 2.66 | 66.19 |
| N (1.023) | 30 | 2.66 | 68.82 |
| Other_Institutes | 308 | 27.32 | 68.93 |
| **Age** | | | |
| $Young(18-20)$ | 95 | 8.42 | 66.59 |
| $Mid-young(21-25)$ | 793 | 70.36 | 68.22 |
| $Mature(26-50)$ | 239 | 21.20 | 68.68 |
| **Gender** | | | |
| Male | 1060 | 94.05 | 68.23 |
| Female | 67 | 5.94 | 67.52 |
| **Native Language** | | | |
| English | 899 | 79.76 | 68.19 |
| French | 28 | 2.48 | 71.72 |
| Other | 200 | 17.74 | 67.45 |

1. Students whose entering *cohort year* is greater than their *first term registered* are removed.
2. Students who deceased while enrolled are removed.

### 6.2.3 Descriptive Analysis

**Relationship between *Sending institutions* of the student and Time to complete the studies *on-time*.**

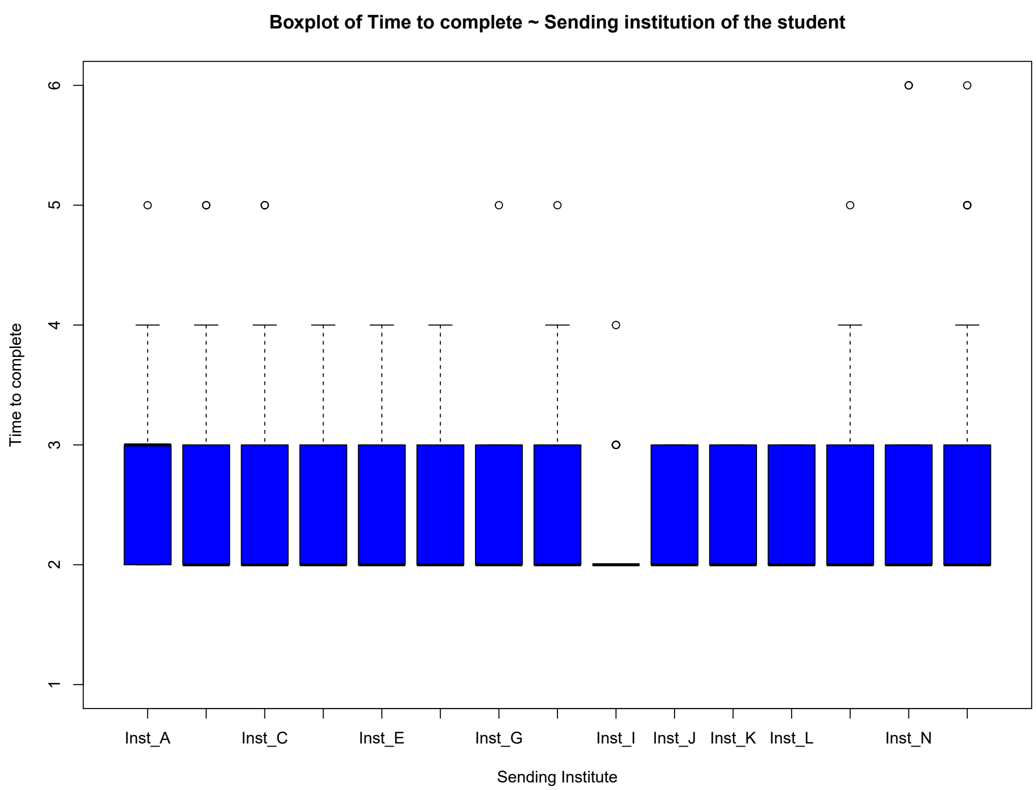


Figure 6.1: Boxplot of sending institutions and time to complete the degree

Figure 6.1 shows that most of the institutes have students that complete their degree in 2-3 years, but there are few institutes which have students that take more time to complete their degree. The x-axis shows the different *sending institutes* and the y-axis shows the time to complete the degree of the students.

**Relationship between Native Language of the student and Time to complete the studies *on-time*.**

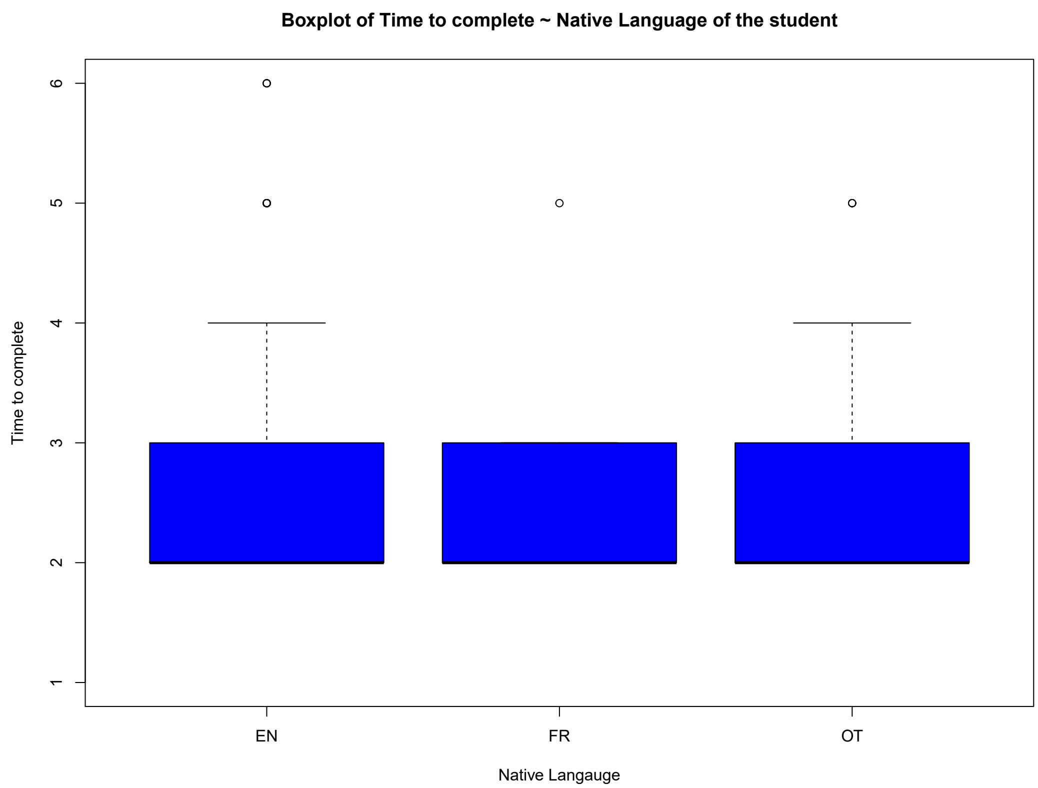


Figure 6.2: Boxplot of native language and time to complete the degree

Figure 6.2 shows how students with different native language complete their studies in the university. The x-axis shows different native language, i.e. English, French, and Other and the y-axis shows time to complete the degree. The average students complete their degree in 2-5 years.

**Relationship between Gender of the student and Time to complete the studies *on-time*.**

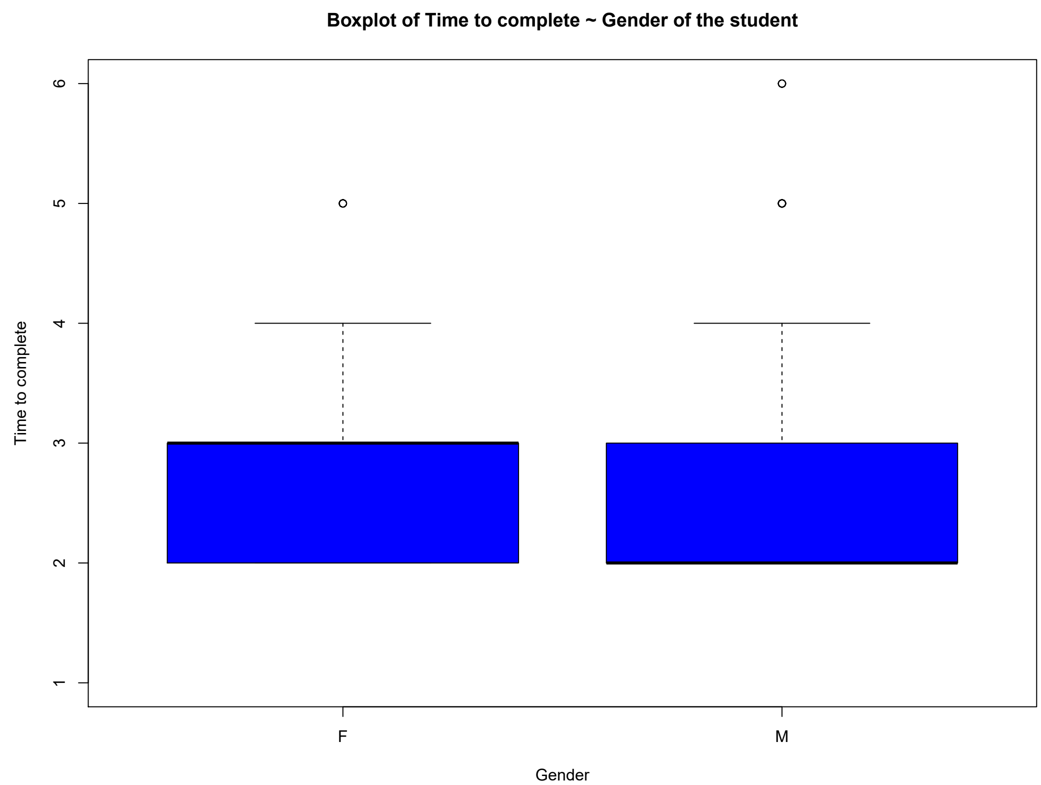


Figure 6.3: Boxplot of gender of the student and time to complete the degree

Figure 6.3 shows the average time to complete for students, according to their gender entered at the time of registration. The x-axis includes the gender of the student, and the y-axis includes the time to complete the degree in university. The average female university student takes three years to complete whereas the average male university student take two years to complete.

**Relationship between Age of the student and Time to complete the studies *on-time*.**

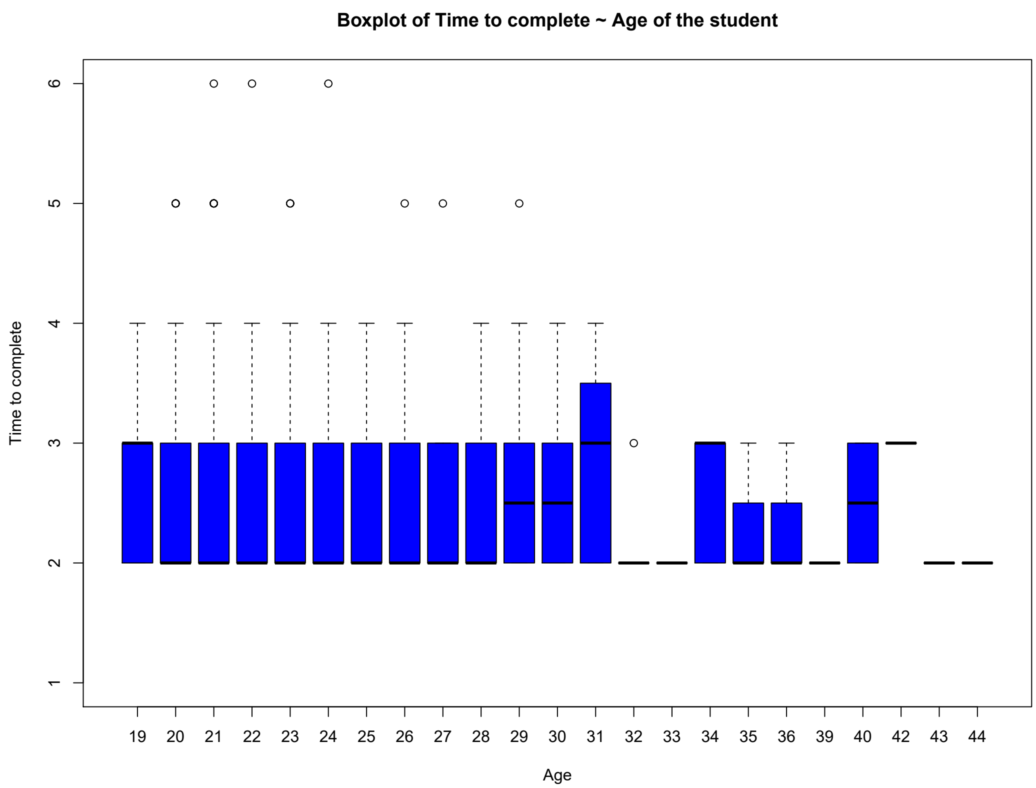


Figure 6.4: Boxplot of age of the student and time to complete the degree

Figure 6.4 shows that the average number of students completing their degree in 2-3 years, but some students take a longer time to complete their degree in university. The x-axis shows the age of the student entered at the time of registration and the y-axis shows the time to complete the degree.

## Correlation Map

The correlation of the variables can be seen with the help of a correlation table. The positive values show that there is a positive correlation between the variables, and the negative values indicate that there is a negative correlation between variables.

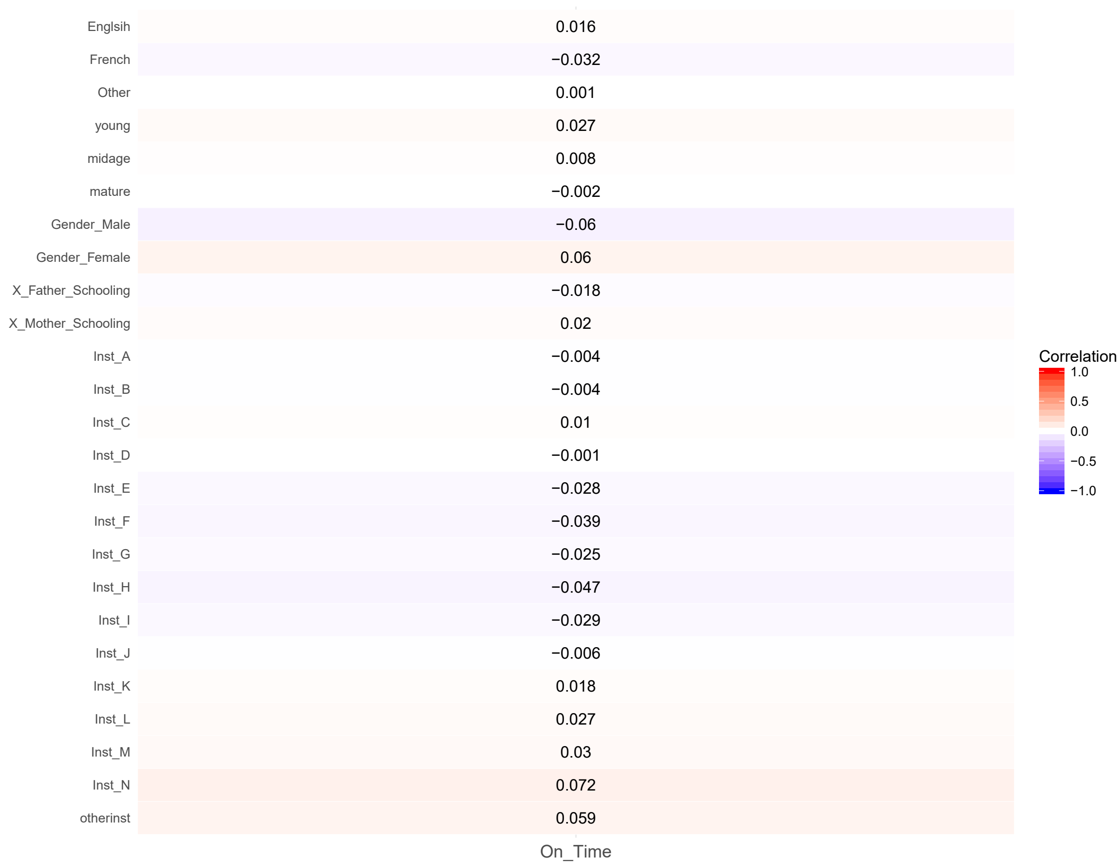


Figure 6.5: Correlation Heat Map

### 6.2.4 Path Analysis

This question uses path analysis to test theoretical models that specify directional relationships among a number of observed variables. Path analysis determines whether there is an actual relationship observed in the data. This chapter deals with models in which all variables are manifest (i.e. observed variables). All different *sending institutes*, *parents education*, *gender*, *age*, and *native language* are independent variables as each is assumed to predict *on-time* degree completion. Similarly, *on-time* degree completion is the dependent variable in the model as the independent variables predict it. The following steps can be followed to answer the hypothesis, reject the null hypothesis, and accept the alternative. The first step is to find out the independent and dependent variables for the hypotheses.

- Inst_A, Inst_B, Inst_C, Inst_D, Inst_E, Inst_F, Inst_G, Inst_H, Inst_I, Inst_J, Inst_K, Inst_L, Inst_M, Inst_N, otherint, Gender_Male, Gender_Female, English, French, Other, X_Father_Schooling, X_Mother_Schooling, young, mid-young, mature are all exogenous variables (or independent variables is a variable that is not affected by other variables).
- On_Time is an endogenous variable (or dependent variables have values that are determined by other variables).

The next step is to create the model according to the variables mentioned above.

**# To create model for the hypotheses:**

```
modelPath3 = '
On_Time ~
Inst_A + Inst_B + Inst_C + Inst_D + Inst_E + Inst_F + Inst_G + Inst_H
+ Inst_I + Inst_J + Inst_K + Inst_L + Inst_M + Inst_N + otheinst + Gen-
der_Male + Gender_Female + English + French + Other + X_Father_Schooling
+ X_Mother_Schooling + young + mid-young + mature
'
```

The last step involves fitting the model with the sample data. The model applied to the sample data evaluate the impact of *sending institutions*, *gender*, *age*, and *native language* of the student on *on-time* degree completion.

**# To fit the model:**

```
path = sem(modelPath3, data = data)
```

The summary of the model can be seen with the help of the following summary command.

**# Summary of the model:**

```
summary(path, standardized = TRUE, rsquare = TRUE)
```

Table 6.2: Summary of the model

| | Estimate($\beta$) | Std.Err | z-value | p-value | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regressions:** | | | | | | |
| On_Time ~ | | | | | | |
| Inst_A | 0.062 | 0.004 | 14.289 | 0.000 | 0.062 | 0.064 |
| Inst_B | 0.046 | 0.005 | 9.945 | 0.000 | 0.046 | 0.038 |
| Inst_C | 0.065 | 0.005 | 13.697 | 0.000 | 0.065 | 0.054 |
| Inst_D | 0.051 | 0.005 | 10.513 | 0.000 | 0.051 | 0.039 |
| Inst_E | 0.031 | 0.005 | 6.675 | 0.000 | 0.031 | 0.025 |
| Inst_F | -0.007 | 0.005 | -1.486 | 0.137 | -0.007 | -0.005 |
| Inst_G | 0.020 | 0.005 | 3.987 | 0.000 | 0.020 | 0.014 |
| Inst_H | -0.015 | 0.005 | -2.886 | 0.004 | -0.015 | -0.010 |
| Inst_I | 0.012 | 0.005 | 2.306 | 0.021 | 0.012 | 0.008 |
| Inst_J | 0.052 | 0.005 | 10.955 | 0.000 | 0.052 | 0.041 |
| Inst_K | 0.090 | 0.006 | 14.878 | 0.000 | 0.090 | 0.046 |
| Inst_L | 0.097 | 0.005 | 17.645 | 0.000 | 0.097 | 0.054 |
| Inst_M | 0.106 | 0.006 | 16.954 | 0.000 | 0.106 | 0.051 |
| Inst_N | 0.217 | 0.007 | 32.674 | 0.000 | 0.217 | 0.097 |
| otherinst | 0.005 | 0.000 | 22.319 | 0.000 | 0.005 | 0.123 |
| Gender_Male | -0.089 | 0.003 | -25.510 | 0.000 | -0.089 | -0.070 |
| Gender_Female | 0.088 | 0.003 | 27.275 | 0.000 | -0.043 | 0.070 |
| English | 0.017 | 0.002 | 8.344 | 0.000 | 0.017 | 0.023 |
| French | -0.043 | 0.004 | -10.147 | 0.000 | -0.043 | -0.027 |
| Other | 0.003 | 0.002 | 1.320 | 0.187 | 0.003 | 0.004 |
| X_Fathr_Schlng | -0.002 | 0.000 | -6.720 | 0.000 | -0.002 | -0.019 |
| X_Mothr_Schlng | 0.003 | 0.000 | 8.703 | 0.000 | 0.003 | 0.024 |
| young | 0.054 | 0.003 | 17.245 | 0.000 | 0.054 | 0.056 |
| mid-young | 0.008 | 0.001 | 12.546 | 0.000 | 0.008 | 0.052 |
| mature | 0.002 | 0.000 | 10.409 | 0.000 | 0.002 | 0.041 |
| **R-Square:** | | | | | | |
| Completion | 0.003 | | | | | |

1. **Std.Err:** Standard Error
2. **Std.lv:** Standard Lavaan
3. **Std.all:** Standard all the variables.

The model can be viewed with different shapes to see the residual terms, covariances and variances among each of the variables.

**# Specifying the variable names for each node**

lbls = c(“Inst_A”, “Inst_B”, “Inst_C”, “Inst_D”, “Inst_E”, “Inst_F”, “Inst_G”, “Inst_H”, “Inst_I”, “Inst_J”, “Inst_K”, “Inst_L”, “Inst_M”, “Inst_N”, “otherinst”, “Male”, “Female”, “English”, “French”, “Other”, “Father Schooling”, “Mother Schooling”, “young”, “mid-young”, “mature”, ”On_Time”)

**# To plot the model you can choose from different types of layout such as tree, circle, spring, tree2, circle2:**

semPaths(path, whatLabels = “std”, layout = “spring”, nodeLabels = lbls, sizeMan = 10, sizeLat = 10, edge.label.cex = 1.5) text(0,1.4, labels = “Effect of sending institution on on-time degree completion”)

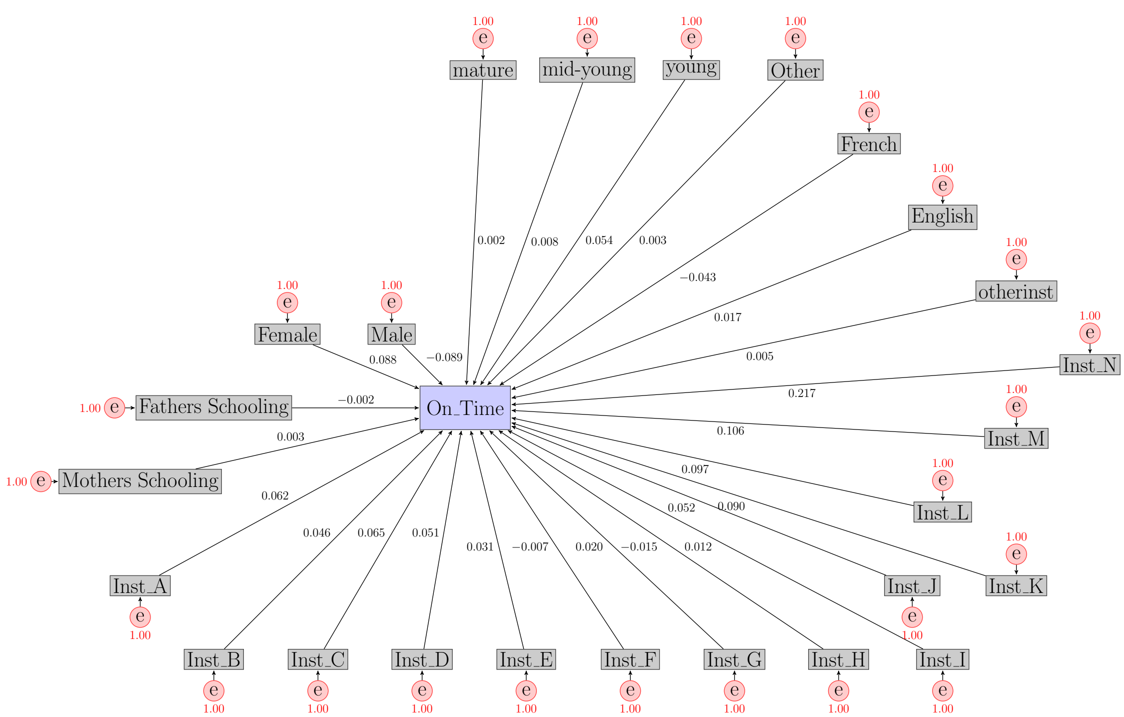


Figure 6.6: SEM path diagram of the path model

## 6.3 Results

- **Effect of sending institution of the student:** The students from *sending institute* N are significantly completing their degree *on-time* compared to the students from other institutes. We can see from the results that the students from whose *sending institute* F and H are taking longer or not completing their degree *on-time*. Institutes other than N, F and H, are completing their degree *on-time* but not as early as students from institute N. The estimated value of Institute N is ($\beta = 0.217, p = 0.000$), compared to the estimated value of Institute F ($\beta = 0.007, p = 0.137$) and Institute H ($\beta = 0.015, p = 0.004$).

- **Effect of native language of the student:** Students who have English as their native language tend to complete the university degree *on-time* compared to students whose native language is French or Other. Variable English shows a significant positive effect on completion ($\beta = 0.017, p = 0.000$), compared to students who have Other as their primary language ($\beta = 0.003, p = 0.187$). Students who have French as their first language shows a negative effect on completion ($\beta = 0.043, p = 0.000$), which implies that they either take more time to complete or not able to complete the degree.

## 6.4 Discussion and Conclusion

Several conclusions seem to be appropriate based on the data of this study. First, the time taken by students who transfer from different colleges to university for the Baccalaureate degree, given sufficient time to complete are significantly affected by several variables. The majority of the students from different *sending institutes* complete their degree requirements and graduate *on-time*, whereas there are only two *sending institutes* where students were seen to not complete their degree *on-time*. Within this data set, there are 11 students overall who did not complete their degree *on-time* and 234 who did not complete their degree at all. The data from this study may be a realistic picture of which transfer students graduate and which do not. It may be that most students who transfer from college, in fact, will graduate if given sufficient time to complete, therefore there are not many institutes with students who do not graduate *on-time*. Glass Jr. and E. Bunn [19] found out that race, employment after transferring, quality and utility of student srevices was a factor related to time to complete graduation. The second conclusion from this study is that native language is a factor in the *on-time* university degree completion for transfer students. One must be cautious with the interpretation of this second conclusion, as several of the native language groups had very few students and this may affect the results of this analysis.

# Chapter 7

# Effect of student past college grades on their current academic performance



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**Summary**

Students' current performance depends on the *past grades* [50]. The current study focuses on the effect of student *past college grades* on the current *academic performance* of students with transfer credit enrolling into STEM-based Baccalaureate degrees at an Ontario university between the

years of 2007 and 2012. *Academic performance* was assessed using the grades of the student in the university at each term. The data was analyzed using descriptive statistics and path analysis, as both the students' current grades, and *past institute grades* are observed. The results revealed that students who studied at Institutes L and J showed a significant positive effect on the current grades, whereas students who studied at other Institutes showed a less significant impact on student's current grades.

## 7.1 Introduction

The primary aim of this study is to find key predictors of students' *academic performance*. *Academic performance* was measured by student's grades during each university term. Past research indicates that *previous institution grades* are the most significant predictors of student's future *academic performance* [50]. Sulaiman et al. used work experience, age, gender, ethnicity, undergraduate CGPA and undergraduate discipline as predictors of Masters of Business Administrations (MBA) students' *academic performance*. They found out that age, ethnicity, gender, and years of work experience have no significant effect on students' current *academic performance*, however students' undergraduate grades are the best predictors of their current *academic performance*.

In this study, we are using student's grades at a *past institution*, *age*, and *gender* as the predictors of Baccalaureate degree transfer students' *academic performance*.

### 7.1.1 Objective

The objective of this study is to find out the effect of the students *college grades* on their current *academic performance*.

### 7.1.2 Hypotheses

The study analysed the following null hypotheses:
$H_0$ : Grades from a *past institution* does not affect the current *academic performance*

of that student.

## 7.2 Method

### 7.2.1 Data

The data included in this study involves students from 14 major sending institutes. The variables include age, gender, marital status, sending institutions grades, and grades at the current university. The data was collected at the time of enrolment at their current Ontario university from the 2007-2012 cohort years. The current sample includes 1259 students representing each of the sending institutions.

### 7.2.2 Data Analysis

To answer the hypotheses, data from 14 major sending institutes was used. The data was analysed using descriptive statistics and path analysis. Path analysis was used because the variables used in this study are all observed variables. The effect of independent variables (e.g. sending institution, and grades) on dependent variables (e.g. current grades), can be seen using Path analysis.

The analysis was completed based on individual sending institutions, as the grading system for each institute is different. For example, *institute A* use A, B, C, D for grades, whereas *institute B* use 95, 85, 75, 65 for grades. This made direct comparisons between institutions impossible to complete for the current study. The *current* and *previous grades* are scaled on a scale of 0-4 to keep consistency in the grades.

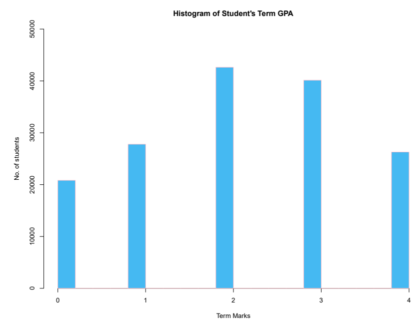
## 7.3 Descriptive Analysis

To understand the data more clearly, descriptive analysis was completed on the variables used. The following figures from fig. 7.1 to 7.14, shows (a) the distribution of the variables used, with the average grades earned by students while attending *previous* and *current institute*, grouped by which *past institute* each student attended and (b) the histogram of the grades at the current university.

Figure 7.1: Institute A

| Characteristics | Number of students | Percentage(%) | Prev_Grade($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| A (1.026) | 126 | 10.007 | 3.273 | 2.148 |
| **Age** | | | | |
| $Young(18-20)$ | 8 | 0.635 | 3.258 | 1.669 |
| $Mid-young(21-25)$ | 97 | 7.704 | 3.275 | 2.192 |
| $Mature(26-50)$ | 21 | 1.667 | 3.267 | 2.121 |
| **Gender** | | | | |
| Male | 122 | 9.690 | 3.266 | 2.166 |
| Female | 4 | 0.317 | 3.447 | 1.669 |
| **Marital Status** | | | | |
| Married | 8 | 0.635 | 3.265 | 2.107 |
| Single | 118 | 9.372 | 3.273 | 2.15 |

(a) Distribution and Mean

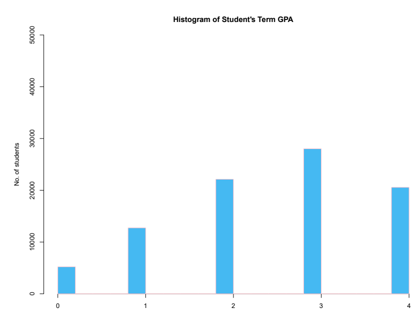



(b) Histogram of Current Grades

Figure 7.2: Institute B

| Characteristics | Number of students | Percentage(%) | Prev_Grade($\bar{x}$) | Curr_Grade($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| B (1.060) | 90 | 7.148 | 3.273 | 2.148 |
| **Age** | | | | |
| $Young(18-20)$ | 10 | 0.794 | 3.647 | 2.473 |
| $Mid-young(21-25)$ | 57 | 4.527 | 3.367 | 2.506 |
| $Mature(26-50)$ | 30 | 2.382 | 3.167 | 2.625 |
| **Gender** | | | | |
| Male | 83 | 6.592 | 3.356 | 2.535 |
| Female | 7 | 0.555 | 3.508 | 2.312 |
| **Marital Status** | | | | |
| Married | 13 | 1.032 | 3.294 | 2.768 |
| Single | 77 | 6.115 | 3.381 | 2.473 |

(a) Distribution and Mean

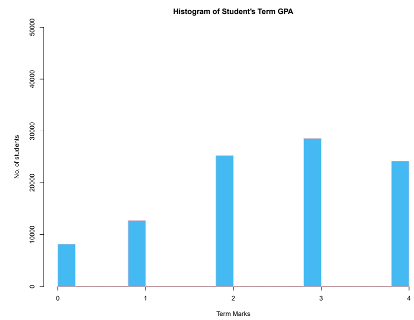



(b) Histogram of Current Grades

Figure 7.3: Institute C

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| C (1.057) | 104 | 8.260 | 3.099 | 2.484 |
| **Age** | | | | |
| $Young(18-20)$ | 8 | 0.635 | 2.9 | 1.995 |
| $Mid-young(21-25)$ | 66 | 5.242 | 3.08 | 2.45 |
| $Mature(26-50)$ | 30 | 2.382 | 3.167 | 2.625 |
| **Gender** | | | | |
| Male | 97 | 7.704 | 3.076 | 2.46 |
| Female | 7 | 0.555 | 3.433 | 2.831 |
| **Marital Status** | | | | |
| Married | 7 | 0.555 | 3.371 | 2.976 |
| Single | 97 | 7.704 | 3.082 | 2.452 |

(a) Distribution and Mean

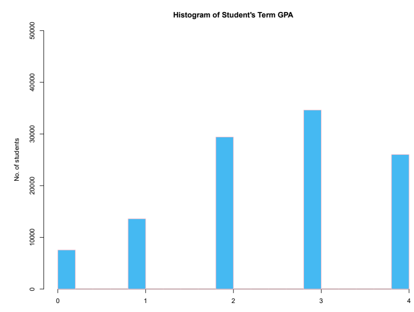



(b) Histogram of Current Grades

Figure 7.4: Institute D

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| D (1.039) | 102 | 8.101 | 3.217 | 2.521 |
| **Age** | | | | |
| $Young(18-20)$ | 6 | 0.476 | 3.284 | 2.347 |
| $Mid-young(21-25)$ | 84 | 6.671 | 3.265 | 2.589 |
| $Mature(26-50)$ | 12 | 0.953 | 2.793 | 2.045 |
| **Gender** | | | | |
| Male | 93 | 7.386 | 3.183 | 2.523 |
| Female | 9 | 0.714 | 3.604 | 2.497 |
| **Marital Status** | | | | |
| Married | 4 | 0.317 | 3.591 | 1.988 |
| Single | 98 | 7.783 | 3.206 | 2.538 |

(a) Distribution and Mean

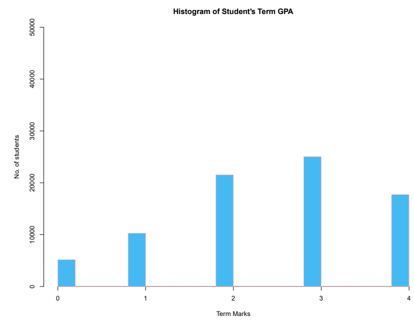



(b) Histogram of Current Grades

Figure 7.5: Institute E

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| E (1.001) | 73 | 5.798 | 3.062 | 2.5 |
| **Age** | | | | |
| $Young(18-20)$ | 5 | 0.397 | 3.471 | 2.999 |
| $Mid-young(21-25)$ | 56 | 4.447 | 3.067 | 2.483 |
| $Mature(26-50)$ | 12 | 0.953 | 2.852 | 2.352 |
| **Gender** | | | | |
| Male | 70 | 5.559 | 3.046 | 2.49 |
| Female | 2 | 0.158 | 3.517 | 2.771 |
| **Marital Status** | | | | |
| Married | 4 | 0.317 | 3.257 | 2.461 |
| Single | 69 | 5.480 | 3.049 | 2.502 |

(a) Distribution and Mean

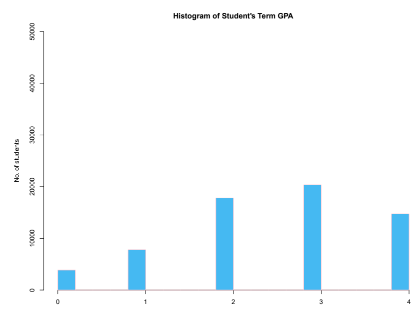



(b) Histogram of Current Grades

Figure 7.6: Institute F

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| F (1.043) | 64 | 5.083 | 3.074 | 2.531 |
| **Age** | | | | |
| $Young(18-20)$ | 9 | 0.714 | 3.269 | 2.454 |
| $Mid-young(21-25)$ | 38 | 3.018 | 3.007 | 2.412 |
| $Mature(26-50)$ | 17 | 1.350 | 3.132 | 2.871 |
| **Gender** | | | | |
| Male | 56 | 4.447 | 3.073 | 2.58 |
| Female | 8 | 0.635 | 3.075 | 2.265 |
| **Marital Status** | | | | |
| Married | 8 | 0.635 | 3.407 | 3.216 |
| Single | 56 | 4.447 | 3.033 | 2.449 |

(a) Distribution and Mean

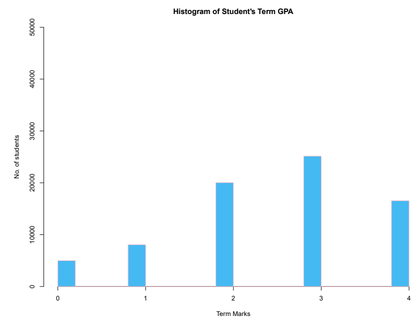



(b) Histogram of Current Grades

Figure 7.7: Institute G

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| G (1.02) | 77 | 6.115 | 3.356 | 2.537 |
| **Age** | | | | |
| $Young(18-20)$ | 6 | 0.476 | 3.62 | 2.562 |
| $Mid-young(21-25)$ | 57 | 4.527 | 3.336 | 2.542 |
| $Mature(26-50)$ | 14 | 1.111 | 3.349 | 2.512 |
| **Gender** | | | | |
| Male | 74 | 5.877 | 3.356 | 2.547 |
| Female | 3 | 0.238 | 3.365 | 2.382 |
| **Marital Status** | | | | |
| Married | 3 | 0.238 | 3.484 | 2.711 |
| Single | 74 | 5.877 | 3.348 | 2.526 |

(a) Distribution and Mean

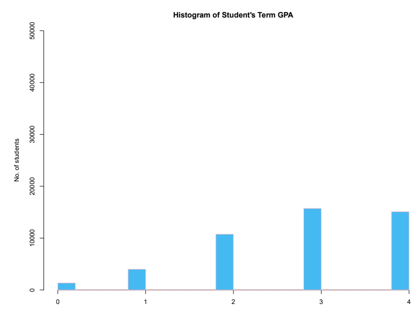



(b) Histogram of Current Grades

Figure 7.8: Institute H

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| H (1.052) | 59 | 4.686 | 3.459 | 2.836 |
| **Age** | | | | |
| $Young(18-20)$ | 1 | 0.079 | 2.714 | 2.909 |
| $Mid-young(21-25)$ | 41 | 3.256 | 3.416 | 2.837 |
| $Mature(26-50)$ | 17 | 1.350 | 3.569 | 2.832 |
| **Gender** | | | | |
| Male | 50 | 3.971 | 3.458 | 2.874 |
| Female | 9 | 0.714 | 3.462 | 2.548 |
| **Marital Status** | | | | |
| Married | 7 | 0.555 | 3.436 | 2.838 |
| Single | 52 | 4.130 | 3.462 | 2.836 |

(a) Distribution and Mean

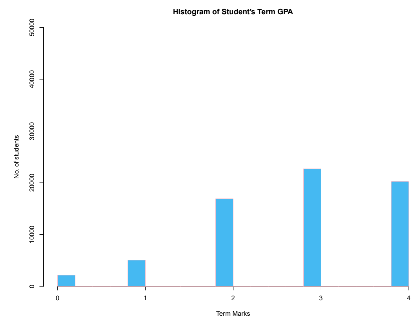



(b) Histogram of Current Grades

Figure 7.9: Institute I

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| I (1.003) | 55 | 4.368 | 2.744 | 2.803 |
| **Age** | | | | |
| $Young(18-20)$ | 5 | 0.397 | 3.026 | 2.805 |
| $Mid-young(21-25)$ | 35 | 2.779 | 2.707 | 2.804 |
| $Mature(26-50)$ | 15 | 1.191 | 2.755 | 2.799 |
| **Gender** | | | | |
| Male | 50 | 3971 | 2.723 | 2.797 |
| Female | 5 | 0.397 | 2.99 | 2.874 |
| **Marital Status** | | | | |
| Married | 2 | 0.158 | 2.6 | 2.422 |
| Single | 53 | 4.209 | 2.751 | 2.821 |

(a) Distribution and Mean

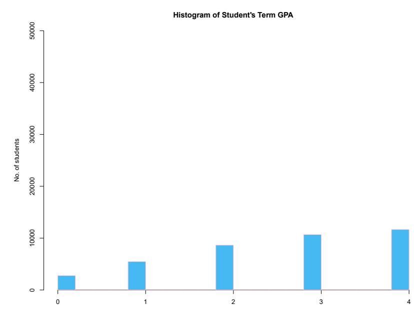



(b) Histogram of Current Grades

Figure 7.10: Institute J

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| J (1.007) | 49 | 3.891 | 3.469 | 2.587 |
| **Age** | | | | |
| $Young(18-20)$ | 4 | 0.317 | 3.664 | 2.827 |
| $Mid-young(21-25)$ | 36 | 2.859 | 3.485 | 2.585 |
| $Mature(26-50)$ | 9 | 0.714 | 3.342 | 2.509 |
| **Gender** | | | | |
| Male | 47 | 3.733 | 3.465 | 2.596 |
| Female | 2 | 0.158 | 3.86 | 1.634 |
| **Marital Status** | | | | |
| Married | 4 | 0.317 | 3.726 | 2.9 |
| Single | 45 | 3.574 | 3.45 | 2.564 |

(a) Distribution and Mean

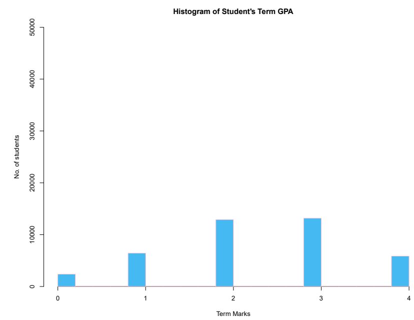



(b) Histogram of Current Grades

Figure 7.11: Institute K

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| K (1.049) | 40 | 3.177 | 2.909 | 2.337 |
| **Age** | | | | |
| $Young(18-20)$ | 5 | 0.397 | 3.497 | 2.717 |
| $Mid-young(21-25)$ | 29 | 2.303 | 2.916 | 2.291 |
| $Mature(26-50)$ | 6 | 0.476 | 2.459 | 2.297 |
| **Gender** | | | | |
| Male | 39 | 3.097 | 2.93 | 2.349 |
| Female | 1 | 0.079 | 2.597 | 2.158 |
| **Marital Status** | | | | |
| Married | 0 | 0.000 | 00.00 | 00.00 |
| Single | 40 | 3.177 | 2.909 | 2.337 |

(a) Distribution and Mean

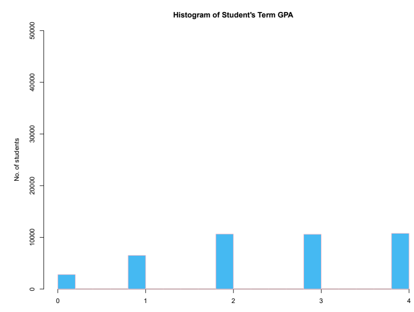



(b) Histogram of Current Grades

Figure 7.12: Institute L

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| L (1.01) | 39 | 3.097 | 3.357 | 2.485 |
| **Age** | | | | |
| $Young(18-20)$ | 3 | 0.238 | 3.409 | 2.42 |
| $Mid-young(21-25)$ | 25 | 1.985 | 3.434 | 2.497 |
| $Mature(26-50)$ | 11 | 0.873 | 3.172 | 2.481 |
| **Gender** | | | | |
| Male | 37 | 2.938 | 3.356 | 2.526 |
| Female | 2 | 0.158 | 3.384 | 1.664 |
| **Marital Status** | | | | |
| Married | 4 | 0.317 | 3.231 | 2.643 |
| Single | 35 | 2.779 | 3.368 | 2.471 |

(a) Distribution and Mean

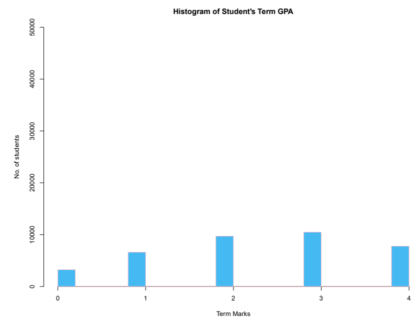



(b) Histogram of Current Grades

Figure 7.13: Institute M

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| M (1.011) | 31 | 2.462 | 3.447 | 2.342 |
| **Age** | | | | |
| $Young(18-20)$ | 2 | 0.158 | 3.414 | 3.001 |
| $Mid-young(21-25)$ | 24 | 1.906 | 3.405 | 2.253 |
| $Mature(26-50)$ | 5 | 0.397 | 3.686 | 2.428 |
| **Gender** | | | | |
| Male | 29 | 2.303 | 3.437 | 2.406 |
| Female | 2 | 0.158 | 3.526 | 1.818 |
| **Marital Status** | | | | |
| Married | 0 | 0.000 | 0.000 | 0.000 |
| Single | 31 | 2.462 | 3.447 | 2.342 |

(a) Distribution and Mean

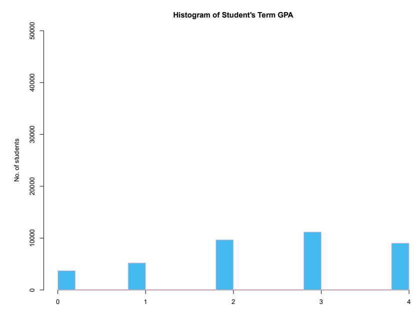



(b) Histogram of Current Grades

Figure 7.14: Institute N

| Characteristics | Number of students | Percentage(%) | Prev_Grade ($\bar{x}$) | Curr_Grade ($\bar{x}$) |
|---|---|---|---|---|
| **Sending Institutions** | | | | |
| N (1.023) | 45 | 3.574 | 3.283 | 2.427 |
| **Age** | | | | |
| $Young(18-20)$ | 1 | 0.079 | 2.667 | 1.698 |
| $Mid-young(21-25)$ | 37 | 2.938 | 3.327 | 2.487 |
| $Mature(26-50)$ | 7 | 0.555 | 3.142 | 2.214 |
| **Gender** | | | | |
| Male | 45 | 3.574 | 3.283 | 2.427 |
| Female | 0 | 0.000 | 0.000 | 0.000 |
| **Marital Status** | | | | |
| Married | 2 | 0.158 | 3.211 | 1.526 |
| Single | 43 | 3.415 | 3.283 | 2.435 |

(a) Distribution and Mean




(b) Histogram of Current Grades

# Correlation

Figure 7.15 shows the correlation-ship between *previous institute* grades and *current grades* of students from different institutes. Institute L shows the highest positive relationship between past/previous grades and current grades. Other institutes show positive relationship with current grades but not as significant as institute L.

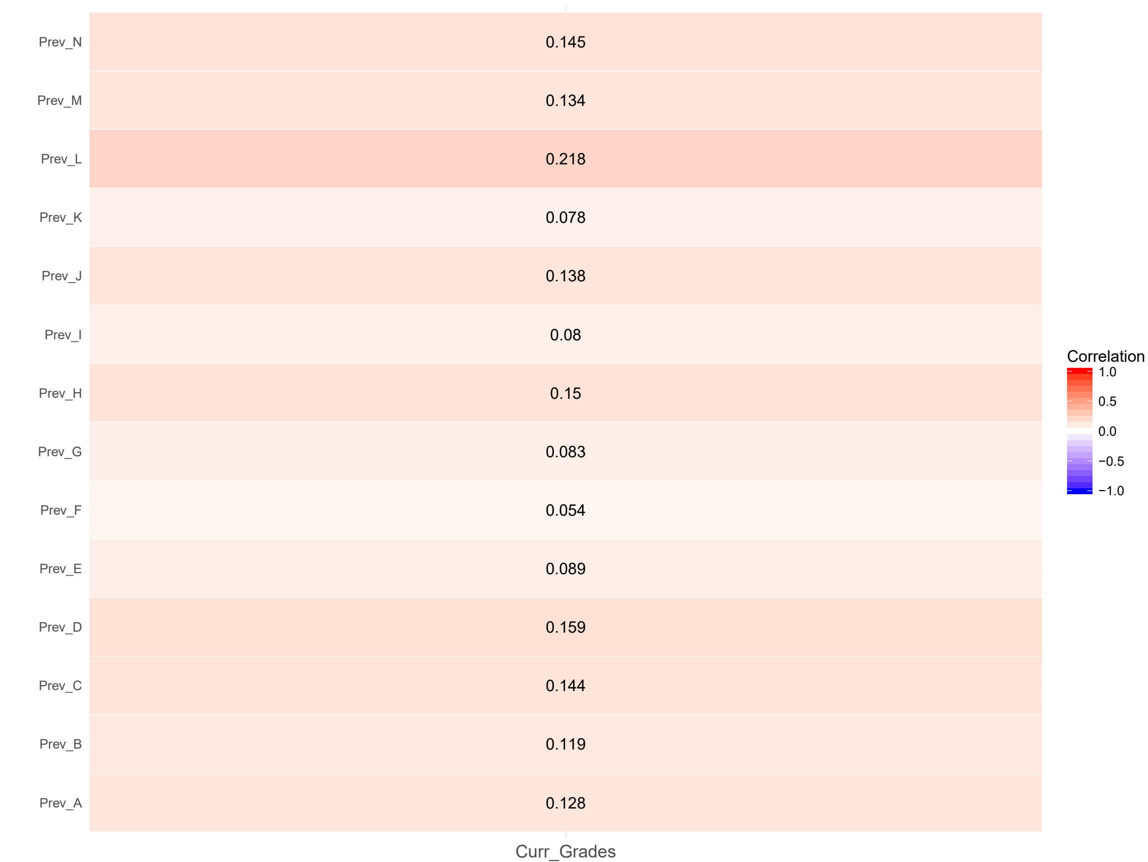



Figure 7.15: Correlation Heat Map

### 7.3.1 Path Analysis

Path analysis was used in this study to help determine the relationship between observed variables. To achieve the goal of this chapter, path analysis is the best approach, as all the variables are present in the current dataset. The independent variables used are *sending institution*, *age at first term*, *gender*, *marital status*, and *previous institute grades* entered at the time of registration in the university. The dependent variables includes grades at each term in the university. The initial stage is to find out all the exogenous and endogenous variables.

- Previous institute grades, age, gender, and marital status are all exogenous variables. These are independent variables, which means that they are not affected by other variables in the study.

- Grade is an endogenous variable. This is a dependent variables, which means that it has values that are determined by other variables.

The model mentioned above can be created with the following lines of code.

```
# To create model for the hypotheses:

modelPath = '
Grades ~
Previous_Institute_Grades + Gender_Male + Gender_Female + Married + Single + young + mid-young + mature
'
```

The final step is to fit the model with the sample dataset with all of the variables mentioned above in it. All the variables mentioned when creating the model have to be present in the provided dataset. It will evaluate the impact of the exogenous variables on the endogenous variable (grade).

```
# To fit the model:

path = sem(modelPath, data = data)
```

Table 7.1 is a summary of the model with the effect of *previous inst grades* on students' current *grades*. The summary of the model can be seen with the help of following summary command in R.

```
# Summary of the model:

summary(path, standardized = TRUE, rsquare = TRUE)
```

For simplicity, only the affect of *previous institute grades* on current grades is shown in Table 7.1.

Table 7.1: Summary of the model

| | Estimate($\beta$) | Std.Err | z-value | p-value | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regressions:** | | | | | | |
| Grade ~ | | | | | | |
| *Institute A:* Prevs_Inst_Grd | 0.184 | 0.004 | 51.644 | 0.000 | 0.184 | 0.129 |
| *Institute B:* Prevs_Inst_Grd | 0.153 | 0.004 | 35.775 | 0.000 | 0.153 | 0.119 |
| *Institute C:* Prevs_Inst_Grd | 0.164 | 0.004 | 45.996 | 0.000 | 0.164 | 0.145 |
| *Institute D:* Prevs_Inst_Grd | 0.188 | 0.003 | 53.965 | 0.000 | 0.188 | 0.160 |
| *Institute E:* Prevs_Inst_Grd | 0.093 | 0.004 | 25.314 | 0.000 | 0.093 | 0.089 |
| *Institute F:* Prevs_Inst_Grd | 0.061 | 0.004 | 13.916 | 0.000 | 0.061 | 0,055 |
| *Institute G:* Prevs_Inst_Grd | 0.103 | 0.005 | 22.823 | 0.000 | 0.103 | 0.083 |
| *Institute H:* Prevs_Inst_Grd | 0.185 | 0.006 | 33.024 | 0.000 | 0185 | 0151 |
| *Institute I:* Prevs_Inst_Grd | 0.083 | 0.004 | 21.045 | 0.000 | 0.083 | 0.081 |
| *Institute J:* Prevs_Inst_Grd | 0.204 | 0.007 | 22.776 | 0.000 | 0.204 | 0.139 |
| *Institute K:* Prevs_Inst_Grd | 0.085 | 0.005 | 15.977 | 0.000 | 0.085 | 0.079 |
| *Institute L:* Prevs_Inst_Grd | 0.312 | 0.007 | 45.424 | 0.000 | 0.312 | 0.218 |
| *Institute M:* Prevs_Inst_Grd | 0.195 | 0.007 | 26.349 | 0.000 | 0.195 | 0.134 |
| *Institute N:* Prevs_Inst_Grd | 0.196 | 0.007 | 28.972 | 0.000 | 0.196 | 0.145 |

1. **Std.Err:** Standard Error
2. **Std.lv:** Standard Lavaan
3. **Std.all:** Standard all the variables.

SemPaths command can allow the user to view the fitted model with the impact results of the variables. It will show all the residual terms, covariances, and variances of each variable.

```
# Specifying the variable names for each node

lbls = c("Previous_Institute_Grades", "Male", "Female", "Married", "Single",
"young", "mid-young", "mature", "Grades")

# To plot the model you can choose from different types of layout
such as tree, circle, spring, tree2, circle2:

semPaths(path, whatLabels = "std", layout = "spring", nodeLabels = lbls,
sizeMan = 10, sizeLat = 10, edge.label.cex = 1.5) text(0,1.4, labels = "Effect
of Past grades and work experience on current academic performance)
```

## 7.4 Results

- **Effect of student grades earned at a past institution:** Institutes L and J shows a significant positive effect on students' grade, whereas other Institutes shows less significant impact on students' grades. The institutes that indicate a high positive effect on current grades include Institute L, J, N, M, D, H, A, C, and B. The institutes that indicated very low positive impact on current grades are F, I, K, E, and G. *Previous institute grades* of Institute L and J have a significant p-value ($\beta = 0.312, p = 0.000$) and ($\beta = 0.204, p = 0.000$), indicating that students from Institute L and J experience a high positive effect on current grades at the university compared to students from Institute F, I and E which show an estimated value of ($\beta = 0.061, p = 0.000$), ($\beta = 0.083, p = 0.000$), and ($\beta = 0.093, p = 0.000$).

## 7.5 Discussion and Conclusion

This chapter focuses on the predictors of *academic performance*, taking *past institutions grades* as the major predicting variable. The results show that students' *previous institute grades* are a good predictor of students' current *academic performance*. Students with excellent grades at their *past/previous institute* perform better at future institutes because they have prior knowledge of the courses taught in their current program. This supports the findings by Sulaiman et al. [50] and Cheung and Kan [8]. *Past grades* appear to play an important role in college students' successful transfer to university.

# Chapter 8

# Effect of bridging courses on students' academic performance

**Summary**

Transferring specific college courses to the university setting requires students to match the requirements of the college classes they have completed with the *academic program* that they wish to take in the university. The current study evaluates whether the number of transfer credits that a student has at a university has an effect on students' *academic performance*. A sample of 1215 (1132 from Spring term start and 83 from Fall term start) students with transfer credits enrolling into STEM-based Baccalaureate degrees at an Ontario university between 2007 and 2012 cohort years were included in this study. The data was divided into Spring term and Fall term starts for the analysis, as there is a difference in transfer required courses between the two terms. The techniques used for the current study are descriptive statistics for frequencies and path analysis to see the *academic performance*. Student grades during each enrolled term were used to represent *academic performance*. More students transferred to the Ontario university during the Spring term compared to the Fall term. The performance of students starting in the Spring term was slightly different than students beginning in the Fall term. In addition, the program taken at the university did have an effect on the transfer required courses.

## 8.1 Introduction

Students from different colleges can transfer to universities and bring with them credits they have already completed at a previous institute [54]. Students do not have to repeat the courses they have transferred but are required to complete specific *bridging courses*, or *transfer required courses*, to match the requirements of the program they are enrolled in at a university. Admission requirements vary from university to university, depending on the program the student wishes to take.

There have been few studies related to the effect of *bridging courses* on students' *academic performance* at the university level [41]. This study will also focus on the impact of *bridging courses* on students transferring from college to university. *Academic performance* is measured by the grades the students earn at the university, excluding the grades of transfer required courses (as the students only have to pass the minimum requirements of the transfer required courses).

In the present study, two main questions are answered. First, the effect of the number of transfer required courses on students' *academic performance*. Second, the impact of the courses they take in a particular program on their *academic performance*.

### 8.1.1 Objectives

The objectives of this study are to determine:

- the effect of the *number of bridging courses* on a students' *academic performance*.
- the effect of *bridging courses* on a students' *academic performance*.

### 8.1.2 Hypotheses

The study analyzed the following null hypotheses:
$H_0$ : The *number of bridging courses* does not affect transfer students' AP.
$H_0$ : There is no effect of the *bridging courses* on students' AP.

## 8.2 Method

### 8.2.1 Data

The data set was divided into two groups- students transferring during the Spring term (May and June) and the students transferring during the Fall term (August and September). These groups were separated as the transfer courses and the number of courses allocated to students is different depending on which term the students transferred to the university. The data used for the analysis consists of both qualitative variables (transfer required courses, and gender) and quantitative variables (number of bridging courses, age, and grades). The majority of the students transferred during the Spring term and very few had transferred during the Fall term.

### 8.2.2 Method of Data Analysis

The data was analysed using descriptive statistics. This allowed the researchers to see the frequencies of students taking each of the required transfer courses and the number of students in each program. Students in more than 10 *bridging courses* were combined for the analysis. Later, path analysis was completed to see the effect of independent variables (number of transfer courses and transfer courses) on the dependent variables (grades with non-transfer courses scores). These techniques were applied separately on:

- Students whose first term registered is *Spring*
- Students whose first term registered is *Fall*

The question uses two significant variables to solve the hypotheses, i.e. the number of transfer courses and the specific transfer courses taken to complete the selected program. The first part of the analysis uses the number of transfer courses >= 5 and the second part uses the transfer courses based on the program that the student has taken at the university.

## 8.3 Effect of number of bridging courses

Every transfer student has different credits when they enter the university depending on the requirements of their sending institution. Therefore, the number of transfer courses required for each student when they enter the program will be different. For example, a student transferring from Institute A who had completed $x$ number of courses might have to take five *bridging courses*, whereas a student transferring from Institute B completed $y$ number of courses and will have to take 14 *bridging courses.* This part of the chapter focuses on the effect of the number of *bridging courses* on students' *academic performance* at the university. The analysis is divided into spring enrolled and fall enrolled students because a majority of the students enrol in the spring term and few enrol in the fall term.

### 8.3.1 Spring Term

Table 8.1 displays the *number of bridging courses*, *age*, and *gender* of the students starting in Spring term with frequencies and overall grade means. Approximately, 93% of the students enrol in spring term with 29% of students taking five *bridging courses*. According to Table 8.1 gender male, mature and students with seven *bridging courses* perform better than other students.

Table 8.1: Frequency distribution of the variables used

| Characteristics | Number of students | Percentage(%) | Grade(Mean) |
|---|---|---|---|
| **Number of Bridging courses in Spring** | | | |
| 5 | 331 | 29.06 | 66.98 |
| 6 | 225 | 19.75 | 69.48 |
| 7 | 264 | 23.17 | 70.18 |
| 8 | 219 | 19.22 | 68.64 |
| 9 | 76 | 6.67 | 65.57 |
| 10 + | 17 | 1.49 | 69.1 |
| **Age** | | | |
| $Young(18-20)$ | 97 | 8.51 | 66.54 |
| $Mid-young(21-25)$ | 817 | 71.72 | 68.5 |
| $Mature(26-50)$ | 225 | 19.75 | 69.22 |
| **Gender** | | | |
| Male | 1070 | 93.94 | 68.57 |
| Female | 69 | 6.05 | 67.78 |

1. Students whose entering *cohort year* is greater than their *first term registered* are removed.
2. Students who deceased while enrolled are removed.

### 8.3.2 Path Analysis

Path analysis was used in this study to find out the impact of the *number of bridging courses* on students' *academic performance*. The variables used in this study are all observed variables. Path analysis specifies the relationships among all the observed variables.

**Path Analysis of students starting in the Spring term**

```
# To create model for the hypotheses:

modelPath = '
Grades ~
Five + Six + Seven + Eight + Nine + Ten + Gender + Age_First_Term
'
```

Table 8.2 shows the summary of the model representing the effect of the *number of bridging courses* of students starting in Spring term, *gender* and *age* on students current *grades*.

Table 8.2: Summary of the model

| | Estimate($\beta$) | Std.Err | z-value | p-value | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regressions:** | | | | | | |
| Grade ~ | | | | | | |
| Five | 3.384 | 0.033 | 103.333 | 0.000 | 3.384 | 0.082 |
| Six | -0.607 | 0.037 | -16.523 | 0.000 | -0.607 | -0.013 |
| Seven | -1.973 | 0.035 | -56.732 | 0.000 | -1.973 | -0.045 |
| Eight | -1.856 | 0.039 | -47.674 | 0.000 | -1.856 | -0.038 |
| Nine | 1.275 | 0.062 | 20.681 | 0.000 | 1.275 | 0.017 |
| Ten | -0.720 | 0.031 | -23.219 | 0.000 | -0.720 | -0.019 |
| Gender | 0.967 | 0.060 | 16.159 | 0.000 | 0.967 | 0.013 |
| Age_First_Term | 0.048 | 0.005 | 10.577 | 0.000 | 0.048 | 0.008 |
| **R-Square:** | | | | | | |
| Grade | 0.009 | | | | | |

1. **Std.Err:** Standard Error
2. **Std.lv:** Standard Lavaan
3. **Std.all:** Standard all the variables.

### 8.3.3 Fall Term

Similarly, Table 8.3 displays the *number of bridging courses*, *age*, and *gender* of the students starting in Fall term with frequencies and overall grade means. We can see that only 7% of students enrolled in the fall term and the majority of them have ten or more *bridging courses*. For fall intake, gender female, mature and students with ten or more transfer required courses perform better compared to other students.

Table 8.3: Frequency distribution of the variables used

| Characteristics | Number of students | Percentage(%) | Grade(Mean) |
|---|---|---|---|
| **Number of Bridging courses in Fall** | | | |
| 5 | 3 | 3.51 | 70 |
| 7 | 15 | 17.85 | 66.65 |
| 8 | 13 | 15.47 | 67.68 |
| 9 | 23 | 27.38 | 66.78 |
| 10 + | 29 | 34.52 | 70.18 |
| **Age** | | | |
| $Young(18-20)$ | 7 | 8.33 | 65.06 |
| $Mid-young(21-25)$ | 60 | 71.42 | 68.47 |
| $Mature(26-50)$ | 18 | 21.42 | 68.58 |
| **Gender** | | | |
| Male | 79 | 94.04 | 67.98 |
| Female | 5 | 5.95 | 72.60 |

1. Students whose entering *cohort year* is greater than their *first term registered* are removed.
2. Students who deceased while enrolled are removed.

#### Path Analysis of students starting in the Fall term

**# To create model for the hypotheses:**

```
modelPath = '
Grades ~
Five + Seven + Eight + Nine + Ten + Gender + Age_First_Term
'
```

Table 8.4 shows the summary of the model representing the effect of the *number of bridging courses* of students starting in Fall term, as well as the effect of *gender* and *age* on students current *grades*. In this group there are no students who took six transfer required courses.

Table 8.4: Summary of the model

| | Estimate($\beta$) | Std.Err | z-value | p-value | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regressions:** | | | | | | |
| Grade ˜ | | | | | | |
| Five | 2.636 | 0.242 | 10.908 | 0.000 | 2.636 | 0.031 |
| Seven | 3.388 | 0.126 | 26.866 | 0.000 | 3.388 | 0.080 |
| Eight | 0.989 | 0.133 | 7.418 | 0.000 | 0.989 | 0.021 |
| Nine | 0.477 | 0.116 | 4.105 | 0.000 | 0.477 | -0.091 |
| Ten | -0.872 | 0.027 | -32.639 | 0.000 | -0.872 | -0.111 |
| Gender | -6.049 | 0.259 | -23.388 | 0.000 | -6.049 | -0.068 |
| Age_First_Term | -0.114 | 0.016 | -6.973 | 0.000 | -0.114 | -0.021 |
| **R-Square:** | | | | | | |
| Grade | 0.016 | | | | | |

1. **Std.Err:** Standard Error
2. **Std.lv:** Standard Lavaan
3. **Std.all:** Standard all the variables.

## 8.4 Results

- **Effect of the number of transfer courses on students with a Spring term start:** Students who do five or nine *bridging courses* show a significant positive effect on grades ($\beta = 3.384, p = 0.000$) ($\beta = 1.275, p = 0.000$). These results show that students beginning in the Spring term and taking five or nine *bridging courses* to complete their degree seem to perform better compared to other students. Students with seven or more *bridging courses* have high negative impact on their grades ($\beta = -1.973, p = 0.000$). Results reveal that students with less number of bridging significantly preform better in the university compared to other students.

- **Effect of the number of transfer courses on students with a Fall term start:** Results are different for the students who are starting in Fall term.

Results show that for the students beginning in the Fall term, the less *bridging courses* they take, the better they perform at the university. Students who take ten *bridging courses* have a negative impact on their grades with an estimated p-value of ($\beta = -0.872, p = 0.000$). Students who enrol in fall-term show similar results that students with fewer *bridging courses* perform better compared to other students.

## 8.5 Effect of *bridging courses*

*Bridging courses* play a vital role in a transfer student's admission to the university. The *bridging courses* offered by the university must allow each student to complete the requirements of the university program they are enrolled in. This process must function to bring all transfer students to the same level. There are five programs offered by the Ontario university focused on in this study that use this process (such as mechanical engineering, civil engineering). This part of the chapter focuses on the effect of transfer courses a student has to complete in a particular program.

### 8.5.1 Spring Term

Table 8.5 shows the *bridging courses* of students beginning in Spring term grouped by the program code (anonymised) and their grade mean. The program code is the type of baccalaureate degree (such as mechanical, software, chemical engineering) a student is doing at the university. They are grouped because the *bridging courses* are different for each group. A majority of the students who enrol in spring term are from group 1.

Table 8.5: Frequency distribution of the variables used

| Characteristics | Number of students | Percentage(%) | Grade(Mean) |
|---|---|---|---|
| **Bridging courses in Spring** | | | |
| Group 1 | 445 | 42.22 | 68.3 |
| Group 2 | 63 | 5.97 | 67.84 |
| Group 3 | 12 | 1.13 | 65.56 |
| Group 4 | 270 | 25.61 | 71.44 |
| Group 5 | 263 | 24.95 | 69.38 |

*Group*1 : Students whose Program code is 50.2061.
*Group*2 : Students whose Program code is 50.3032.
*Group*3 : Students whose Program code is 50.4017.
*Group*4 : Students whose Program code is 50.5035.
*Group*5 : Students whose Program code is 50.6024.
∗ Students whose entering *cohort year* is greater than their *first term registered* are removed.
∗ Students who deceased while enrolled are removed.

### 8.5.2 Path Analysis

Transfer required courses, number of transfer courses, gender, and age of the student are all independent variables to predict students' AP. The student grades at each term (without *bridging courses* marks) functions as a dependent variable in the model as the independent variables predict it. This model is analysed using path analyses to see the directional relationships among independent and dependent variables.

#### Path Analysis of students starting in the Spring term

```
# To create model for the hypotheses:

modelPath = '
Grades ~
TRF_REQ_COURSE + NUM_TRF_REQ_CO + Gender + Age_First_Term
'
```

Table 8.6 shows the summary of the path model of students starting in Spring term with the effect of *transfer required courses* and *number of transfer required courses* on students' current *grades*.

Table 8.6: Summary of the model

| | Estimate($\beta$) | Std.Err | z-value | p-value | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regressions:** | | | | | | |
| Grade ~ | | | | | | |
| *Group 1:* | | | | | | |
| TRF_REQ_COURSE | -0.055 | 0.005 | -12.084 | 0.000 | -0.055 | -0.030 |
| NUM_TRF_REQ_CO | 1.136 | 0.028 | 40.270 | 0.000 | 1.136 | 0.098 |
| *Group 2:* | | | | | | |
| TRF_REQ_COURSE | -0.065 | 0.006 | -10.159 | 0.000 | -0.065 | -0.038 |
| NUM_TRF_REQ_CO | -0.741 | 0.050 | -14.805 | 0.000 | -0.741 | -0.062 |
| *Group 3:* | | | | | | |
| TRF_REQ_COURSE | 3.067 | 0.048 | 63.906 | 0.000 | 3.067 | 0.772 |
| NUM_TRF_REQ_CO | 9.124 | 0.136 | 67.214 | 0.000 | 9.124 | 0.787 |
| *Group 4:* | | | | | | |
| TRF_REQ_COURSE | 0.022 | 0.001 | 22.811 | 0.000 | 0.022 | 0.034 |
| NUM_TRF_REQ_CO | -1.463 | 0.021 | -68.312 | 0.000 | -1.463 | -0.100 |
| *Group 5:* | | | | | | |
| TRF_REQ_COURSE | -0.116 | 0.003 | -36.532 | 0.000 | -0.116 | -0.061 |
| NUM_TRF_REQ_CO | -0.551 | 0.024 | -22.904 | 0.000 | -0.551 | -0.038 |

1. **Std.Err:** Standard Error
2. **Std.lv:** Standard Lavaan
3. **Std.all:** Standard all the variables.

### 8.5.3 Fall Term

Similarly, Table 8.7 shows the *bridging courses* of students beginning in Fall term grouped by the program code (anonymised) and their grade mean. Approximately 34% of the students enrolled in fall-term are from group 1 and 4. Students from group 3 show higher grade mean compared to other students.

Table 8.7: Frequency distribution of the variables used

| Characteristics | Number of students | Percentage(%) | Grade(Mean) |
|---|---|---|---|
| **Bridging courses in Fall** | | | |
| Group 1 | 23 | 33.33 | 70.25 |
| Group 2 | 4 | 5.79 | 70.9 |
| Group 3 | 4 | 5.79 | 73.84 |
| Group 4 | 24 | 34.78 | 66.97 |
| Group 5 | 14 | 20.28 | 70.98 |

*Group*1 : Students whose Program code is 50.2061.
*Group*2 : Students whose Program code is 50.3032.
*Group*3 : Students whose Program code is 50.4017.
*Group*4 : Students whose Program code is 50.5035.
*Group*5 : Students whose Program code is 50.6024.
∗ Students whose entering *cohort year* is greater than their *first term registered* are removed.
∗ Students who deceased while enrolled are removed.

### Path Analysis of students starting in the Fall term

**# To create model for the hypotheses:**

```
modelPath = '
Grades ~
TRF_REQ_COURSE + NUM_TRF_REQ_CO + Gender + Age_First_Term
'
```

Table 8.8 shows the summary of the path model of students starting in Fall term with the effect of *transfer required courses* and *number of transfer required courses* on students' current *grades*.

Table 8.8: Summary of the model

| | Estimate($\beta$) | Std.Err | z-value | p-value | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regressions:** | | | | | | |
| Grade ~ | | | | | | |
| *Group 1:* | | | | | | |
| TRF_REQ_COURSE | 0.510 | 0.039 | 13.066 | 0.000 | 0.510 | 0.077 |
| NUM_TRF_REQ_CO | 1.298 | 0.054 | 23.856 | 0.000 | 1.298 | 0.135 |
| *Group 2:* | | | | | | |
| TRF_REQ_COURSE | -1.071 | 0.130 | -8.233 | 0.000 | -1.071 | -0.099 |
| NUM_TRF_REQ_CO | 1.071 | 0.130 | 8.233 | 0.000 | 1.071 | 0.099 |
| *Group 3:* | | | | | | |
| TRF_REQ_COURSE | 4.348 | 0.228 | 19.103 | 0.000 | 4.348 | 0.223 |
| NUM_TRF_REQ_CO | -4.348 | 0.228 | -19.103 | 0.000 | -4.348 | -0.223 |
| *Group 4:* | | | | | | |
| TRF_REQ_COURSE | -0.303 | 0.012 | -25.033 | 0.000 | -0.303 | -0.126 |
| NUM_TRF_REQ_CO | 0.243 | 0.059 | 4.119 | 0.000 | 0.243 | 0.023 |
| *Group 5:* | | | | | | |
| TRF_REQ_COURSE | 1.274 | 0.053 | 24.048 | 0.000 | 1.274 | 0.171 |
| NUM_TRF_REQ_CO | 2.603 | 0.088 | 29.434 | 0.000 | 2.603 | 0.201 |

1. **Std.Err:** Standard Error
2. **Std.lv:** Standard Lavaan
3. **Std.all:** Standard all the variables.

## 8.6 Results

- **Effect of transfer courses for students enrolled at the Spring term:** Results reveal that students in transfer courses in program group 3 and 4 have a significant positive effect on students' grades, whereas the other program groups have a negative impact on their performance. Results show that students in program group 3 and 4, with transfer courses, perform significantly better with an estimated value of ($\beta = 3.067; p = 0.000$) ($\beta = 0.022; p = 0.000$).

- **Effect of transfer courses for students enrolled at the Fall term:** Students starting in the Fall term, with transfer courses, have better performance than students beginning in the Spring term. Of the students with transfer credits in program groups 1, 3, and 5, students performed better compared to students in program group 2 and 4. The highest performing group includes students from the program group 3 with an estimated value of ($\beta = 4.348; p = 0.000$).

## 8.7 Discussion and Conclusion

In conclusion, this study has assessed the *academic performance* of transfer students with transfer credits enrolling into STEM-based Baccalaureate degrees at an Ontario university between the years of 2007 to 2012. This study has looked at the effect of the *number of bridging courses* and *bridging courses* on students' *academic performance*. It was found that the students with fewer transfer courses performed better at the university, in particular, five *bridging courses*. Students enrolled in spring and fall taking five *bridging courses* significantly perform better than other students. The *bridging course* the student has to take also affect students' *academic performance* [41]. Moreover, students in different programs, with different transfer courses, had positive and negative effects on their performance depending on the enrolment term (either Spring or Fall). Transfer required courses from group 3 have a significant positive impact on students' current grades. These findings are consistent with Vargas et al. [41] that *bridging courses* do effect on students' *academic performance*.

# Chapter 9

# Discussion and conclusion

This study illustrates the factors influencing the *academic performance* (AP) of students with transfer credit that were enrolled in STEM-based Baccalaureate degrees at an Ontario university between the years of 2007 and 2012. Figure 9.1 shows the SEM diagram of the hypothesis solved in this study. Our hypotheses were developed based on similar studies on predictors of AP [7] [26] [33] [23] [19] [50] [41]. In this study, the AP was measured by on-time program completion and grades for each term, excluding the scores in transfer courses. The variables were modified, and new variables created according to the requirements of each hypothesis. For example, the immigration status with other different visa categories combined to the student visa, and summer and spring in the First term registered combined to A. Time to complete created by subtracting students' Cohort year from First reunion class.

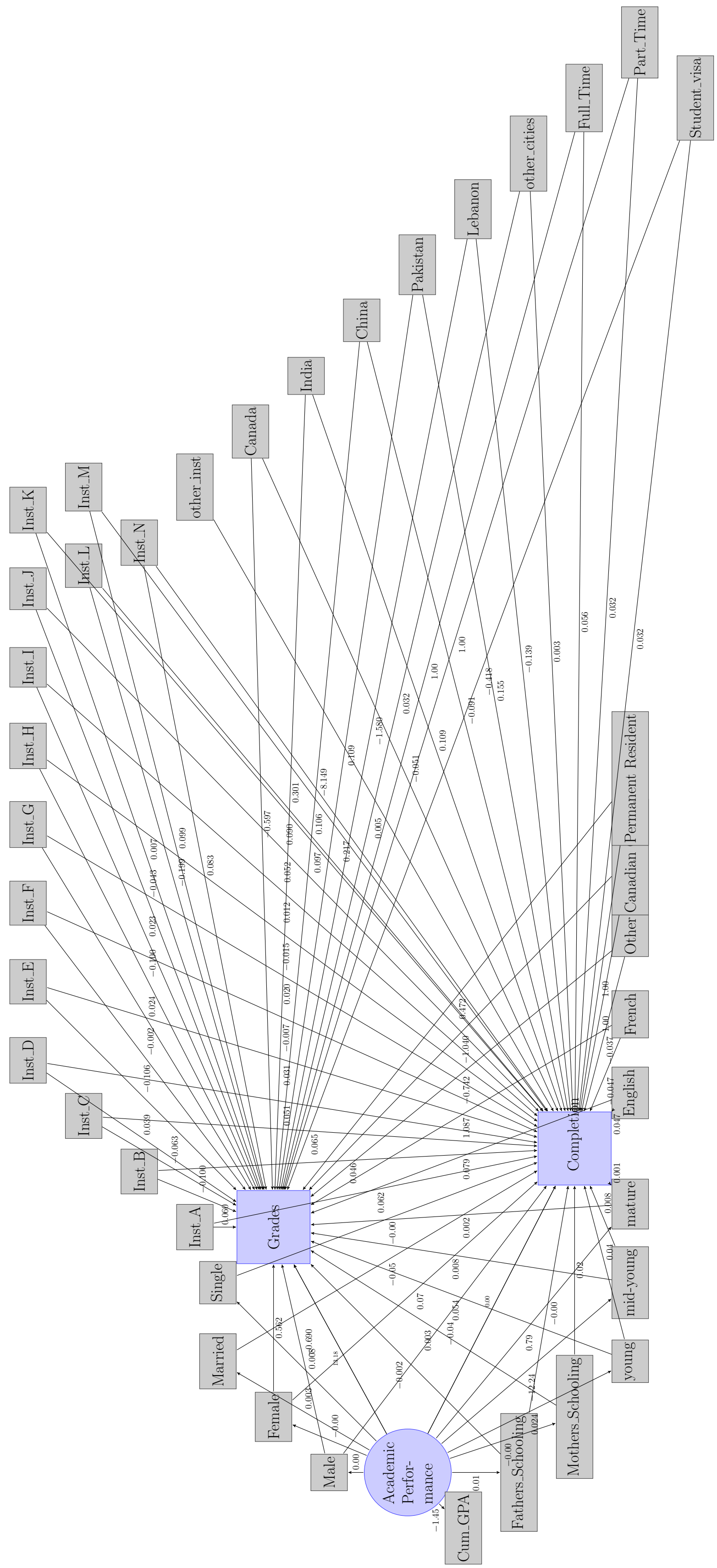



Figure 9.1: SEM diagram

Several conclusions can be drawn based on the results in this study. The first conclusion is *the effect of students' marital status, gender and age on students academic performance*. Ninety-five percent of the transfer students enrolling into STEM-based Baccalaureate degree are male and five percent female. It appears that the *academic performance* of male students is better than females. With respect to age at the time of registration, young (18-20) and mature (26-50) students have better *academic performance* as compared to mid-young (21-25) students. Based on our results, most students who transfer from colleges to universities are males and mid-young. Also, there was no effect of student marital status on their performance which is consistent with earlier published results of Amuda et al [7].

The second conclusion from this study is that *younger students who are females complete their program requirements on-time*. However, only five percent of students enrolled in Baccalaureate degrees are female. It appears that young female transfer students graduate from university on-time. One must be cautious with this conclusion because there are so few young females students in the dataset. The results clearly support the conclusion that age and gender have an effect on on-time degree completion. These findings are consistent with previous results by Jacob [26] indicate that older students take more time to complete, as they are most likely to be part-time.

The third conclusion is the *effect of citizenship, immigration status and primary language on AP*. All of these factors do have a significant impact on *academic performance*. Ninety-one percent of the students have Canadian citizenship as their immigration status and Canada in citizenship. There are only 18 students from India and seven from Pakistan; however, they have better performance than other students. The effect of primary language show fascinating results indicating that students who speak French as their primary language have higher grades than other students within the sample.

The *effect of students' past/sending institution on time to complete their degree*. 1127 students successfully provided the details of their previous institute. Three percent of the students coming from Institute N significantly complete their studies on-time in university. Possible explanations include: the student might have to do few transfer required courses, did a similar program in the previous institute, a full-time student, the majority of the students are young. The results support that there is an effect of sending institution on students' on-time degree completion. These findings are similar to the previous results that past/sending colleges do effect in the length of time required to graduate in future institutions [19].

The fifth conclusion from this study is that the *effect of students' college grades on their current AP*. Based on the data of the sending institution grades, the analyses for each institute is done separately, as grading systems are different. The past grades of the students coming from Institute L and J have a significant positive impact on their current grades. It is very likely that because there are few students from that institutes, which may have some effect on the results. Sulaiman et al. [50] also found out that previous institutes grades are the best predictors of their current AP.

A final conclusion from this study is that the *number of transfer required courses and the transfer courses itself affect student AP*. All the students transferring to a Baccalaureate degree have to complete the transfer required courses, in addition to the courses offered for the program enrolled in. It appears that students with fewer number of transfer required courses perform significantly better than students with more transfer courses. The stress of more transfer courses affects their AP. Fewer transfer required courses help students to focus on the main courses for the program they enrol in. The different program provides different transfer courses; transfer courses also affect students' AP. Transfer courses offered in Fall shows better results on AP than the ones offered in Spring.

## 9.1 Lessons

There are few lessons learned in this study:

- **Unequal group sizes and small samples may affect results:** The variation in sample sizes may affect the results. For example, there is only five percent of females and ninety-five percent of males. If all the females are performing well and completing their degree on-time, then those 95 percent males will show an adverse effect on their AP.

- **When trying to replicate studies, often exact variables are not available and proxies are used:** Students' immigration status, citizenship and primary language variable were used instead of students' ethnicity. Sometimes the required variables are not present in the dataset, so their alternate variables are used.

## 9.2 Future Work

It could be interesting to build a predictive model using the same variables but different techniques, such as Fuzzy Cognitive Map (FCM) which was used by Singh et al. [48] to build a model for predicting Cardiovascular Disease and Mago et al. [32] for Periodical Disease Assessment. The way the data is analysed and a model is constructed could also be changed, instead of providing the values through R programming, it could be better to have an easy to use interface for users to simply upload the whole dataset, specify the variables, and get the summary of the effect of independent variables on dependent variable. Unfortunately, due to time constraint, the data has to be manually inputted, and the results are generated through a hand coded system.

The data could be used for future decision making. It would be interesting to use a machine learning approach to build a decision-making system to predict the *academic performance* of future students.

# Appendix A

# Correlation Formula

**Correlation** is a statistical technique that shows how strong the variables x and y are related. For example, marks and time to complete; students with very low scores tend not to complete the university on-time. The formula to calculate correlation is:

$$r = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{[N\sum x^2 - (\sum x)^2][N\sum y^2 - (\sum y)^2]}} \tag{A.1}$$

where:
$N$ = number of pairs of scores.
$\sum xy$ = sum of the products of paired scores.
$\sum x$ = sum of x scores.
$\sum y$ = sum of y scores.
$\sum x^2$ = sum of squared x scores.
$\sum y^2$ = sum of squared y scores.

The value of r will always be between -1.0 and +1.0. If the correlation is negative, there is a negative relationship; and if its positive, the relationship is positive.

# Appendix B

# SEM Measuring Model Fit

**P-value :** P-value is represented as:

$$Pr(X >= x|H) \text{ for right tail event,}$$
$$Pr(X <= x|H) \text{ for left tail event,}$$
$$2minPr(X <= x|H), Pr(X >= x|H) \text{ for double tail event.}$$

A small p-value (typically $<= 0.05$) indicates strong evidence, so null hypothesis can be rejected. A large p-value ($> 0.05$) indicates weak evidence to reject null hypothesis.

**R-squared** also know as coefficient of determination, or the coefficient of multiple determination for multiple regression is a statistical measure of how close the data are to the fitted regression line. R-square smaller than 1 shows that the model is acceptable. The equation to calculate R-squared is:

$$R - Squared = 1 - (ExplainedVariation/TotalVariation)$$

$\chi^2$ **:** Chi-square value is sensitive to the sample size of the data. It assesses the overall fit and the discrepancy between the data and fitted matrices [49]. The formula for the chi-square statistic used in the chi square test is:

$$\chi^2 = \sum \frac{(Observed - Expected)^2}{Expected}$$

**df :** Regression coefficient + error terms + covariance between variables + variance for exogenous variables.

**RMSEA :** Root Mean Square Error of approximation is a parsimony adjusted index. Values closer to 0 represents a good fit [49]. Its computational formula is:

$$\frac{\sqrt(\chi^2 - df)}{\sqrt(df(N-1))}$$

where, N is the sample date size and df is the degree of freedom.

**SRMR :** Standardized Root Mean Square Residual is the square root of the difference between the residuals of the sample covariance matrix and the hypothesised model. [49]

**CFI :** Comparative Fit Index compares the fit of a target model to the fit of an independent model. It is not very sensitive to sample size [49]. The formula for CFI is:

$$\frac{d(NullModel - d(ProposedModel))}{d(NullModel)}$$

where, $d = \chi^2 - df$ (degree of freedom of the model)

**GFI :** Goodness of Fit is the proportion of variance accounted for the estimated population covariance. It ranges from 0 (poor fit) to 1 (perfect fit). [49]

**AGFI :** Adjusted Goodness of Fit is similar to GFI but adjusts for model complexity. It ranges from 0 (poor fit) to 1 (perfect fit).

# Appendix C

# Code-book of the variables used

| Variable Name | Description | Value |
|---|---|---|
| **Student_ID** | Unique student identifier | |
| **COHORTYEAR** | year of student's first enrolment in specified program | 2007-2012 |
| **Last_Term_Registered** | last term of student enrolment at the institution | 2007A/F - 2012A/F |
| **First_Term_Registered** | first term of student enrolment at the institution | 2007A/F - 2012A/F |
| **Deceased_Date** | the date the student became deceased | 11-Feb-2007 |
| **First_Reunion_Class** | the year the student first graduated with a degree from the institution | 2008 |
| **Native_Language** | student's reported first language | English, French, Other |
| **Aboriginal_Declaration** | Response of the student to the option to declare aboriginal status | Yes, No, Opted out, Null |
| **Aboriginal_Declaration_Type** | If student has declared aboriginal status, the specific status | First Nation; Metis; Non-Status; Null |
| **Citizenship_Desc** | Student's reported country of citizenship | top 10: Canada, India, China, Pakistan, Nigeria, Colombia, Lebanon, Iran, Sri Lanka, Philipinnes |
| **Fathers_Schooling** | Student's reported highest education level of their father | Attended university without earning a degree; completed a bachelor's degree; did not finish high school; completed a doctoral degree; completed a master's degree; graduated from high school; opted out; some or completed college; null |
| **Mothers_Schooling** | Student's reported highest education level of their father | Attended university without earning a degree; completed a bachelor's degree; did not finish high school; completed a doctoral degree; completed a master's degree; graduated from high school; opted out; some or completed college; null |
| **Graduation_Type** | Whether the student has a recorded graduation date from the institution | Y;N |
| **Marital_Status** | Student's reported marital status | M;S |
| **Gender** | Student's reported gender | M;F |
| **Immigration_Status** | Student's immigration status | CC;PR;SV |
| **Term_GPA** | Student's GPA for a given term | 0-100 |
| **Term** | The term which data is tied to | 2007F/S - 2012F/S |
| **Cum_GPA** | The cumulative GPA of all courses ever taken at the institution | 30-100 |
| **Term** | The term which data is tied to | 2007F/S - 2012F/S |
| **Term** | The term which data is tied to | 2007F/S - 2012F/S |
| **Degree_Program** | the program which the degree is for | 10.0616; 12.3547; 22.1568; 33.1547 |
| **Sending_Institution** | The identifiers for the institution(s) the student attended previously | top 5: 1.026; 1.060; 1.057; 1.039; 1.001 |
| **Sending_Institute_Type** | whether the past/sending institute is a university, college, or other. | 1; 2; 3 |
| **Registration_Status** | registration status of the student at the institute | FT; PT |
| **Previous_Inst_Grade** | Grades the student got in the previous institute | A; B; C+; 85; 92.5 |
| **Age** | Age of the student as per First term registered | young(18-20); mid-young (21-25); mature (26-50) |
| **TRF_REQ_COURSES** | the required courses as part of the transfer process (i.e. make-up courses) | 50.5057.3187; 30.2619.9411; 50.1034.6028 |
| **NUM_TRF_REQ** | the number of transfer required courses (make-ups and transition) | 5; 6; 7; 8; 9; 10; 11; 12; 13; 14 |

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