Throughput of UWC students who did at least one semester of third-year Statistics

by

Abduraghiem Latief

A minithesis submitted in partial fulfillment of the requirements for the degree of Magister Scientiae in the Department of Statistics, Faculty of Science, University of the Western Cape.

Supervisor: Prof. R. Blignaut

Co-supervisor: Prof. D. Kotze

October 2005

Throughput of UWC students who did at least one semester of third-year Statistics

Keywords

Education

Throughput rate

Statistics

Completion rate

Pass rate

Undergraduate

University studies

First time entrants

Graduation

Enrolment

Abstract

Throughput of UWC students who did at least one semester of third-year Statistics

The study explores the completion rates (the number of years a student takes to complete a degree) of graduates at the University of the Western Cape (UWC) in South Africa. The graduates in the study all did at least one semester of statistics in their final year of study. The students' completion will be described with respect to school results and socio-demographics. Differences between students who finished their studies in the prescribed time of three years and those who took longer than the prescribed time will be highlighted.

Factors that aid or hinder students from successfully completing their studies in the prescribed time will be analyzed. An entry selection model will be developed to screen the students. This will assist with an enrolment strategy.

The most significant result found was that the political environment played the most significant role in throughput. The next significant result from the study showed that the grade 12 aggregate played a significant role in throughput. It is suggested that UWC be proactive in developing alternative methods of selecting students, since the

new Further Education Training (FET) school system, which will be implemented in 2006, will omit the grade 12 aggregate.

October 2005

Declaration

I declare that ***Throughput of UWC students who did at least one semester of third-year Statistics*** is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Abduraghiem Latief October 2005

Signed: ....

List of tables

List of figures

Abbreviations

ASCII	American Standard Code for Information Interchange
CESM	Classification of Educational Subject Matter
CHE	Christian Higher Education
DoE	Department of Education
DVN	Diploma in Veterinary Nursing
EXCEL	Microsoft spreadsheet
FET	Further Education Training
HDI	Historically Disadvantaged Institutions
HE	Higher Education
HEIs	Higher Education Institutions
HWI	Historically White Institutions
ICS	Information and Communication Services
MPM	Mean percentage mark
PoE	Place-on-exam
PRN	Print file format
SAPSE	South African Post-Secondary Education
SAS	Statistical Analysis Systems
SAUVCA	South African Universities' Vice Chancellors' Association
SPSS	Statistical Package for Social Science
UWC	University of the Western Cape

Acknowledgements

I would like to thank my parents, my wife (Shaheema), my supervisors (Professor R. Blignaut and Professor D. Kotze), the Madsens from USA and colleagues for their patience and support. Lastly I thank the Almighty for giving me the strength and health to finish this thesis.

Contents

Chapter 4: **Analyses and results** 28

Chapter 1

Introduction

1.1 Background to the study

The Department of Education (DoE) restructured the higher education (HE) system in 2000 (Asmal, 1999). The restructuring caused universities to re-align themselves with the priorities of the Department of Education. In 2001 the Department of Education introduced its new five-year national plan for higher education. One of the priorities in the national plan was to increase undergraduate output to ensure that the current demand for high-level managerial and professional skills be met (Department of Education, 2001a).

This priority to increase undergraduate output (also known as undergraduate throughput) initiated the study described in this mini-thesis. This study explores the throughput rate of UWC students who did at least one semester of third-year level Statistics. *Throughput* is the number of undergraduates who complete their studies in the prescribed time (Cairncross, 1999). The throughput is one of the factors that the government uses for funding a university (Department of Education, 2001b).

The Department of Education has introduced a new funding formula which is applicable to all higher education institutions (HEIs). This new formula takes undergraduate output as a factor in determining the funding that a university will receive (Department of Education, 2001b). The previous South African post-secondary education (SAPSE) formula was based on four criteria:

1. Student numbers - the overall number of students.
2. Area of study - for example humanities/science.
3. Student throughput - the pass rate.
4. Level of studies - honour’s level is equal to two times the undergraduate level, master’s level is three times the undergraduate level and doctoral level is equal to four times the undergraduate level.

The South Africa post-secondary education (SAPSE) funding formula favoured the historically-white institutions (HWI) more than the historically-disadvantaged institutions (HDI), which had high failure rates, few science students and low postgraduate student numbers (The Mail and Guardian, 1999).

1.2 Statement of the problem

The study will investigate the throughput of students who did at least one semester of third-year level Statistics in the Department of Statistics at the University of the Western Cape (UWC). Completion of undergraduate studies by a student in three consecutive years will be defined as successful throughput. The study explores factors that could contribute to students successfully completing their studies in the prescribed amount of time.

1.3 Purpose of the study

The school system under-prepares students for higher learning (Nair, 2002). This is worsened when they enter into higher institutions. In other words, it leads to low throughput rates. O' Connell (2004) indicated that UWC's throughput rate is 17% for the whole university. This study will describe the throughput rate of a subset of students from UWC and explore some factors that might contribute to throughput.

1.4 Aim of the study

The aim of the study was to explore the throughput rate of third-year Statistics students in the Department of Statistics and to model the probability of successful throughput with certain factors or predictor variables. The following factors were explored: gender, race, home language, Grade 12 aggregate, Grade 12 mathematics results, entering university directly after school and student registration before and after the 1994 elections in South Africa (first democratic election).

1.5 Research questions of the study

The goal was to identify what factors influence successful throughput. Various modelling techniques were used to identify the factors that significantly predict successful throughput. Logistic regression and decision trees were used. The aim was, furthermore, to establish if the change in the political arena, specifically the change after the democratic elections in 1994, had an influence on successful throughput.

1.6 Importance of the study

By improving throughput, more skilled students will become quality scientists and employees. The benefits of increasing undergraduate output are:

1. More successful students will enter into the job market and promote UWC in their company profiles (as alumni).

2. More undergraduate students will be available from whom to recruit for postgraduate studies.

3. If students complete their studies in the prescribed time, they will save on tuition fees. The university will gain by earning its subsidy more quickly.

4. More funds will be forthcoming for research and postgraduate studies.

The information from this study can aid in improving enrolment strategies at UWC.

1.7 Outline of the study

The following topics will be dealt with in each chapter:

Chapter 2 is a literature review. In this chapter, the views of other researchers on throughput and the factors that contribute to it are expressed.

Chapter 3 describes the methodology: How the sample was collected, what population was of interest and what objectives were defined.

Chapter 4 presents the findings of the analysis. First, descriptive results are shown, followed by univariate and multivariate logistic regression analysis. Decision-tree results are summarized.

Chapter 5 discusses and interprets the findings. This chapter concludes with suggestions and recommendations.

The next chapter will deal with the views of some scholars on the topic of throughput.

Chapter 2

Literature review

In the previous chapter, background information as to how the study evolved was described. In this chapter, literature on how others view the problem of throughput and what factors they believe contribute towards throughput will be shown. Different studies investigated different factors within specific programmes. To make the literature comparable, emphasis is placed on those factors that are important to this study. The chapter deals with the demographic background (gender, race and home language), school background (aggregate and mathematics) and the political environment under which the students studied.

Fraser and Killen (2003) use the term *academic success* to indicate that students are able to meet the assessment requirement of the programme in which they enroll; if these requirements can be met in the minimum time, that represents greater success than if subjects have to be repeated. Bitzer and Troskie-De Bruin (2004) argue that throughput and completion rates should not be seen as the only criteria of quality or the hallmark of high standards.

Cairncross (1999) investigated the fourth/final-year level Human Ecology students' throughput rates and completion rates. She defines throughput rate as "the number of students who pass through a period in the allocated time period" (p. 2). The throughput in the case of the Human Ecology students is the number of students who completed their studies in four years. She also defines completion rate as "the number of students who complete their studies" (p. 3). She mentions that, historically, Grade 12 results are used to categorise students into those who qualify for degree courses and those who qualify for diploma courses. She refers to a student who leaves a course as a "dropout" (p. 2). She does recommend that dropout students be referred to as "early exits" (p. 2). Table 2.1 below summarises her findings in terms of the following categories – the overall findings (all the students together), the Human Ecology student registration for the years 1994 to 1996, the Human Ecology degree course and the Human Ecology diploma course.

Table 2.1 **Throughput and completion rate results of Cairncross's study**

	Overall	1994	1995	1996	Degree	Diploma
Throughput rate	37 (33.9%)	9 (25.7%)	12 (32.4%)	16 (42.2%)	38.8%	16.7%
Completion rate	18 (16.5%)	7 (20%)	11 (29.7%)	0 (0%)	17.6%	12.5%
Dropout rate	54 (49.54%)	19 (54.3%)	14 (37.8%)	21 (56.8%)	43.5%	70.8%

(Source: Cairncross, 1999)

Since the entrance requirements are different for a degree and a diploma, it can be seen that the throughput rates are higher for the degree course compared to the diploma course in Human Ecology. For the individual years of registration from 1994 to 1996, the throughput rates increased. In 1996 more than half of the students dropped out of the Human Ecology course. This means that all the students who remained in the course completed it in the prescribed amount of time. For the degree course (Grade 12 exemption) the throughput rates were more than double those of the diploma course. The dropout rate for the diploma course was higher than that observed for the degree course.

The quality and characteristics of students at different universities were investigated by Taylor and Harris (2002). They derived their data from the South African post-secondary education (SAPSE) information system. Those universities whose South African post-secondary education (SAPSE) databases were incomplete were excluded from their study; therefore, they could only include ten universities in their study. The ten universities are the University of Cape Town, the University of Durban-Westville, the University of the Orange Free State, the University of Port Elizabeth, Potchefstroom University for CHE, the University of Pretoria, Rand Afrikaans University, Rhodes University, the University of Stellenbosch, and the University of Zululand. Taylor and Harris (2002) define a university to be efficient if it complies with the following definition of efficiency: “Efficiency involves minimizing the inputs required to produce a given output or, conversely, maximizing the output from given inputs” (p. 184). The input measure for a university includes students, personnel and financial resources. The output is graduates and research production. Dawes P., Yeld N. and Smith M.J. (1999) state that the national enrolment goals will be linked to funding in future. Graduate output was a factor in the old funding system (SAPSE) and it will also be a factor in the new funding system.

2.1 Demographic background

Dawes et al. (1999) express the need to increase the participation rate of black Africans in higher education (HE). They mention that black Africans are being disadvantaged in the selection system for higher education because of unequal schooling (study under unfavourable and disadvantaged conditions). They mention that access and admission to higher education will become more difficult for black

Africans because more black Africans will enter with low aggregates. They encourage the investigation of race and gender to see if there is an increase in enrolment.

Nair (2002) defines throughput rate as "number of years used by many students to complete a degree or diploma" (p.98). Nair relates low throughput to under-preparedness due to the inadequate schooling system. Nair gives the national average of the throughput rate in HEIs in Table 2.2 as follows:

Table 2.2 **Throughput rate at HEIs nationwide**

Throughput rate (%) for population groups	
African students	8
White students	25
Throughput rate (%) in key subject areas for African students	
Engineering	3
Medicine	9
Natural Science	12

(Source: Frank Meintjies: Deloitte Consulting, taken from Nair, 2002)

Lourens and Smit (2003) built a predictive model to predict the success of students in their first-year level of studies. Lourens and Smit (2003) used the following demographic background predictors - age of student, province of matriculation, Grade 12 aggregate, Grade 12 English symbol (defined as adequate or inadequate), ethnic group, gender, campus of study (Pretoria campuses versus satellite campuses), method of study (full-time versus part-time), financial aid (yes or no), marital status, type of accommodation (resident student or not) and classification of educational subject matter (CESM), i.e. major field of study, to describe the type of students entering Technikon Pretoria. Lourens and Smit (2003) divided the English grade symbols into two groups, namely, the "adequate" group - higher grade D symbols or better, the standard grade - C symbols or better and the lower grade - B symbols or better. The rest were in the "inadequate" group. They made use of stepwise logistic regression to find the model with the most significant predictors. Lourens and Smit (2003) confirmed a relationship between school aggregate and first-year success rate. Lourens and Smit (2003) also found that a relationship does not exist for second and third-year successes. They used eight significant independent variables in the study to build two models. The first model consisted of all eight variables and the other model only consisted of the CESM category and the Grade 12 aggregate. They then compared the performance of the two models. They concluded that both models have more than a 70% predictive accuracy and that the Grade 12 aggregate and major field of study play an important role in terms of students' first-year success at Technikon Pretoria.

Van Rooyen (2001) found that English as a home language was a significant predictor of the bridging-year mean percentage mark (MPM). Agar (1991) confirmed that disadvantaged students found it difficult to express themselves in English. He found that 75.3% of students in a bridging programme at the University of the Witwatersrand attribute the difficulties of academic actualization to language barriers. Howie (2003) confirms these views, showing that pupils' English proficiency was a strong predictor of success in mathematics.

2.2 School background

Nair (2002) states that the government loses millions on students who fail at higher education institutions (HEIs) and also spends millions on a schooling system which produces school leavers who are under-prepared for higher education and the job market. Keeping this in mind, Botha A.E., McCrindle C.M.E. and Owen J.H. (2003) state:

> "In the South African education system, students write a standardized, independently set, matriculation examination at the end of their school career (Grade 12). The results of this examination are used as the main criteria for admission to tertiary educational institutions. Subjects may be taken on two levels –higher grade and standard grade. A proposed new matriculation curriculum, however, will eliminate the difference between the standard and higher grades" (p. 132).

The Diploma in Veterinary Nursing (DVN) programme uses Grade 12 mathematics with its grades as a selection criterion (Botha et al., 2003).

Table 2.3 **Scoring system used by the University of Pretoria**

Matriculation symbol	Higher grade	Standard grade
A (more than 80%)	5	4
B (70 – 79%)	4	3
C (60 – 69%)	3	2
D (50 – 59%)	2	1
E (40 – 49%)	1	0

(Source: Botha, McCrindle & Owen, 2003).

Botha et al. (2003) define the adjusted mark as "standard grade minus 10%" (see Table 2.3) and set the minimum of 40% of the adjusted mark for both higher grade and standard grade. They used the Mann-Whitney non-parametric test to test for the difference between groups (p-value = 0.0097) and found that a statistically significant difference does exist in the adjusted mark obtained for Grade 12 mathematics between the groups that passed and failed the first-year veterinary nursing course. This means Grade 12 mathematics is related to success or failure of veterinary nursing students at tertiary level. They recommend that students with Grade 12 mathematics marks higher than 57% be given preference for admission to veterinary nursing courses. Therefore mathematics can be used as an admission criterion for enrolment for a veterinary nursing course.

Table 2.4 **First-year level result versus Grade 12 mathematics grade of diploma course students in Veterinary Nursing**

Result	Higher grade	Standard grade
Pass	12	26
Fail	48	56

(Source: Botha, McCrindle & Owen, 2003)

Botha et al. (2003) found that no statistically significant relationship (Table 2.4 gives a Chi-square p-value = 0.1196) exists between the grade of mathematics at matriculation level and the success or failure in the first-year level of study.

The following people oppose the view that Grade 12 mathematics is a significant factor in successful completion of tertiary education. Mitchell (1988) says that there is no significant difference between those students who did Grade 12 mathematics and those who did not do Grade 12 mathematics, with respect to an accounting degree, excluding the quantitative courses. Bargate (1999) also found that Grade 12 mathematics did not play a significant role in overall academic performance.

Dawes et al. (1999), in their study, used the aggregate school score, which is the raw total of all the marks for all a student's school subjects. They then define a place-on-exam (PoE) indicator by taking the individual aggregate school score for all the students at a particular school and assigning the indicator to that rank score. They give three reasons for the advantage of using the place-on-exam. Firstly, scores are compared within the same school, so students will not become victims of circumstances. Secondly, it can be used as a measure of relative merit for students without it being influenced by the examination system or internal assessments at the school. Thirdly, it is easy to use and interpret (Dawes et al., 1999). Dawes et al. (1999) say that in a study done by Stoker D.J., Engelbrecht C.S., Crowther N.A.S., Du Toit S.H.C. and Herbst A. (1986), it was found that aggregate score was the strongest single predictor of success at university. Dawes et al. (1999) also state that other South African studies done by Skuy M., Zolessi S., Mentis M., Fridjhon P. and Cockcroft K. (1996); Badenhorst F.D., Foster D.H. and Lea S.J. (1990) and Shochet (1985) support Stoker et al. (1986)s' findings, but they did not focus on race or gender. In some studies (Badenhorst et al., 1990; Shochet, 1985) in which race was investigated, the sample of Blacks was too small to deduce information regarding race as predictor. Where the sample size was large, the results between school examination and success at university were too complex to understand (Dawes et al., 1999).

Lourens and Smit (2003) found, in their study, that Grade 12 aggregate and major field of study were the most important predictors for the success of students in their first-year level of study. They found, in their study, that only 20.96% (1016 out of 4848) of first-years passed all their subjects first time around.

2.3 Political environment

Taylor and Harris (2002) investigated the efficiency of the following universities: the University of Cape Town, the University of Durban-Westville, the University of the Orange Free State, the University of Port Elizabeth, Potchefstroom University for CHE, the University of Pretoria, Rand Afrikaans University, Rhodes University, the University of Stellenbosch, and the University of Zululand. Taylor and Harris (2002) found that the student numbers increased, from 1994 to 1997 for the ten universities, by an average of 4.7% (compound rate) per annum. They state that a university with high student numbers is generally associated with improved university efficiency. But the academic successes of students have no relationship to the efficiency of a university (Taylor & Harris, 2002).

In the next chapter, the research design and methodology will be discussed.

Chapter 3

Research design and methodology

3.1 Statement of the problem

Completion of undergraduate studies by a student in three consecutive years will be defined as successful throughput in this study. The study explores factors or predictor variables that could contribute to students successfully completing their studies in the prescribed amount of time.

3.2 Aim of the study

The aim of the study was to model the probability of successful throughput with certain factors. The following factors were explored: gender, race, home language, Grade 12 aggregate, Grade 12 mathematics results, entering university directly after school and student registration before and after the 1994 elections in South Africa (first democratic election).

3.3 Objectives of the study

The objective of the study was to investigate the relationship between the factors (mentioned below) and successful throughput. The factors considered were: gender, race, home language, Grade 12 aggregate, Grade 12 mathematics results and time between school and university. Afterwards various modelling techniques (logistic regression and decision trees) were used to identify the factors that significantly predict successful throughput. The aim was, furthermore, to establish if the change in the political arena, specifically the change after the democratic elections in 1994, had an influence on successful throughput.

3.4 Hypotheses

The following hypotheses were tested:

1. Females were more likely to complete their studies in the prescribed time than males.
2. African students were less likely to complete their studies in the prescribed time than non-African students.
3. Students who speak English as a home language were more likely to complete their studies in the prescribed time than non-English home language speaking students.
4. The throughput rate of students with Grade 12 aggregate symbols less than 60% was lower than those with Grade 12 aggregate symbols of 60% and above.
5. The throughput rate of students with Grade 12 mathematics symbols less than 60% was lower than those with Grade 12 mathematics symbols of 60% and above.
6. A relationship exists between throughput and a break between school and university studies.

3.5 Study design

The study design was a historical cohort (retrospective) study because historical student records were used. The cohorts under consideration were those who completed their studies within three years versus those who took longer than three years. The events like registration and completion of academic studies occurred prior to the start of the study.

3.6 Study population

The population for this study consisted of all students who had completed at least one semester of either Mathematical Statistics or Applied Statistics at the third-year level in the Department of Statistics at the University of the Western Cape. It did not matter if the student had failed the semester or repeated the semester in the next academic year. Students who registered for both semesters and obtained zero for both semesters were omitted from the study. The students who obtained zero for both semesters either did not deregister for the course or stopped attending lectures and completed no assignments, tests or exams. All transfer students from other institutions where omitted from the study. Transfer students, are students who have finished some of their subjects or academic year levels at an institution other than UWC, and then come and registered at UWC to continue their studies.

The entrance requirements for students to study Statistics at UWC are:

1. A matriculation exemption certificate issued by the Matriculation Board of the South African Universities' Vice Chancellors' Association (SAUVCA);
2. A pass of at least 40% in the higher grade or 50% in the standard grade examination for Mathematics; and
3. A pass of at least 40% in the higher grade or 50% in the standard grade examination for either Biology or Physical Science; or
4. An examination recognized by the Joint Matriculation Board for this purpose.

The duration of a B.Sc. degree in the Science Faculty at UWC is three years, with a time limit of five years for full-time study. Furthermore, the student has to obtain a minimum of 360 credits to obtain the degree. To major in Statistics, a student either starts in his/her first-year level with Statistics and then follows it through to third-year level, or starts in the second-year level and continues to third-year level. The option of starting from second-year level depends on the student passing first-year level university Mathematics (Science Faculty, 2004).

In 1987 and 1990, UWC introduced Mathematical Statistics and Applied Statistics up to a third-year level, respectively. Both courses were divided into two semesters. Students should pass both semesters of Mathematical Statistics or Applied Statistics at third-year level to major in Statistics. The Applied Statistics course contained theoretical elements with its application, but less emphasis is placed on mathematical ability. In 2002, the two courses were combined for various reasons, none of which are relevant for the purpose of this study. Data were collected for these two courses from 1975 to 2004.

3.7 Sample size

Data on all students who completed at least one semester of third-year Statistics were collected. In total, 409 students met the criteria for inclusion.

3.8 Data collection

Data for this study were historic (retrospective) and were collected from the university records. The data were extracted internally from the UWC's mainframe database (secondary source) without the need for a research instrument. The database is maintained by UWC's Information and Communication Services (ICS). All student data generated during the normal academic enrolment, such as registration, student marks, year of completion, year of graduation, et cetera, were captured. The data were then stored in an ORACLE mainframe student database. With the permission of ICS, any academic staff member can request information regarding his or her students for research purposes.

Requested data can either be in paper or electronic format. The data were electronically mailed as an attachment in a print file format (PRN). The data were then imported into EXCEL. The variable names were assigned in EXCEL; for example, the variable name *studnum* was assigned to the student numbers in all the EXCEL files. The data in the EXCEL files were then imported into SAS.

The subject code 381311 for the first semester and subject code 381321 for the second semester were used for the Mathematical Statistics course. The subject codes 172315 and 381315 for the first semester, and subject codes 172325 and 381325 for the second semester were used for the Applied Statistics course. The reason why Applied Statistics had two codes for each semester was that subject codes 172315 and 172325 were used from 1990 until 1996. After 1996, the subject codes were changed from 172315 and 172325 to 381315 and 381325 respectively. The following information was requested on students who did the above subjects: student number, student surname, student initials, third-year academic year, third-year Statistics exam mark, third-year Statistics supplementary exam mark, third-year Statistics exam comment and third-year Statistics supplementary exam comment.

The Grade 12 data for all the students who did at least one semester of third-year Statistics were requested as follows: year matriculated, Grade 12 exemption, Grade 12 aggregate (average), Grade 12 mathematics grades, Grade 12 mathematics symbols. The following academic year-level results were requested: final undergraduate academic year at UWC, degree code, degree name, academic year-level results. For these students, the following personal data were requested: sex of the student, race of the student, home language of the student and date of birth in yyyymmdd format. The year of first enrolment (variable name *begyear*) was extracted from the student number.

3.9 Measurements

In the study, the outcome of interest was successful throughput. Successful throughput meant that the student should have completed his/her undergraduate studies in three consecutive years from the year of first-time enrolment. Students who took more than three years to complete their studies or dropped out were considered as unsuccessful throughput students.

The throughput response indicator variable was called *through*. The categorical random variable *through* is a nominal scale measurement with discrete data. A '**1**' indicates that a student successfully completed his/her studies in three consecutive years, and a '**0**' indicates that a student did not complete his/her studies in three consecutive years. The category labels for the variable *through* were defined as 1="**THROUGHPUT**" and 0="**NON-THROUGHPUT**".

The following variables were needed to determine the throughput response variable: the variable *endyear* indicated one of the following events - the final year the student completed his/her undergraduate study at UWC or the year the student dropped out at UWC or the student is still currently in the system at UWC in 2004. All years were recorded as four digits, for example, 1997, in the study. The variable *begyear* indicated the year the student first enrolled at UWC. A new variable, *compl*, was computed by subtracting *begyear* from *endyear*. This new variable, *compl,* gives the number of years a student studied at UWC. The values for *compl* are discrete. If the value in *compl* was equal to '**3**', then the student finished his/her studies in the prescribed time of three years.

The demographic variables which describe the students in the population were the variable *gender*, indicating the sex of the students, and the variable *race*, indicating which race group a student belonged to. The categories were: '**COLOURED**', '**AFRICAN**', '**INDIAN**' and '**WHITE**'. The variable *homelang* indicated the language the student spoke at home. The categories were '**AFRIKAANS**', '**ENG & AFR**', '**ENGLISH**', '**NORTH SOTHO**', '**SOUTH SOTHO**', '**SWATI**', '**TSONGA**', '**TSWANA**', '**VENDA**', '**XHOSA**', '**ZULU**' and '**OTHER**'. A category was created for people who spoke both English and Afrikaans at home since Afrikaans was one of the two official languages during apartheid and both languages were spoken in many homes. It was assumed that the Africans only spoke their African languages at home and not a mixture of, for example, Xhosa and English.

School background information, such as Grade 12 aggregate and Grade 12 mathematics, was used in the study. The variable *agg_sym* indicated the Grade 12 aggregate (average) symbol. The categories were: '**A**', '**B**', '**C**', '**D**', '**E**' and '**F**'. The variable *math_grd* indicated the Grade 12 mathematics grade category of higher grade or standard grade. The categories were: '**H**' for higher grade and '**S**' for standard grade. The variable *math_sym* indicated the Grade 12 mathematics symbol. The categories were: '**A**', '**B**', '**C**', '**D**', '**E**' and '**F**'. As the Grade 12 mathematics symbols are related to higher grade and standard grade, a common scale was needed for comparison purposes. The variable *common1* was used to transform the Grade 12 mathematics grades and Grade 12 mathematics symbols to a common scale, namely, that an '**A**' on standard grade is equivalent to a '**B**' on higher grade; a '**B**' on standard grade is equivalent to a ‘**C**’ on higher grade, and so forth. The categories were: ‘**A**’, ‘**B**’, ‘**C**’, ‘**D**’, ‘**E**’, ‘**F**’ and ‘**G**’.

A logistic regression model was built using the following predictor variables. The variable *gender* was included. The variable *race* was categorized as follows: all the African students were grouped into a category “AFRICAN” and the Coloured, White and Indian students were categorized as “NON-AFRICAN”, which formed the new predictor variable *african*. The category labels were: 1=”**AFRICAN**” and 0=”**NON-AFRICAN**”. This categorical random variable *african* is a nominal scaled measurement which was included in the modelling procedure.

The predictor variable *english* was created with all the English home language speaking students and the English and Afrikaans (speaking both languages) home language speaking students in one group versus all the other home language speaking students into the alternative group. The category labels were: 1=”**ENGLISH**” and 0=”**NON-ENGLISH**”. The categorical random variable *english* is a nominal scaled measurement.

The predictor variable *agg_grp* was created using the academic background of a student entering UWC. The student either had a Grade 12 aggregate symbol of 60% and above (that is C and above) or below 60% (D and below). The category labels were: 1=“**60% AND ABOVE**” (A, B and C) and 0=“**BELOW 60%**” (D, E and F). The categorical random variable *agg_grp* is an ordinal scaled measurement.

The predictor variable *math_grp* was created using the *common1* variable, which was divided into two groups. The student either had a Grade 12 mathematics symbol of 60% and above (that is C and above) or below 60% (D and below). The category labels were: 1=“**60% AND ABOVE**” (A, B and C) and 0=”**BELOW 60%**” (D, E, F and G). The categorical random variable *math_grp* is an ordinal scaled measurement.

The predictor variable *immediate* indicated that the student had either enrolled at UWC immediately after leaving school (if the variable *imed_yrs* is equal to one or zero) or after some years (if the variable *imed_yrs* is more than one). The variable *imed_yrs* was the number of years between school and entrance into university. If *imed_yrs* was equal to zero, it meant that the student had matriculated in the same year he/she enrolled at UWC. For example, the student had failed a subject in Grade 12, written a supplementary exam the following year, and then matriculated while enrolled at UWC in that same year. The variable *imed_yrs* was calculated by subtracting the year the student matriculated (variable *matyear*) from the year the student enrolled for the first time (variable *begyear*). The values of variable *imed_yrs* are discrete. In the variable *imed_yrs*, ‘**1**’ meant a student had entered UWC immediately after school; ‘**2**’ meant a student had entered university after one year, and so on. The categories of variable *immediate* were: 1= “**DIRECTLY AFTER SCHOOL**” and 0= “**NOT DIRECTLY AFTER SCHOOL**”. The categorical random variable *immediate* is a nominal scaled measurement.

The years of first registration were grouped into two groups, namely: pre-democratic versus post-democratic election years. In this study, the pre-democratic election years were from 1975 to 1994, and the post-democratic election years were from 1995 to 2001.The predictor variable *year_cov* indicates pre-democratic election years and post-democratic election years. The categorical labels were: 1=”**POST-ELECTION YEARS**” and 0=”**PRE-ELECTION YEARS**”. The categorical random variable *year_*cov is an ordinal scaled measurement which was included in the modelling procedure as a covariate. See Table 3.1 for an overview of the variables in the study.

3.10 Limitations of the study

All academic years follow a calendar year. A student who finished in three and half years was recorded as finishing in four years. If a student repeated a subject, the highest mark obtained over all the years the student repeated the subject was recorded. Students who registered for both semesters but did not attend class, did not write examinations, and had no course mark for either semester were excluded from the study. Verification of the data was not required as it was requested from the UWC student database, which is assumed to be correct. There are cases where the information concerning Grade 12 results are missing, for example the Grade 12 aggregate. The study does not investigate the throughput of students who major in Statistics because the sample would then become too small for modelling purposes.

Table 3.1 **Table of variable names**

Variable name	Variable description	Variable created from
studnum	Student number	Original
Surname	Student surname	Original
init	Student initials	Original
year	Third-year academic year	Original
exam	Third-year Statistics exam mark	Original
sup	Third-year Statistics supplementary exam mark	Original
exam_cmt	Third-year Statistics exam comment	Original
*sup_*cmt	Third-year Statistics supplementary exam comment	Original
matyear	Year matriculated	Original
exemp	Grade 12 exemption	Original
agg_sym	Grade 12 aggregate (average)	Original
math_grd	Grade 12 mathematics grade	Original
math_sym	Grade 12 mathematics symbol	Original
endyear	Final undergraduate academic year at UWC	Original
degcode	Degree code	Original
degname	Degree name	Original
result	Academic year level results	Original
gender	Sex of the student	Original
race	Race of the student	Original
homelang	Home language of the student	Original
dobirth	Date of birth in yyyymmdd format	Original
begyear	Year of first enrolment	Derived from *studnum*
compl	Number of years at UWC	Derived from *endyear* minus *begyear*
through	Successful throughput	Derived from *compl*
common1	Common scale mathematics	Derived from *math_grd* and *math_sym*
african	African race category	Derived from *race*
english	Home language category	Derived from *homelang*
agg_grp	Grade 12 aggregate grouping	Derived from *agg_sym*
math_grp	Grade 12 mathematics based on common scale grouping	Derived from *common1*
immediate	Directly enters UWC after school grouping	Derived from *imed_yrs*
imed_yrs	Number of years after school before entering UWC	Derived from *begyear* minus *matyear*
year_cov	Covariate year influence	Derived from *begyear*

3.11 Data analysis

The data requested were imported from a text file into Microsoft EXCEL. The SAS software was used to transform data into a format ready for analysis. The data were analyzed using descriptive statistics, frequencies and cross tabulations. Associations between nominal scaled variables were tested using Chi-Square or Fisher's Exact Tests. Models were built using logistic regression and decision trees.

In the next chapter, the analysis of the results will be reported.

Chapter 4

Analyses and results

4.1 Demographic background of students

The study consisted of 409 students who enrolled from 1975 to 2001 and who completed at least one semester of Statistics at third-year level (see Table A7, Appendix A). The study was comprised of 117 males (43.28%) and 232 females (56.72%) (see Table A1 in Appendix A). There were 230 African students (56.23%), 156 Coloured students (38.14%), 22 Indian students (5.38%) and one White student (0.24%) (see Table A2 in Appendix A). The most common home language spoken by students was Xhosa (32.52%), followed by English and Afrikaans (22.49 + 8.56= 31.05%). The following languages were spoken the least, in decreasing order – Venda (1.96%), Tonga (1.47%) and Swati (1.22%) (see Table 4.1 and Table A3 in Appendix A).

Table 4.1 **List of home languages**

Home language	Frequency	Percentage
Xhosa	133	32.52
English	92	22.49
Afrikaans	51	12.47
English and Afrikaans (both)	35	8.56
Tswana	30	7.33
South Sotho	17	4.16
Zulu	12	2.93
North Sotho	12	2.93
Other	8	1.96
Venda	8	1.96
Tsonga	6	1.47
Swati	5	1.22

4.2 Third-year Statistics course

In the study, 205 (50.12%) students registered for the Mathematical Statistics course and 204 (49.88%) for the Applied Statistics course (see Table A21 in Appendix A). Of the 409 students, 361 (88.26%) passed both semesters and majored in Statistics (see Table A23 in Appendix A). The students who did not major in Statistics (11.74%) either failed both semesters (3.18%) or passed only one semester of third-year Statistics (8.56%) (see Table A22 in Appendix A).

4.3 Number of years to complete studies

More than 50% of the students (29.83 + 24.45 = 54.28%) took between four and five years to complete their studies (see Table A9 in Appendix A). The average number of years they took to complete their studies was five years; the median was four years (see Table A10 in Appendix A).

4.4 Grade 12 results

4.4.1 Aggregate

Most students entered UWC with a ‘D’ aggregate (46.53%) (see Table 4.2 and Table A12 in Appendix A). Of 404 students, 134 (33.18%) students achieved an aggregate of 60% and above. From Table 4.2, it can be seen that 82 (20.3%) students entered UWC with an aggregate below a D (less than 50%).

Table 4.2 **Grade 12 aggregates**

Symbol	Frequency	Percentage
A	2	0.50
B	26	6.44
C	106	26.24
D	188	46.53
E	78	19.31
F	4	0.99

Note: Five missing values.

4.4.2 Mathematics

In the study, 198 students (48.89%) had taken mathematics on the higher grade, and 207 students (51.11%) had completed Grade 12 mathematics on the standard grade (note: four missing values) (see Table A14 in Appendix A). The majority of students entered UWC with an 'E' symbol in mathematics on the higher grade or a 'D' symbol on the standard grade (see Table 4.3). There were 32 students who entered UWC with symbols less than the requirement stipulated in the Science Faculty yearbook. Only 4 students had an 'A' symbol on the higher grade (see Table 4.3). The common scale was created for comparison purposes between the higher grade and the standard grade. An 'A' on the standard grade was set equivalent to a 'B' on the higher grade. There were 27 students who had an 'A' on the standard grade. These 27 students plus the 17 students with 'B' symbols on the higher grade add up to 44 students on the common scale. From Table 4.4, we can see that the majority of students (38.71%) had an 'E' symbol on the common scale.

Table 4.3 **Mathematics symbols**

Symbol	Higher grade count	Standard grade count
A	4	27
B	17	38
C	26	45
D	58	64
E	92	24
F	0	8

Note: Six missing values.

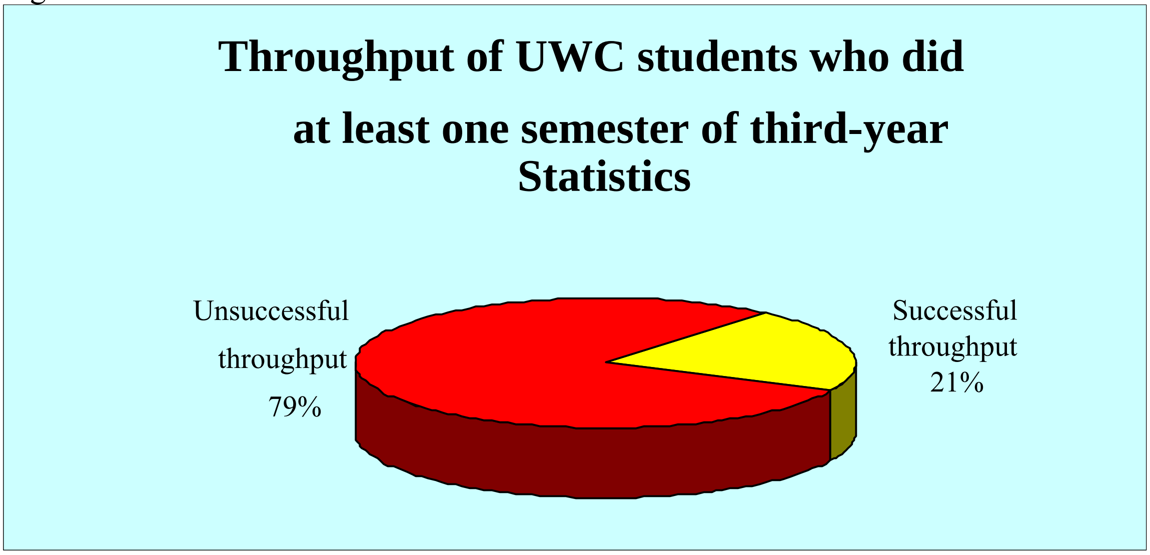
Table 4.4 **Common scale symbols**

Common scale	Frequency	Percentage
A	4	0.99
B	44	10.92
C	64	15.88
D	103	25.56
E	156	38.71
F	24	5.96
G	8	1.99

4.5 Response variable

In the study of 409 students, 86 students (21.03%) finished their studies successfully in the prescribed time of three years (see Table A11 in Appendix A). The other 323 students (78.97%) either took more than three years to finish their studies or dropped out or are still currently registered (see Figure 4.1).

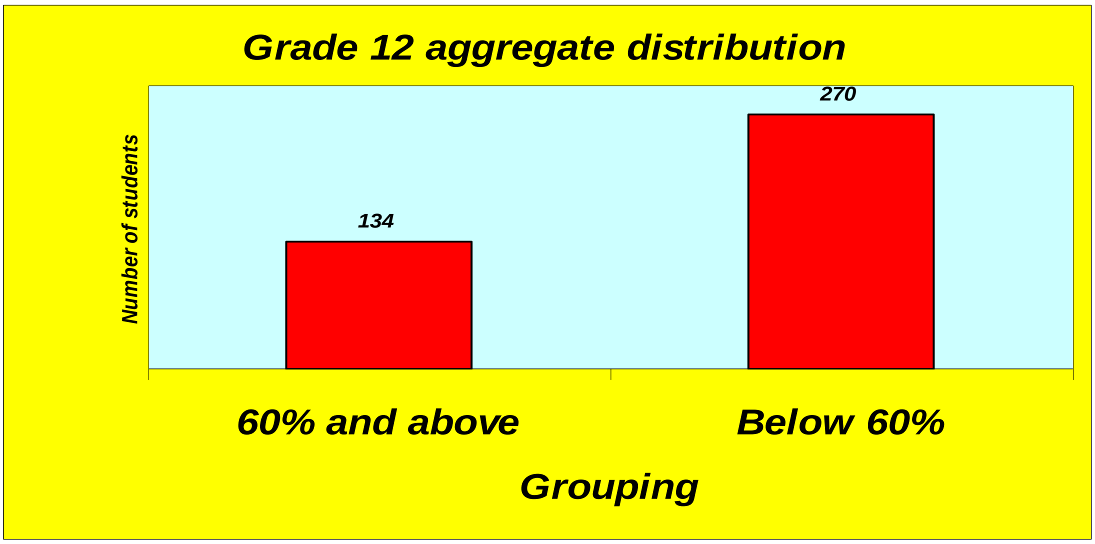
Figure 4.1



4.6 Predictor variables

In this section, the distribution of the predictors will be described (see Table 4.5). The predictor variable *african* had 230 African students (56.23%) and 179 non-African students (43.77%) (see Table A4 in Appendix A). There were 127 English home language speaking students (31.05%) and 282 non-English home language speaking students (68.95%) (see Table A5 in Appendix A). From Figure 4.2, it can be seen there were 134 students (33.17%) who had a Grade 12 aggregate of 60% and above, and 270 students (66.83%) who had a Grade 12 aggregate below 60% (note: 5 missing values) (see Table A13 in Appendix A). There were 112 students (27.79%) who had a common-scale Grade 12 mathematics symbol of 60% and above, and 291 students (72.21%) who had a Grade 12 mathematics symbol below 60% (note: 6 missing values) (see Table A18 in Appendix A). There were 238 students (58.19%) who entered UWC immediately after school, and 171 students (41.81%) who had a break of some years before they enrolled at UWC (see Table A20 in Appendix A). There were 213 students (52.08%) who enrolled at UWC for the first time after the 1994 democratic election, and 196 students (47.92%) who were enrolled for the first time before the 1994 democratic election (see Table A8 in Appendix A).

Figure 4.2



4.7 Throughput associations (refer to Table 4.6)

4.7.1 Gender

The rate of successful throughput, given it was a female, was 30/177 (16.95%) compared to the rate of successful throughput, given that it was a male, was 56/232 (24.14%). The throughput among gender did not differ at a 5% level of significance (Chi-square test, χ^2 = 3.1246; p-value=0.0771) (see Table A24 in Appendix A).

4.7.2 African

The probability of successful throughput, given an African, was 40/230 (17.39%), and the probability of successful throughput, given a non-African, was 46/179 (25.70%). Non-African students had a significantly higher throughput rate compared to African students (Chi-square test, χ^2 = 4.1831; p-value= 0.0408) (see Table A25 in Appendix A).

4.7.3 English

Only 36 of 127 English-speaking students (28.35%) were successful in completing their studies in the prescribed time of three years, compared to 50 of 282 non-English-speaking students (17.73%) who had completed their studies in the prescribed time of three years. The English-speaking students had a significantly higher throughput rate compared to the non-English students (Chi-square test, $\chi^2 = 5.9428$; p-value = 0.0148) (see Table A26 in Appendix A).

4.7.4 Aggregate

The probability of successful throughput, given the students' aggregate symbol was 60% and above, was 43/134 (32.09%) versus the probability of successful throughput, given the students' symbol was below 60%, was 43/270 (15.93%). The students with an aggregate symbol of 60% and above had a significantly higher throughput rate than those students who had an aggregate symbol below 60% (Chi-square test, $\chi^2 = 13.9637$; p-value= 0.0002) (see Table A27 in Appendix A).

4.7.5 Mathematics

In the 60%-and-above group for mathematics, the rate of successful throughput was 32/112 (28.57%) and the rate for the below-60% group was 53/291 (18.21%). The throughput rate of students whose symbols were 60% and above for mathematics was significantly higher than those who had below 60% for mathematics on a common scale (Chi-square test, $\chi^2 = 5.2138$; p-value= 0.0224) (see Table A28 in Appendix A).

4.7.6 Immediately

The rate of successful throughput of the student who entered UWC immediately after school was 44 out of 238 (18.49%) compared to the rate of successful throughput of those who did not enter UWC immediately after school, which was 42 out of 171 (24.56%). The break between school and university did not significantly influence the throughput rate (Chi-square test, χ^2 = 2.2108; p-value= 0.1370) (see Table A29 in Appendix A).

4.7.7 Year covariate

The probability of successful throughput of those who registered after the 1994 election was 61/213 (28.64%) compared to the probability before the 1994 election, which was 25/196 (12.76%). The throughput rate increased significantly after the 1994 elections (Chi-square test, χ^2 = 15.5076; p-value = < 0.0001) (see Table A30 in Appendix A).

Table 4.5 **Throughput versus predictor associations**

Predictor	Chi-square p-value	Conclusion
Year covariate	< 0.0001	Significant
Aggregate	0.0002	Significant
English	0.0148	Significant
Mathematics	0.0224	Significant
African	0.0408	Significant
Gender	0.0771	Non-significant
Immediately	0.1370	Non-significant

Note: The conclusion column is based upon a significance level of 5%.

Table 4.5 is a summary of the Chi-square p-values of all the predictors. As can be seen, the highest significant predictor with successful throughput was the Year covariate, followed by the Aggregate predictor. The predictors Gender and Immediately were not significantly related to successful throughput. The table below gives a global view of throughput cross tabulated with all the predictors.

Table 4.6 **Probability of throughput given predictor**

(refer to Tables A24 to Table A30 in Appendix A)

Predictor	Throughput	Non-throughput	Chi- square p-value
Total frequency (Percentage)	86 (21.03%)	323 (78.97%)	
Female = 177 (43.28%)	30 (16.95%)	147 (83.05%)	0.0771
Male = 232 (56.72%)	56 (24.14%)	176 (75.86%)	
African = 230 (56.23%)	40 (17.39%)	190 (82.61%)	0.0408 *
Non-African = 179 (43.77%)	46 (25.70%)	133 (74.30%)	
Cramer's V = - 0.1011			
English = 127 (31.05%)	36 (28.35%)	91 (71.65%)	0.0148 *
Non-English = 282 (68.95%)	50 (17.73%)	232 (82.27%)	
Cramer's V = 0.1205			
60% and above aggregate = 134 (33.17%)	43 (32.09%)	91 (67.91%)	0.0002 * *
Below 60% aggregate = 270 (66.83%)	43 (15.93%)	227 (84.07%)	
Cramer's V = 0.1859			
60% and above mathematics = 112 (27.79%)	32 (28.57%)	80 (71.43%)	0.0224 *
Below 60% mathematics = 291 (72.21%)	53 (18.21%)	238 (81.79%)	
Cramer's V = 0.1137			
Directly after school = 238 (58.19%)	44 (18.49%)	194 (81.51%)	0.1370
Not Directly after school = 171 (41.81%)	42 (24.56%)	129 (75.44%)	
Post-election = 213 (52.08%)	61 (28.64%)	152 (71.36%)	<0.0001 * *
Pre-election = 196 (47.92%)	25 (12.76%)	171 (87.24%)	
Cramer's V = 0.1947			

Note: 1. All the percentages in brackets are row percentages.
2. * Significant at a 5% level.
3. ** Significant at a 1% level.

4.8 Predictor associations

4.8.1 Gender

The Gender predictor variable was highly significant with the African predictor variable (Chi-square test, χ^2 = 10.9705; p-value=0.0009) (see Table A31 in Appendix A). From Table A31, it can be seen that there were more black female students.

A significant association exists between Gender and Aggregate (Chi-square test, χ^2 = 4.5884; p-value=0.0322) (see Table A33 in Appendix A). There were 143 males (62.45%) and 127 female (72.57%) who had an aggregate below 60%. There were 86 males (37.55%) and 48 females (27.43%) who had an aggregate of 60% and above.

Gender with the Mathematics predictor was highly significantly associated (Chi-square test, χ^2 = 11.1790; p-value=0.0008) (see Table A34 in Appendix A). In the category of 60% and above, there were more males (34.36%) than females (19.32%).

The gender difference between those who entered UWC immediately after school and those who did not was significant (Chi-square test, χ^2 = 9.2142; p-value=0.0024) (see Table A35 in Appendix A). More females (66.67%) than males (51.72%) enrolled at UWC directly after school.

4.8.2 African

A highly significant difference between the African and the non-African who speak the English language at home can be seen (Chi-square test, $\chi^2 = 223.605$; p-value= < 0.0001). (see Table A37 in Appendix A). There are only two non-Africans who speak English at home.

The Aggregate and African predictors are highly significantly associated with each other (Chi-square test, $\chi^2 = 94.2142$; p-value= < 0.0001) (see Table A38 in Appendix A). Most of the African students in the study attained an aggregate below 60% (196 out 404 students). There were 105 non-African students who had an aggregate of 60% and above compared to only 29 African students.

Mathematics was also significantly associated with the African predictor (Chi-square test, $\chi^2 = 45.5008$; p-value= < 0.0001) (see Table A39 in Appendix A). The majority of African students (194 out of 403 students) had a mathematics result on the common scale below 60%.

The difference between African and non-African students entering UWC immediately after school was highly significant (Chi-square test, $\chi^2 = 12.9939$; p-value= 0.0003) (see Table A40 in Appendix A). More African students (49.57%) than non-African students (31.84%) did not enter UWC directly after school. Sixty-eight percent of non-African and 50.43% African students entered UWC immediately after school.

4.8.3 English

The English predictor with Aggregate was highly significantly associated (Chi-square test, $\chi^2 = 40.2588$; p-value= < 0.0001) (see Table A42 in Appendix A). More non-English home language speaking students (213 out of 404 students) entered UWC with an aggregate below 60%.

The difference between English and non-English home language speaking students, when comparing their mathematics results on a common scale, was significant (Chi-square test, $\chi^2 = 8.2615$; p-value= 0.0040) (see Table A43 in Appendix A). More non-English home language speaking students (212 out of 403) had results below 60% for mathematics on the common scale.

4.8.4 Aggregate and mathematics

The Aggregate and Mathematics predictors were highly significantly related to each other (Chi-square test, $\chi^2 = 55.6667$; p-value = < 0.0001) (see Table A46 in Appendix A). More than fifty percent (222 out of 398) of the students in the study had an aggregate below 60% and were in the below-60% group for mathematics. In the below-60% aggregate group, there were five times more students who had below 60% for mathematics compared to the students who had 60% and above on the common scale for mathematics. In the 60%-and-above aggregate group, there was not much difference between those who had a mathematics result below 60% compared to those who had 60% and above.

4.8.5 Immediately and Year covariate

The association between the predictor Immediate and the Year covariate was significant (Chi-square test, $\chi^2 = 4.0702$; p-value = 0.0436) (see Table A51 in Appendix A). In the era after the 1994 elections, 134 students enrolled directly after school at UWC, compared to the 104 students who entered in the era before the 1994 elections. The enrolment of students not entering UWC directly after school, dropped from 92 students (in the era before 1994) to 79 students (in the era after 1994). Table 4.7 is a summary of all the predictor associations.

Table 4.7 **Predictor associations**
(refer to Table A31 to Table A51 in Appendix A)

Chi-square p-value	Gender	African	English	Aggregate	Mathematics	Immediately	Year covariate
Gender		0.0009 **	0.1333	0.0322 *	0.0008 **	0.0024 **	0.0780
African			<0.0001 **	<0.0001 **	<0.0001 **	0.0003 **	0.1010
English				<0.0001 **	0.0040 **	0.0487	0.5019
Aggregate					<0.0001 **	0.6095	0.4781
Mathematics						0.1994	0.1089
Immediately							0.0436 *
Year covariate							

Note: 1. * Significant at a 5% level.
2. ** Significant at a 1% level.

Table 4.7 is a summary of Chi-square p-values of the predictor associations. The predictor Gender was significantly associated with the predictors African, Aggregate, Mathematics and Immediately. The predictor African was significantly associated with the predictors English, Aggregate, Mathematics and Immediately. The predictor English was significantly associated with the predictors Aggregate, Mathematics and Immediately. The predictor Aggregate was highly significantly associated with Mathematics. The predictor Immediately and the Year covariate were highly significantly associated with each other.

4.9 Logistic regressions of throughput - single predictors

In the next section, a logistic regression model for each predictor variable was built. Each model was evaluated by the percentage observations correctly predicted by the model. All models were evaluated at a probability threshold of 0.22 for comparison purposes.

4.9.1 Gender model (refer to Table 4.8 and Table B1 in Appendix B)

The logistic regression model for throughput using Gender as a predictor was:

$$\ln \text{ [odds of throughput given Gender]} = \ln [\frac{p}{1-p}]$$

$$= - 1.3671 - 0.2220 * gender$$

Taking the exponential both sides in the above equation, we get the odds:

$$\frac{p}{1-p} = e^{(- 1.3671 - 0.2220 * gender)} = e^{(- 1.3671)} * e^{(- 0.2220*gender)}.$$

The odds of successful throughput, given it was a female (*gender* = 1), was

$e^{(- 1.3671)} * e^{(- 0.2220*1)} =0.2548 * 0.8009 = 0.204$ (i.e. 30/147 from Table 4.8),

and the odds of successful throughput, given that it was male (*gender* = -1), was

$e^{(- 1.3671)} * e^{(- 0.2220*-1)} =0.2548 * 1.2486 = 0.318$ (i.e. 56 / 176 from Table 4.8).

Comparing the above two odds, we see that the odds of successful throughput, given a male, was higher.

Making p the subject of the formula, we get the estimated probability $p = (1+ e^{-(- 1.3671 - 0.2220 * gender)})^{-1}$. Thus, the estimated probability of successful throughput, given it was a female (*gender* = 1), was

$(1 + e^{-(- 1.3671 - 0.2220 * 1)})^{-1} = (1 + e^{-(-1.5891)})^{-1} = (1 + 4.8993)^{-1} = (5.8993)^{-1} = 0.1695,$

and the estimated probability of successful throughput, given it was a male (*gender* = -1), was

$(1 + e^{-(- 1.3671 - 0.2220 *-1)})^{-1} = (1 + e^{-(-1.1451)})^{-1} = (1 + 3.1426)^{-1} = (4.1428)^{-1} = 0.2414$

The above two estimated probabilities correspond to the row percentages in Table 4.6. Comparing the above two estimated probabilities, we see the estimated probability of successful throughput for a male was higher.

The Gender model correctly predicted 49.6% of the observations at a probability level of 0.22. For a probability level of 0.16, the model correctly predicted only 21% of the observations.

4.9.2 African model (refer to Table 4.8 and Table B2 in Appendix B)

The logistic regression model for throughput using African as a predictor was:

$$\ln \text{[odds of throughput given African]} = \ln \left[\frac{p}{1-p}\right]$$

$$= - 1.0616 - 0.4964 * \textit{african}.$$

Taking the exponential both sides in the above equation we get the odds:

$$\frac{p}{1-p} = e^{(- 1.0616 - 0.4964 * \textit{african})} = e^{(- 1.0616)} * e^{(- 0.4964*\textit{african})}.$$

The odds of successful throughput, given it was an African (*african* = 1), was $e^{(- 1.0616)} * e^{(- 0.4964*1)} = 0.3459 * 0.6087 = 0.211$ (i.e. 40/190 from Table 4.8) and the odds of successful throughput, given that it was non-African (*african* = 0), was $e^{(- 1.0616)} * e^{(- 0.4964*0)} = 0.3459$ (i.e. 46 / 133 from Table 4.8).

Comparing the above two odds, we see that the odds of successful throughput, given a non-African, was higher.

Making p the subject of the formula, we get the estimated probability

$p = (1+ e^{-(- 1.0616 - 0.4964 * african)})^{-1}$.

Thus, the estimated probability of successful throughput, given it was an African ($african = 1$), was

$(1+ e^{-(- 1.0616 - 0.4964 * 1)})^{-1} = (1 + e^{-(-1.5584)})^{-1} = (1 +4.7512)^{-1} = (5.7512)^{-1}$

$= 0.1739$

and the estimated probability of successful throughput, given it was a non-African ($african = 0$), was

$(1+ e^{-(- 1.0616 - 0.4964 * 0)})^{-1} = (1 + e^{-(-1.0617)})^{-1} = (1 + 2.8913)^{-1} = (3.8913)^{-1}$

$= 0.2570$.

The above two estimated probabilities correspond to the row percentages in Table 4.6. Comparing the above two estimated probabilities, we see the estimated probability of successful throughput for a non-African student was higher.

The African model correctly predicted 57.7% of the observations at a probability level of 0.22. For a probability level of 0.16, the model correctly predicted only 21% of the observations.

4.9.3 English model (refer to Table 4.8 and Table B3 in Appendix B)

The logistic regression model for throughput using English as a predictor was:

ln [odds of throughput given English] = ln [$\frac{p}{1-p}$]

$$= - 1.5347 + 0.6074 * \mathit{english}.$$

Taking the exponential both sides in the above equation, we get the odds:

$$\frac{p}{1-p} = e^{(- 1.5347 + 0.6074 * \mathit{english})} = e^{(- 1.5347)} * e^{(0.6074*\mathit{english})}.$$

The odds of successful throughput, given it was an English (*english*=1), was

$e^{(- 1.5347)} * e^{(0.6074*1)} =0.2155 * 1.8357 = 0.396$ (i.e. 36/91 from Table 4.8),

and the odds of successful throughput, given that it was a non-English (*english*=0), was $e^{(- 1.5347)} * e^{(0.6074*1)} =0.2155$ (i.e. 50/232 from Table 4.8). Comparing the above two odds, we see that the odds of successful throughput for an English speaking student was higher.

Making p the subject of the formula, we get the estimated probability

$$p = (1+ e^{-(- 1.5347 + 0.6074 * \mathit{english})})^{-1}.$$

Thus, the estimated probability of successful throughput, given it was an English (*english*=1), was

$(1 + e^{-(- 1.5347 + 0.6074 * 1)})^{-1} = (1 + e^{-(-0.9273)})^{-1} = (1 + 2.5277)^{-1} = (3.5277)^{-1}$

$= 0.2835$,

and the estimated probability of successful throughput, given that it was a non-English (*english*=0), was

$(1 + e^{-(- 1.5347 + 0.6074 * 0)})^{-1} = (1 + e^{-(-1.5347)})^{-1} = (1 + 4.64)^{-1} = (5.64)^{-1} = 0.1773.$

The above two estimated probabilities correspond to the row percentages in Table 4.6. Comparing the above two estimated probabilities, we see the estimated probability of successful throughput for an English speaking student was higher.

The English model correctly predicted 65.5% of the observations at a probability level of 0.22. For a probability level of 0.16, the model correctly predicted only 21% of the observations.

4.9.4 Aggregate model (refer to Table 4.8 and Table B4 in Appendix B)

The logistic regression model for throughput using Aggregate as a predictor was:

$$\ln [\text{odds of throughput given Aggregate}] = \ln \left[\frac{p}{1-p}\right]$$

$$= - 1.6637 + 0.9141 * agg\_grp$$

Taking the exponential both sides in the above equation we get the odds:

$$\frac{p}{1-p} = e^{(- 1.6637 + 0.9141 * agg\_grp)} = e^{(- 1.6637)} * e^{(0.9141 * agg\_grp)}$$

The odds of successful throughput, given an aggregate of 60% and above (*agg_grp* = 1), was $e^{(- 1.6637)} * e^{(0.9141 * 1)}$ =0.1894 * 2.4945 = 0.473 (i.e. 43/91 from Table 4.8), and the odds of successful throughput, given an aggregate below 60% (*agg_grp* = 0), was $e^{(- 1.6637)} * e^{(0.9141 * 0)}$ =0.1894 (i.e. 43 / 227 from Table 4.8).

Comparing the above two odds, we see that the odds of successful throughput, given that the Aggregate was 60% and above, was higher.

Making p the subject of the formula, we get the estimated probability

$p = (1+ \mathrm{e}^{-(- 1.6637 + 0.9141 * agg\_grp)})^{-1}$.

Thus, the estimated probability of successful throughput, given an aggregate of 60% and above (*agg_grp* = 1), was

$(1 + \mathrm{e}^{-(- 1.6637 + 0.9141 *1)})^{-1} = (1 + \mathrm{e}^{-(-0.7497)})^{-1} = (1 + 2.1164)^{-1} = (3.1164)^{-1} = 0.3209$,

and the estimated probability of successful throughput, given an aggregate below 60% (*agg_grp* = 0), was

$(1 + \mathrm{e}^{-(- 1.6637 + 0.9141 *0)})^{-1} = (1 + \mathrm{e}^{-(-1.6637)})^{-1} = (1 + 5.2788)^{-1} = (6.2788)^{-1}$

$= 0.1593$.

The above two estimated probabilities correspond to the row percentages in Table 4.6. Comparing the above two estimated probabilities, we observed that the estimated probability of successful throughput for an aggregate of 60% and above was higher.

The Aggregate model correctly predicted 66.8% of the observations at a probability level of 0.22. For a probability level of 0.14, the model correctly predicted only 21.3% of the observations.

4.9.5 Mathematics model (refer to Table 4.8 and Table B5 in Appendix B)

The logistic regression model for throughput using Mathematics as a predictor was:

$$\ln [\text{odds of throughput given Mathematics}] = \ln [\frac{p}{1-p}]$$

$$= - 1.5020 + 0.5857 *math\_grp.$$

Taking the exponential both sides in the above equation, we get the odds:

$$\frac{p}{1-p} = \mathrm{e}^{(- 1.5020 + 0.5857 *math\_grp)} = \mathrm{e}^{(- 1.5020)} * \mathrm{e}^{(0.5857 *math\_grp)}.$$

The odds of successful throughput, given mathematics was 60% and above, (*math_grp* = 1) was $e^{(-\ 1.5020)} * e^{\ (0.5857\ *1)}$ =0.2227 * 1.7962 = 0.4 (i.e. 32/80 from Table 4.8), and the odds of successful throughput, given mathematics was below 60% (*math_grp* = 0), was $e^{(-\ 1.5020)} * e^{\ (0.5857\ *0)}$ =0.2227 (i.e. 53 / 238 from Table 4.8). Comparing the above two odds, we see that the odds of successful throughput, given mathematics was 60% and above, was higher.

Making p the subject of the formula, we get the estimated probability

$p = (1+ e^{-(-\ 1.5020\ +\ 0.5857\ *math\_grp)})^{-1}$.

Thus, the estimated probability of successful throughput, given mathematics was 60% and above (*math_grp* = 1), was

$(1 + e^{-(-\ 1.5020\ +\ 0.5857\ *1)})^{-1}$

$= (1 + e^{-(-0.9163)})^{-1} = (1 + 2.5)^{-1} = (3.5)^{-1} = 0.2857$,

and the estimated probability of successful throughput, given mathematics was below 60% (*math_grp* = 0), was

$(1 + e^{-(-\ 1.5020\ +\ 0.5857\ *0)})^{-1}$

$= (1 + e^{-(-1.5020)})^{-1} = (1 + 4.4907)^{-1} = (5.4907)^{-1} = 0.1821$

The above two estimated probabilities correspond to the row percentages in Table 4.6. Comparing the above two estimated probabilities, we observed that the estimated probability of successful throughput for mathematics at 60% and above was higher.

The Mathematics model correctly predicted 67% of the observations at a probability level of 0.22. For a probability level of 0.16, the model correctly predicted only 21.1% of the observations.

4.9.6 Immediately model (refer to Table 4.8 and Table B6 in Appendix B)

The logistic regression model for throughput using Immediately as a predictor was:

$$\ln [\text{odds of throughput given Immediately}] = \ln [\frac{p}{1-p}]$$

$$= - 1.1221 - 0.3615 * \textit{immediate}.$$

Taking the exponential both sides in the above equation, we get the odds:

$$\frac{p}{1-p} = e^{(- 1.1221 - 0.3615 * \textit{immediate})} = e^{(-1.1221)} * e^{(- 0.3615 * \textit{immediate})}.$$

The odds of successful throughput given entering UWC directly after school (*immediate* = 1) was $e^{(- 1.1221)} * e^{(- 0.3615 * 1)}$ =0.3256 * 0.6966 = 0.227 (i.e. 44/194 from Table 4.8), and the odds of successful throughput, given not entering UWC directly after school (*immediate* = 0), was $e^{(- 1.1221)} * e^{(- 0.3615 * 0)}$ =0.3256 (i.e. 42 / 129 from Table 4.8). Comparing the above two odds, we see that the odds of successful throughput, given not entering UWC directly after school, was higher.

Making p the subject of the formula, we get the estimated probability

$$p = (1+ e^{-(- 1.1221 - 0.3615 * \textit{immediate})})^{-1}$$

Thus, the estimated probability of successful throughput,

given entering UWC directly after school (*immediate* = 1), was

$$(1 + e^{-(- 1.1221 - 0.3615 * 1)})^{-1} = (1 + e^{-(-1.4837)})^{-1} = (1 + 4.4092)^{-1} = (5.4092)^{-1}$$

$$= 0.1849,$$

and the estimated probability of successful throughput, given not entering UWC directly after school (*immediate* = 0), was

$(1 + e^{-(- 1.1221 – 0.3615 * 0)})^{-1} = (1 + e^{-(-1.1221)})^{-1} = (1 + 3.0713)^{-1} = (4.0713)^{-1}$

$= 0.2456$

The above two estimated probabilities correspond to the row percentages in Table 4.6. Comparing the above two estimated probabilities, we see the estimated probability of successful throughput for not entering UWC directly after school was higher.

The Immediately model correctly predicted 57.7% of the observations at a probability level of 0.22. For a probability level of 0.18, the model correctly predicted only 21% of the observations.

4.9.7 Year covariate model (refer to Table 4.8 and Table B7 in Appendix B)

The logistic regression model for throughput using the Year covariate as a predictor was: ln [odds of throughput given Year covariate] = ln [$\frac{p}{1-p}$]

$= - 1.9228 + 1.0098 * year\_cov$

Taking the exponential both sides in the above equation, we get the odds:

$$\frac{p}{1-p} = e^{(- 1.9228 + 1.0098 * year\_cov)} = e^{(- 1.9228)} * e^{(1.0098 * year\_cov)}.$$

The odds of successful throughput for enrolments after the 1994 election (*year_cov* =1) was

$e^{(- 1.9228)} * e^{(1.0098 * 1)} = 0.1462 * 2.7451 = 0.401$ (i.e. 61/152 from Table 4.8), and the odds of successful throughput for enrolments before 1994 election (*year_cov* =0) was

$e^{(-1.9228)} * e^{(1.0098 * 0)} = 0.1462$ (i.e. 25 / 171 from Table 4.8). Comparing the above two odds, we see that the odds of successful throughput, given post-election, was higher. Making p the subject of the formula, we get the estimated probability $p = (1+ e^{-(-1.9228 + 1.0098 * year\_cov)})^{-1}$

Thus, the estimated probability of successful throughput for enrolments after 1994 election ($year\_cov$ =1) was $(1 + e^{-(-1.9228 + 1.0098 * 1)})^{-1} = (1 + e^{-(-0.9130)})^{-1}$

$= (1 + 2.4918)^{-1} = (3.4918)^{-1} = 0.2864$,

and the estimated probability of successful throughput for enrolments before the 1994 election ($year\_cov$ =0) was

$(1 + e^{-(-1.9228 + 1.0098 * 0)})^{-1} = (1 + e^{-(-1.9228)})^{-1} = (1 + 6.8401)^{-1} = (7.8401)^{-1} = 0.1275$

The above two estimated probabilities correspond to the row percentages in Table 4.6. Comparing the above two estimated probabilities, we observed that the estimated probability of successful throughput for enrolments after the 1994 election was higher.

The Year covariate model correctly predicted 56.7% of the observations at a probability level of 0.22. For a probability level of 0.12, the model correctly predicted only 21% of the observations. Table 4.8 for gives a summary of all the single predictor variables.

Table 4.8 **Throughput logistic regression models for the seven predictors**

(refer to Table B1 to Table B7 in Appendix B)

Predictor (value used to calculate ln odds from model)	Throughput (Frequencies)	Non-throughput (Frequencies)	Odds ratio (OR)	Logistic regression model
				Model = - 1.3671 – 0.2220 * _gender_
Female (= 1)	30	147	0.641	Model(_gender_=1) = - 1.5892= ln (30/147)
Male (= - 1)	56	176		Model(_gender_= -1) = - 1.1451 = ln 56/176)
	Odds=30/56	Odds=147/176		
				Model= - 1.0616 – 0.4964 * _african_
African (= 1)	40	190	0.609	Model(_african_=1) =- 1.5584 = ln (40/190)
Non-African (= 0)	46	133		Model(_african_=0) = - 1.0617 = ln (46/133)
	Odds=40/46	Odds=190/133		
				Model= - 1.5347 + 0.6074 * _english_
English (= 1)	36	91	1.836	Model(_english_=1) = - 0.9273 = ln (36/91)
Non-English (= 0)	50	232		Model(_english_=0) = - 1.5347 = ln (50/232)
	Odds=36/50	Odds=91/232		
				Model= - 1.6637 + 0.9141 * _agg_grp_
60% and above aggregate (= 1)	43	91	2.495	Model(_agg_grp_ =1) = - 0.7497 = ln (43/91)
Below 60% aggregate (= 0)	43	227		Model(_agg_grp_ =0) = - 1.6637 = ln (43/227)
	Odds=43/43	Odds=91/227		
				Model= - 1.5020 + 0.5857 *math_grp
60% and above mathematics (= 1)	32	80	1.796	Model(math_grp=1) = - 0.9163 = ln (32/80)
Below 60% mathematics (= 0)	53	238		Model(math_grp=0) = - 1.5020 = ln (53/238)
	Odds=32/53	Odds=80/238		
				Model= - 1.1221 – 0.3615 * immediate
Directly after school (= 1)	44	194	0.697	Model(immediate=1) = - 1.4837 = ln (44/194)
Not Directly after school (= 0)	42	129		Model(immediate=0) = - 1.1221 = ln (42/129)
	Odds=44/42	Odds=194/129		
				Model= - 1.9228 + 1.0098 * year_cov
Post-election (= 1)	61	152	2.745	Model(year_cov=1) = - 0.9130 = ln (61/152)
Pre-election (= 0)	25	171		Model(year_cov=0) = - 1.9228 = ln (25/171)
	Odds=61/25	Odds=152/171		

Note:
1. Males are equal to -1 because the variable *gender* is a string variable.
2. Odds Ratio (OR) is Odds of throughput divided by Odds of non-throughput.

After having evaluated the individual predictor models, the next step was to use either all or some of the predictors in one model. Three models were evaluated: the full model with all predictor variables, the full model without the Year covariate and the stepwise selection model.

4.10 Logistic regression of throughput - many predictors

4.10.1 Full logistic regression model

ln [odds of throughput given all the predictors] = ln $[\frac{p}{1-p}]$

$= -2.5021 - 0.1942 * gender + 0.2054 * african + 0.5922 * english +$

$0.68869 * agg\_grp + 0.4032 * math\_grp - 0.4343 * immediate + 1.1449 * year\_cov$

From the p-values of the parameters, it was seen that only the intercept

(< 0.0001), the aggregate (0.0256) and the year_cov (< 0.0001) were significant in the full model (see Table C1 Appendix C).

The full model correctly predicted 68.3% of the observations at a probability level of 0.22. For a probability level of 0.04, the model correctly predicted only 21.4% of the observations (see Table C1 in Appendix C). In the next model, the Year covariate was removed to evaluate the effect it had on the full model.

4.10.2 Full logistic regression model without the year covariate

ln [odds of throughput given all predictors without the Year covariate] = ln $[\frac{p}{1-p}]$

$$= -1.9869 - 0.186 * \mathit{gender} + 0.3801 * \mathit{african} + 0.6022 * \mathit{english} +$$

$$0.8117 * \mathit{agg\_grp} + 0.2545 * \mathit{math\_grp} - 0.2899 * \mathit{immediate}.$$

From the p-values of the parameters, it was seen that only the intercept (< 0.0001) and Aggregate (0.0071) were significant in the model (see Table D1 Appendix D).

The model correctly predicted 64.1% of the observations at a probability level of 0.22. For a probability level of 0.06, the model correctly predicted only 21.4% of the observations (see Table D1 in Appendix D). In the next model, the stepwise selection method was applied to select the best variables for the model.

4.10.3 Stepwise logistic regression model

ln [odds of throughput given aggregate and year_cov predictors] = ln $[\frac{p}{1-p}]$

$$= -2.2755 + 0.9374 * \mathit{agg\_grp} + 0.9964 * \mathit{year\_cov}$$

The model correctly predicted 76.1% of the observations at a probability level of 0.22. For a probability level of 0.08, the model correctly predicted only 21.4% of the observations (see Table E1 in Appendix E).

Table 4.9 **Evaluations of predictive abilities of models**

Model	% Correctly predicted
Stepwise selection model (with only Year covariate and Aggregate)	76.1
Full model	68.3
Mathematics	67
Aggregate	66.8
Year covariate	56.7
English	65.5
Full model without Year covariate	64.1
African	57.7
Immediately	57.7
Gender	49.6

Note: All models evaluated at probability threshold of 0.22

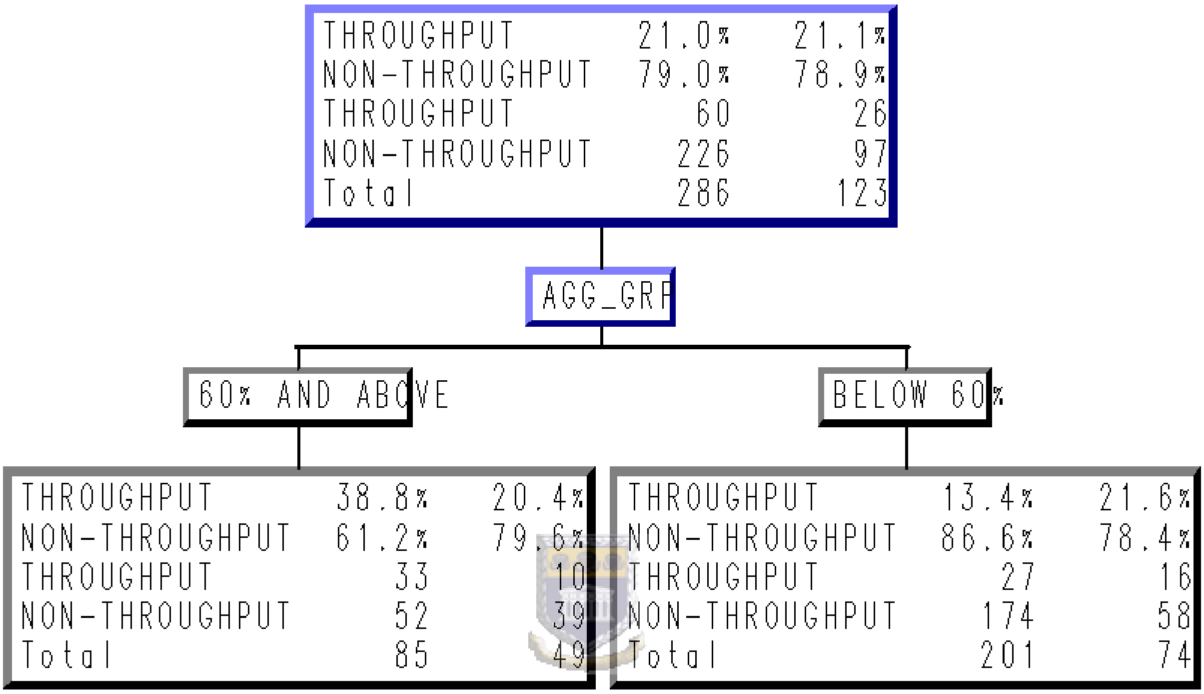
Table 4.9 gives a summary of all the models. The model with only the Year covariate and the Aggregate was the best model to predict throughput. In the following section, the decision tree analysis technique was applied as an alternative way of determining which predictors to include in the model to predict successful throughput.

4.11 Decision Tree Analysis

4.11.1 Aggregate Decision Tree model

The throughput of a student who had an aggregate of 60% and above was 38.8% for the training model and 20.4% for the validation data set, compared to the throughput of a student who had an aggregate of below 60%, which was 13.4% for training data and 21.6% for the validated data set. The validations' modelling throughput for the predictor Aggregate was similar for both validation datasets. The huge difference between the validation and training data sets indicates the instability of the model. The reason for the instability was too few data observations. However, it is interesting to note that the Aggregate predictor was selected although the model is unstable and no statistical interpretation can be inferred from it (see Figure 4.3).

Figure 4.3 **Decision tree aggregate model**



4.12 Conclusion

The decision tree analysis and the stepwise logistic regression both selected the Aggregate predictor as a factor that affected successful throughput. In the following chapter, the findings of Chapter 4 will be discussed and interpreted.

Chapter 5

Discussion and Recommendation

5.1 Discussions of findings

In this thesis, an investigation into how certain factors influence throughput was undertaken. Throughput is the number of students who complete their university studies in the prescribed time. This thesis does not explore the financial and social influences on throughput. The thesis looks at factors like gender, race, home language, Grade 12 aggregate, Grade 12 mathematics, entering UWC immediately after school and the political environment prior and after 1994.

5.1.1 Gender factor

Gender does not play a significant role when investigating throughput. In the study, a significant increase in the number of African female students who enrolled for Statistics was observed.

5.1.2 Race factor

Race is a factor that influences throughput. More non-African students than African students are finishing their studies in the prescribed time.

5.1.3 Home language factor

Home language influences throughput. More non-English students are not finishing their studies in the prescribed time. This shows that if the medium of instruction is different from the students' home language, it can play a role in influencing how long students take to finish their studies.

5.1.4 Grade 12 aggregate factor

The Grade 12 aggregate is the most significant factor influencing throughput. This finding is also confirmed in a study conducted by Lourens and Smit (2003). The aggregate is a factor that should be considered when selecting students, as a higher aggregate relates to better throughput.

5.1. 5 Grade 12 mathematics factor

Mathematics should be made a prerequisite for subjects where calculation and abstract thinking is necessary. The issue is: at what level should students have passed mathematics to be selected for a science subject? This also has enrolment implications in that if the mathematics prerequisite is set too high, the student enrolment in science will drop significantly. If the mathematics prerequisite is set too low, more students with low grades will apply to study in the Science Faculty. Students with low grades in Grade 12 mathematics will take longer to grasp concepts, which will influence the time they take to finish their studies.

5.1.6 Entering UWC immediately after school factor

The impact on throughput of students in the study enrolling at UWC directly after Grade 12 was also investigated. It was found that a short break between school completion and university enrolment does not influence the throughput. In fact, the throughput was better for students who did not enter university immediately after school. The reason could be that older students are more serious about their studies.

5.1.7 Political environment (year covariate) factor

The political environment is one factor which is not often considered in academic studies. It was found that the political change of 1994 did have an impact on throughput. The throughput rate doubled after the 1994 election. However, the intake of students who did at least one semester of third-year Statistics only increased by 17 students after the 1994 election until 2001. The throughput rate doubled most probably because students saw a post-Grade 12 qualification as a means to a brighter future in South Africa.

A logistic regression model was built using the abovementioned factors. It was found that the Grade 12 aggregate and the political environment were the most significant variables to distinguish between students completing their studies in the prescribed time and students taking more that three years. The students in this study were categorized into two groups: those with a Grade 12 aggregate of 60% and above, and those with a Grade 12 aggregate below 60%. The students who had an aggregate of 60% and above had a significantly improved throughput rate compared to those with an aggregate below 60%. The goal is to enroll more students with aggregates higher than 60% so that the throughput rate can be increased.

5.2 Relevance of study

In the study, a model was developed that took into account certain factors that influence university throughput. The model and factors could assist with university policies regarding student selection. Furthermore, minimizing study years would result in students entering the workforce quicker and becoming economically active at an earlier stage. Students could also start sooner with postgraduate studies after successful completion of undergraduate studies.

5.3 Recommendation

As aggregate is an important measure of success at university, it should possibly be retained in the Further Education Training (FET) school system to be implemented in 2006. The new FET system measures a student’s performance per subject on a scale of one to five, without an aggregate. Universities should be proactive in formulating new selection criteria systems. A new selection process should be put in place to determine if learners are capable of studying at higher education institutions (HEIs). The entrance requirement for mathematics should also be more strictly enforced to select the best students. It sounds unfair to those students who obtained low grades due to the specific school environment, but higher education institutions cannot repeat the work that the school system should have covered. The responsibility rests on the school teachers and the learners to ensure that learners who want to enroll at university be informed of their choices and how to achieve their goals.

5.4 Limitations of study

The sample was not representative of all the students at UWC as the study was limited to students majoring in Statistics. Historical data was used which was limited to what was on the UWC database. No data were available on students' socio-economic factors, such as financial constraints, mode of transport to university, adequate place to study, and so forth.

5.5 Further research

The study could be replicated to include all students at UWC. Future research could possibly investigate how financial, social and academic factors influence throughput. An interesting question to ask would be: Is South Africa producing enough graduates to meet the labour market demands in terms of specific skills?

In other words, are the targets set by the Department of Education met in terms of graduate output for the new century?

Bibliography

Agar D.L. (1991). *Academic support and academic progress: English-Second-Language speakers in a Faculty of Commerce at a university in South Africa*. Journal of Negro Education Vol. 60(1) : 62 – 77.

Asmal K. (1999). *Call to action: nine priorities of the Minister of Education*. Pretoria, Department of Education.

Badenhorst F.D., Foster D.H. and Lea S.J. (1990). *Factors affecting academic performance in the first-year psychology at the University of Cape Town*. South African Journal of Higher Education (SAJHE) Vol. 4(1) : 39 – 45.

Bargate K. (1999). *Mathematics as an indicator of success in first year Accounting programmes at Technicon Natal*. South African Journal of Higher Education (SAJHE) Vol. 13(1) : 139 – 143.

Bitzer E. and Troskie-De Bruin C. (2004). *The effect of factors related to prior schooling on student persistence in higher education*. South African Journal of Education Vol. 24(2) : 119 – 125.

Botha A.E., McCrindle C.M.E. and Owen J.H. (2003). *Mathematics at matriculation level as an indicator of success or failure in the 1st year of the Veterinary Nursing Diploma at the Faculty of Veterinary Science, University of Pretoria*. Journal of the South African Veterinary Association Vol. 74(4) : 132 – 134.

Cairncross A. (1999). *Progression of students through the Human Ecology Programme (1994 - 1999)*. Department of Human Ecology and Dietetics, UWC. Bellville.

Dawes P., Yeld N. and Smith M.J. (1999). *Access, selection and admission to higher education: maximizing the use of the school-leaving examination*. South African Journal of Higher Education (SAJHE) Vol. 13(3) : 97 – 104.

Department of Education (2001a). *National Plan for Higher Education (NPHE)*. Ministry of Education, Pretoria, February 2001.

Department of Education (2001b). *Funding of Public Higher Education: A New Framework.* Ministry of Education, Pretoria, March 2001.

Fraser W.J. and Killen R. (2003). *Factors influencing academic success or failure of first-year and senior university students: do education students and lectures perceive things differently?* South African Journal of Higher Education (SAJHE) Vol. 23(4) : 254 – 260.

Howie S.J. (2003*). Language and other background factors affecting pupils' performance in mathematics in South Africa.* African Journal of Research in SMT Education Vol. 7 : 1 – 20.

Lourens A. and Smit I.P.J. (2003). *Retention: predicting first-year success*. South African Journal of Higher Education (SAJHE) Vol. 17(2) : 169 – 176.

Mitchell F. (1988). *High school accounting and students' performance in the first level university accounting course: a UK study*. Journal of Accounting Education Vol. 6 : 279 – 291.

Nair P.A.P. (2002). *A theoretical framework for an access programme encompassing further education training: remedy for educational wastage*. South African Journal of Higher Education (SAJHE) Vol. 16 (2) : 94 – 103.

O' Connell B. (2004). *Recapitalisation*. Internal discussion at UWC by Rector, August 2004.

Science Faculty (2004). *UWC Faculty of Science, Undergraduate year book*. UWC.

Skuy M., Zolessi S., Mentis M., Fridjhon P. and Cockcroft K. (1996). *Selection of advantaged and disadvantaged South African students for university admission*. South African Journal of Higher Education (SAJHE) Vol. 10(1) : 110 – 118.

Shochet I. (1985). *University Admission: Can we measure potential?* Paper presented at Academic Support Programme Annual Conference, University of the Witwatersrand.

Stoker D.J., Engelbrecht C.S., Crowther N.A.S., Du Toit S.H.C. and Herbst A. (1986). *Investigation into differential entrance requirement for tertiary educational institutions: an abridged version of Report Ws-31*. Report Number WS-32. Pretoria: Human Science Research Council.

Taylor B. and Harris G. (2002). *The efficiency of South African universities: a study based on the analytical technique.* South African Journal of Higher Education (SAJHE) Vol. 16(2) : 183 – 192.

The Mail and Guardian (1999). *Tertiary state subsidies to change*. 24 November 1999.

Van Rooyen E. (2001). *Die voorspelling van die akademiese prestasie van studente in'n universiteitsoorbruggings- program*. South African Journal of Higher Education (SAJHE) Vol. 15(1) : 180 – 189.

APPENDIX A

A1 Frequencies of variables

Table A1 GENDER

GENDER	Frequency	Percent	Cumulative Frequency	Cumulative Percent
FEMALE	177	43.28	177	43.28
MALE	232	56.72	409	100.00

Table A2 RACE

RACE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
AFRICAN	230	56.23	230	56.23
COLOURED	156	38.14	386	94.38
INDIAN	22	5.38	408	99.76
WHITE	1	0.24	409	100.00

Table A3 HOMELANG

HOMELANG	Frequency	Percent	Cumulative Frequency	Cumulative Percent
AFRIKAANS	51	12.47	51	12.47
ENG & AFR	35	8.56	86	21.03
ENGLISH	92	22.49	178	43.52
NORTH SOTHO	12	2.93	190	46.45
OTHER	8	1.96	198	48.41
SOUTH SOTHO	17	4.16	215	52.57
SWATI	5	1.22	220	53.79
TSONGA	6	1.47	226	55.26
TSWANA	30	7.33	256	62.59
VENDA	8	1.96	264	64.55
XHOSA	133	32.52	397	97.07
ZULU	12	2.93	409	100.00

Table A4 AFRICAN

AFRICAN	Frequency	Percent	Cumulative Frequency	Cumulative Percent
NON-AFRICAN	179	43.77	179	43.77
AFRICAN	230	56.23	409	100.00

Table A5 ENLGISH

ENGLISH	Frequency	Percent	Cumulative Frequency	Cumulative Percent
NON-ENGLISH	282	68.95	282	68.95
ENGLISH	127	31.05	409	100.00

Table A6 ENDYEAR

ENDYEAR	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1989	2	0.49	2	0.49
1990	8	1.96	10	2.44
1991	2	0.49	12	2.93
1992	9	2.20	21	5.13
1993	12	2.93	33	8.07
1994	17	4.16	50	12.22
1995	19	4.65	69	16.87
1996	40	9.78	109	26.65
1997	48	11.74	157	38.39
1998	43	10.51	200	48.90
1999	48	11.74	248	60.64
2000	46	11.25	294	71.88
2001	32	7.82	326	79.71
2002	39	9.54	365	89.24
2003	28	6.85	393	96.09
2004	16	3.91	409	100.00

Table A7

begyear	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1975	1	0.24	1	0.24
1977	1	0.24	2	0.49
1982	1	0.24	3	0.73
1983	1	0.24	4	0.98
1984	4	0.98	8	1.96
1985	4	0.98	12	2.93
1986	1	0.24	13	3.18
1987	7	1.71	20	4.89
1988	7	1.71	27	6.60
1989	8	1.96	35	8.56
1990	25	6.11	60	14.67
1991	19	4.65	79	19.32
1992	29	7.09	108	26.41
1993	41	10.02	149	36.43
1994	47	11.49	196	47.92
1995	42	10.27	238	58.19
1996	39	9.54	277	67.73
1997	49	11.98	326	79.71
1998	27	6.60	353	86.31
1999	16	3.91	369	90.22
2000	29	7.09	398	97.31
2001	11	2.69	409	100.00

Table A8

year_cov	Frequency	Percent	Cumulative Frequency	Cumulative Percent
PRE-ELECTION YEARS	196	47.92	196	47.92
POST-ELECTION YEARS	213	52.08	409	100.00

Table A9

compl	Frequency	Percent	Cumulative Frequency	Cumulative Percent
3	87	21.27	87	21.27
4	122	29.83	209	51.10
5	100	24.45	309	75.55
6	42	10.27	351	85.82
7	20	4.89	371	90.71
8	14	3.42	385	94.13
9	8	1.96	393	96.09
10	6	1.47	399	97.56
11	3	0.73	402	98.29
12	2	0.49	404	98.78
14	1	0.24	405	99.02
17	2	0.49	407	99.51
18	1	0.24	408	99.76
26	1	0.24	409	100.00

The UNIVARIATE Procedure
Variable: compl

Table A10

Basic Statistical Measures

Location		Variability	
Mean	4.973105	Std Deviation	2.31190
Median	4.000000	Variance	5.34486
Mode	4.000000	Range	23.00000
		Interquartile Range	1.00000

Table A11

through	Frequency	Percent	Cumulative Frequency	Cumulative Percent
NON-THROUGHPUT	323	78.97	323	78.97
THROUGHPUT	86	21.03	409	100.00

Note: Student 2005379 studied three years but did not complete his studies. He repeated his second year and was refused re-entry. Thus 87 - 1 = 86 students who completed their studies.

Table A12

AGG_SYM

AGG_SYM	Frequency	Percent	Cumulative Frequency	Cumulative Percent
A	2	0.50	2	0.50
B	26	6.44	28	6.93
C	106	26.24	134	33.17
D	188	46.53	322	79.70
E	78	19.31	400	99.01
F	4	0.99	404	100.00

Frequency Missing = 5

Table A13

agg_grp	Frequency	Percent	Cumulative Frequency	Cumulative Percent
BELOW 60%	270	66.83	270	66.83
60% AND ABOVE	134	33.17	404	100.00

Frequency Missing = 5

Table A14

MATH_GRD

MATH_GRD	Frequency	Percent	Cumulative Frequency	Cumulative Percent
H	198	48.89	198	48.89
S	207	51.11	405	100.00

Frequency Missing = 4

Table A15

MATH_SYM

MATH_SYM	Frequency	Percent	Cumulative Frequency	Cumulative Percent
A	32	7.90	32	7.90
B	55	13.58	87	21.48
C	72	17.78	159	39.26
D	122	30.12	281	69.38
E	116	28.64	397	98.02
F	8	1.98	405	100.00

Frequency Missing = 4

Table A16

```
                       Table of MATH_GRD by MATH_SYM

  MATH_GRD(MATH_GRD)     MATH_SYM(MATH_SYM)

Frequency,
Percent  ,
Row Pct  ,
Col Pct  ,A       ,B       ,C       ,D       ,E       ,F       ,  Total
         ,        ,        ,        ,        ,        ,        ,
         ,        ,        ,        ,        ,        ,        ,
fffffffffˆffffffffˆffffffffˆffffffffˆffffffffˆffffffffˆffffffffˆ
H        ,      4 ,     17 ,     26 ,     58 ,     92 ,      0 ,    197
         ,   0.99 ,   4.22 ,   6.45 ,  14.39 ,  22.83 ,   0.00 ,  48.88
         ,   2.03 ,   8.63 ,  13.20 ,  29.44 ,  46.70 ,   0.00 ,
         ,  12.90 ,  30.91 ,  36.62 ,  47.54 ,  79.31 ,   0.00 ,
fffffffffˆffffffffˆffffffffˆffffffffˆffffffffˆffffffffˆffffffffˆ
S        ,     27 ,     38 ,     45 ,     64 ,     24 ,      8 ,    206
         ,   6.70 ,   9.43 ,  11.17 ,  15.88 ,   5.96 ,   1.99 ,  51.12
         ,  13.11 ,  18.45 ,  21.84 ,  31.07 ,  11.65 ,   3.88 ,
         ,  87.10 ,  69.09 ,  63.38 ,  52.46 ,  20.69 , 100.00 ,
fffffffffˆffffffffˆffffffffˆffffffffˆffffffffˆffffffffˆffffffffˆ
Total          31       55       71      122      116        8      403
             7.69    13.65    17.62    30.27    28.78     1.99   100.00

                        Frequency Missing = 6
```

Table A17

common1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
A	4	0.99	4	0.99
B	44	10.92	48	11.91
C	64	15.88	112	27.79
D	103	25.56	215	53.35
E	156	38.71	371	92.06
F	24	5.96	395	98.01
G	8	1.99	403	100.00

Frequency Missing = 6

Table A18

math_grp	Frequency	Percent	Cumulative Frequency	Cumulative Percent
BELOW 60%	291	72.21	291	72.21
60% AND ABOVE	112	27.79	403	100.00

Frequency Missing = 6

Table A19

```
                                                   Cumulative    Cumulative
imed_yrs      Frequency        Percent      Frequency       Percent
------------------------------------------------------------
       0            238          58.19            238         58.19
       1             75          18.34            313         76.53
       2             30           7.33            343         83.86
       3             30           7.33            373         91.20
       4             15           3.67            388         94.87
       5              7           1.71            395         96.58
       6              5           1.22            400         97.80
       7              2           0.49            402         98.29
       8              2           0.49            404         98.78
      10              2           0.49            406         99.27
      14              1           0.24            407         99.51
      15              1           0.24            408         99.76
      70              1           0.24            409        100.00
```

Table A20

```
                                                          Cumulative    Cumulative
                 immediate      Frequency        Percent      Frequency       Percent
        -----------------------------------------------------------------------
    NOT DIRECTLY AFTER SCHOOL            171          41.81            171         41.81
    DIRECTLY AFTER SCHOOL                238          58.19            409        100.00
```

Table A21

```
                                                        Cumulative    Cumulative
                  subjcode      Frequency        Percent      Frequency       Percent
         --------------------------------------------------------------------
     MATHEMATICAL STATISTICS            205          50.12            205         50.12
     APPLIED STATISTICS                 204          49.88            409        100.00
```

Table A22

```
                                                         Cumulative    Cumulative
                      pass      Frequency        Percent      Frequency       Percent
   ---------------------------------------------------------------------------
   FAIL BOTH SEMESTER                    13           3.18             13          3.18
   PASS ONLY FIRST SEMESTER               9           2.20             22          5.38
   PASS ONLY SECOND SEMESTER             26           6.36             48         11.74
   PASS BOTH SEMESTERS                  361          88.26            409        100.00
```

Table A23

```
                                                Cumulative    Cumulative
      major      Frequency        Percent      Frequency       Percent
------------------------------------------------------------
      N                 48          11.74             48         11.74
      Y                361          88.26            409        100.00
```

A2 Throughput associations

```
Table A24             Association of Throughput by GENDER

                          Throughput         GENDER(GENDER)

                          Frequency      ,
                          Percent        ,
                          Row Pct        ,
                          Col Pct        ,FEMALE  ,MALE    ,  Total
                          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                          NON-THROUGHPUT ,    147 ,    176 ,    323
                                         ,  35.94 ,  43.03 ,  78.97
                                         ,  45.51 ,  54.49 ,
                                         ,  83.05 ,  75.86 ,
                          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                          THROUGHPUT     ,     30 ,     56 ,     86
                                         ,   7.33 ,  13.69 ,  21.03
                                         ,  34.88 ,  65.12 ,
                                         ,  16.95 ,  24.14 ,
                          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                          Total               177      232      409
                                            43.28    56.72   100.00


                      Statistics for Association of Throughput by GENDER

                    Statistic                     DF       Value      Prob
                    ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                    Chi-Square                     1      3.1246    0.0771
                    Likelihood Ratio Chi-Square    1      3.1735    0.0748
                    Continuity Adj. Chi-Square     1      2.7067    0.0999
                    Mantel-Haenszel Chi-Square     1      3.1170    0.0775
                    Phi Coefficient                       0.0874
                    Contingency Coefficient               0.0871
                    Cramer's V                            0.0874


                                 Fisher's Exact Test
                              ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                              Cell (1,1) Frequency (F)       147
                              Left-sided Pr <= F          0.9714
                              Right-sided Pr >= F         0.0492

                              Table Probability (P)       0.0206
                              Two-sided Pr <= P           0.0868

                                      Sample Size = 409
```

Table A25 Association of Throughput by african

```
      Throughput         african

      Frequency      ,
      Percent        ,
      Row Pct        ,
      Col Pct        ,NON-AFRI,AFRICAN ,  Total
                     ,CAN     ,        ,
      fffffffffffffffˆffffffffˆffffffffˆ
      NON-THROUGHPUT ,    133 ,    190 ,    323
                     ,  32.52 ,  46.45 ,  78.97
                     ,  41.18 ,  58.82 ,
                     ,  74.30 ,  82.61 ,
      fffffffffffffffˆffffffffˆffffffffˆ
      THROUGHPUT     ,     46 ,     40 ,     86
                     ,  11.25 ,   9.78 ,  21.03
                     ,  53.49 ,  46.51 ,
                     ,  25.70 ,  17.39 ,
      fffffffffffffffˆffffffffˆffffffffˆ
      Total               179      230      409
                        43.77    56.23   100.00


  Statistics for Association of Throughput by african

Statistic                     DF       Value      Prob
ffffffffffffffffffffffffffffffffffffffffffffffffffffff
Chi-Square                     1      4.1831    0.0408
Likelihood Ratio Chi-Square    1      4.1546    0.0415
Continuity Adj. Chi-Square     1      3.6978    0.0545
Mantel-Haenszel Chi-Square     1      4.1728    0.0411
Phi Coefficient                      -0.1011
Contingency Coefficient               0.1006
Cramer's V                           -0.1011


                 Fisher's Exact Test
          ffffffffffffffffffffffffffffffffff
          Cell (1,1) Frequency (F)       133
          Left-sided Pr <= F          0.0275
          Right-sided Pr >= F         0.9847

          Table Probability (P)       0.0122
          Two-sided Pr <= P           0.0501

                  Sample Size = 409
```

```
Table A26              Association of Throughput by english

                           Throughput         english

                           Frequency      ,
                           Percent        ,
                           Row Pct        ,
                           Col Pct        ,NON-ENGL,ENGLISH ,  Total
                                          ,ISH     ,        ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           NON-THROUGHPUT ,    232 ,     91 ,    323
                                          ,  56.72 ,  22.25 ,  78.97
                                          ,  71.83 ,  28.17 ,
                                          ,  82.27 ,  71.65 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           THROUGHPUT     ,     50 ,     36 ,     86
                                          ,  12.22 ,   8.80 ,  21.03
                                          ,  58.14 ,  41.86 ,
                                          ,  17.73 ,  28.35 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           Total               282      127      409
                                             68.95    31.05   100.00


                       Statistics for Association of Throughput by english

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1      5.9428    0.0148
                     Likelihood Ratio Chi-Square    1      5.7270    0.0167
                     Continuity Adj. Chi-Square     1      5.3207    0.0211
                     Mantel-Haenszel Chi-Square     1      5.9283    0.0149
                     Phi Coefficient                       0.1205
                     Contingency Coefficient               0.1197
                     Cramer's V                            0.1205


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)       232
                               Left-sided Pr <= F          0.9943
                               Right-sided Pr >= F         0.0115

                               Table Probability (P)       0.0057
                               Two-sided Pr <= P           0.0182

                                       Sample Size = 409
```

```
Table A27              Association of Throughput by agg_grp

                           Throughput         agg_grp

                           Frequency      ,
                           Percent        ,
                           Row Pct        ,
                           Col Pct        ,BELOW 60,60% AND ,  Total
                                          ,%       ,ABOVE   ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           NON-THROUGHPUT ,    227 ,     91 ,    318
                                          ,  56.19 ,  22.52 ,  78.71
                                          ,  71.38 ,  28.62 ,
                                          ,  84.07 ,  67.91 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           THROUGHPUT     ,     43 ,     43 ,     86
                                          ,  10.64 ,  10.64 ,  21.29
                                          ,  50.00 ,  50.00 ,
                                          ,  15.93 ,  32.09 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           Total               270      134      404
                                             66.83    33.17   100.00

                                     Frequency Missing = 5

                       Statistics for Association of Throughput by agg_grp

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1     13.9637    0.0002
                     Likelihood Ratio Chi-Square    1     13.3920    0.0003
                     Continuity Adj. Chi-Square     1     13.0157    0.0003
                     Mantel-Haenszel Chi-Square     1     13.9292    0.0002
                     Phi Coefficient                       0.1859
                     Contingency Coefficient               0.1828
                     Cramer's V                            0.1859


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)       227
                               Left-sided Pr <= F          0.9999
                               Right-sided Pr >= F      1.998E-04

                               Table Probability (P)    1.244E-04
                               Two-sided Pr <= P        2.801E-04

                                  Effective Sample Size = 404
                                     Frequency Missing = 5
```

```
Table A28              Association of Throughput by math_grp

                           Throughput         math_grp

                           Frequency      ,
                           Percent        ,
                           Row Pct        ,
                           Col Pct        ,BELOW 60,60% AND ,  Total
                                          ,%       ,ABOVE   ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           NON-THROUGHPUT ,    238 ,     80 ,    318
                                          ,  59.06 ,  19.85 ,  78.91
                                          ,  74.84 ,  25.16 ,
                                          ,  81.79 ,  71.43 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           THROUGHPUT     ,     53 ,     32 ,     85
                                          ,  13.15 ,   7.94 ,  21.09
                                          ,  62.35 ,  37.65 ,
                                          ,  18.21 ,  28.57 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           Total               291      112      403
                                             72.21    27.79   100.00

                                     Frequency Missing = 6
```

```
                                       The FREQ Procedure

                       Statistics for Association of Throughput by math_grp

                     Statistic                     DF       Value      Prob
                     ffffffffffffffffffffffffffffffffffffffffffffffffffffff
                     Chi-Square                     1      5.2138    0.0224
                     Likelihood Ratio Chi-Square    1      4.9927    0.0255
                     Continuity Adj. Chi-Square     1      4.6100    0.0318
                     Mantel-Haenszel Chi-Square     1      5.2008    0.0226
                     Phi Coefficient                       0.1137
                     Contingency Coefficient               0.1130
                     Cramer's V                            0.1137


                                      Fisher's Exact Test
                               ffffffffffffffffffffffffffffffffff
                               Cell (1,1) Frequency (F)       238
                               Left-sided Pr <= F          0.9912
                               Right-sided Pr >= F         0.0173

                               Table Probability (P)       0.0085
                               Two-sided Pr <= P           0.0288

                                  Effective Sample Size = 403
                                     Frequency Missing = 6




Table A29              Association of Throughput by immediate

                           Throughput         immediate

                           Frequency      ,
                           Percent        ,
                           Row Pct        ,
                           Col Pct        ,NOT DIRE,DIRECTLY,  Total
                                          ,CTLY AFT, AFTER S,
                                          ,ER SCHOO,CHOOL   ,
                                          ,L       ,        ,
                           fffffffffffffffˆffffffffˆffffffffˆ
                           NON-THROUGHPUT ,    129 ,    194 ,    323
                                          ,  31.54 ,  47.43 ,  78.97
                                          ,  39.94 ,  60.06 ,
                                          ,  75.44 ,  81.51 ,
                           fffffffffffffffˆffffffffˆffffffffˆ
                           THROUGHPUT     ,     42 ,     44 ,     86
                                          ,  10.27 ,  10.76 ,  21.03
                                          ,  48.84 ,  51.16 ,
                                          ,  24.56 ,  18.49 ,
                           fffffffffffffffˆffffffffˆffffffffˆ
                           Total               171      238      409
                                             41.81    58.19   100.00

                                       The FREQ Procedure

                       Statistics for Association of Throughput by immediate

                     Statistic                     DF       Value      Prob
                     ffffffffffffffffffffffffffffffffffffffffffffffffffffff
                     Chi-Square                     1      2.2108    0.1370
                     Likelihood Ratio Chi-Square    1      2.1916    0.1388
                     Continuity Adj. Chi-Square     1      1.8601    0.1726
                     Mantel-Haenszel Chi-Square     1      2.2054    0.1375
                     Phi Coefficient                      -0.0735
                     Contingency Coefficient               0.0733
                     Cramer's V                           -0.0735


                                      Fisher's Exact Test
                               ffffffffffffffffffffffffffffffffff
                               Cell (1,1) Frequency (F)       129
                               Left-sided Pr <= F          0.0867
                               Right-sided Pr >= F         0.9458

                               Table Probability (P)       0.0325
```

```
                               Two-sided Pr <= P           0.1420

                                       Sample Size = 409




Table A30              Association of Throughput by year_cov

                           Throughput         year_cov

                           Frequency      ,
                           Percent        ,
                           Row Pct        ,
                           Col Pct        ,PRE-ELEC,POST-ELE,  Total
                                          ,TION YEA,CTION YE,
                                          ,RS      ,ARS     ,
                           fffffffffffffffˆffffffffˆffffffffˆ
                           NON-THROUGHPUT ,    171 ,    152 ,    323
                                          ,  41.81 ,  37.16 ,  78.97
                                          ,  52.94 ,  47.06 ,
                                          ,  87.24 ,  71.36 ,
                           fffffffffffffffˆffffffffˆffffffffˆ
                           THROUGHPUT     ,     25 ,     61 ,     86
                                          ,   6.11 ,  14.91 ,  21.03
                                          ,  29.07 ,  70.93 ,
                                          ,  12.76 ,  28.64 ,
                           fffffffffffffffˆffffffffˆffffffffˆ
                           Total               196      213      409
                                             47.92    52.08   100.00

                                       The FREQ Procedure

                       Statistics for Association of Throughput by year_cov

                     Statistic                     DF       Value      Prob
                     ffffffffffffffffffffffffffffffffffffffffffffffffffffff
                     Chi-Square                     1     15.5076    <.0001
                     Likelihood Ratio Chi-Square    1     15.9555    <.0001
                     Continuity Adj. Chi-Square     1     14.5658    0.0001
                     Mantel-Haenszel Chi-Square     1     15.4697    <.0001
                     Phi Coefficient                       0.1947
                     Contingency Coefficient               0.1911
                     Cramer's V                            0.1947


                                      Fisher's Exact Test
                               ffffffffffffffffffffffffffffffffff
                               Cell (1,1) Frequency (F)       171
                               Left-sided Pr <= F          1.0000
                               Right-sided Pr >= F      5.563E-05

                               Table Probability (P)    3.646E-05
                               Two-sided Pr <= P        9.032E-05

                                       Sample Size = 409
```

A3 Predictor associations

```
Table A31              Association of GENDER by african

                              GENDER(GENDER)     african

                              Frequency,
                              Percent  ,
                              Row Pct  ,
                              Col Pct  ,NON-AFRI,AFRICAN ,  Total
                                       ,CAN     ,        ,
                              ƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                              FEMALE   ,     61 ,    116 ,    177
                                       ,  14.91 ,  28.36 ,  43.28
                                       ,  34.46 ,  65.54 ,
                                       ,  34.08 ,  50.43 ,
                              ƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                              MALE     ,    118 ,    114 ,    232
                                       ,  28.85 ,  27.87 ,  56.72
                                       ,  50.86 ,  49.14 ,
                                       ,  65.92 ,  49.57 ,
                              ƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                              Total         179      230      409
                                          43.77    56.23   100.00

                                       The FREQ Procedure

                       Statistics for Association of GENDER by african

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1     10.9705    0.0009
                     Likelihood Ratio Chi-Square    1     11.0696    0.0009
                     Continuity Adj. Chi-Square     1     10.3143    0.0013
                     Mantel-Haenszel Chi-Square     1     10.9437    0.0009
                     Phi Coefficient                      -0.1638
                     Contingency Coefficient               0.1616
                     Cramer's V                           -0.1638


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)        61
                               Left-sided Pr <= F      6.320E-04
                               Right-sided Pr >= F        0.9997

                               Table Probability (P)   3.275E-04
                               Two-sided Pr <= P          0.0013

                                       Sample Size = 409
```

```
Table A32              Association of GENDER by english

                              GENDER(GENDER)     english

                              Frequency,
                              Percent  ,
                              Row Pct  ,
                              Col Pct  ,NON-ENGL,ENGLISH ,  Total
                                       ,ISH     ,        ,
                              ƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                              FEMALE   ,    129 ,     48 ,    177
                                       ,  31.54 ,  11.74 ,  43.28
                                       ,  72.88 ,  27.12 ,
                                       ,  45.74 ,  37.80 ,
                              ƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                              MALE     ,    153 ,     79 ,    232
                                       ,  37.41 ,  19.32 ,  56.72
                                       ,  65.95 ,  34.05 ,
                                       ,  54.26 ,  62.20 ,
                              ƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                              Total         282      127      409
                                          68.95    31.05   100.00

                                       The FREQ Procedure

                       Statistics for Association of GENDER by english

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1      2.2542    0.1333
                     Likelihood Ratio Chi-Square    1      2.2704    0.1319
                     Continuity Adj. Chi-Square     1      1.9420    0.1635
                     Mantel-Haenszel Chi-Square     1      2.2486    0.1337
                     Phi Coefficient                       0.0742
                     Contingency Coefficient               0.0740
                     Cramer's V                            0.0742


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)       129
                               Left-sided Pr <= F          0.9466
                               Right-sided Pr >= F         0.0814

                               Table Probability (P)       0.0280
                               Two-sided Pr <= P           0.1608

                                       Sample Size = 409
```

```
Table A33             Association of agg_grp by GENDER

                           agg_grp        GENDER(GENDER)

                           Frequency     ,
                           Percent       ,
                           Row Pct       ,
                           Col Pct       ,FEMALE  ,MALE    ,  Total
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           BELOW 60%     ,    127 ,    143 ,    270
                                         ,  31.44 ,  35.40 ,  66.83
                                         ,  47.04 ,  52.96 ,
                                         ,  72.57 ,  62.45 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           60% AND ABOVE ,     48 ,     86 ,    134
                                         ,  11.88 ,  21.29 ,  33.17
                                         ,  35.82 ,  64.18 ,
                                         ,  27.43 ,  37.55 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           Total              175      229      404
                                            43.32    56.68   100.00

                                    Frequency Missing = 5

                                      The FREQ Procedure

                      Statistics for Association of agg_grp by GENDER

                    Statistic                     DF       Value      Prob
                    ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                    Chi-Square                     1      4.5884    0.0322
                    Likelihood Ratio Chi-Square    1      4.6346    0.0313
                    Continuity Adj. Chi-Square     1      4.1430    0.0418
                    Mantel-Haenszel Chi-Square     1      4.5771    0.0324
                    Phi Coefficient                       0.1066
                    Contingency Coefficient               0.1060
                    Cramer's V                            0.1066


                                   Fisher's Exact Test
                              ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                              Cell (1,1) Frequency (F)       127
                              Left-sided Pr <= F          0.9880
                              Right-sided Pr >= F         0.0205

                              Table Probability (P)       0.0086
                              Two-sided Pr <= P           0.0335

                                 Effective Sample Size = 404
                                    Frequency Missing = 5
```

Table A34 Association of math_grp by GENDER

```
       math_grp       GENDER(GENDER)

       Frequency     ,
       Percent       ,
       Row Pct       ,
       Col Pct       ,FEMALE  ,MALE    ,  Total
       ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
       BELOW 60%     ,    142 ,    149 ,    291
                     ,  35.24 ,  36.97 ,  72.21
                     ,  48.80 ,  51.20 ,
                     ,  80.68 ,  65.64 ,
       ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
       60% AND ABOVE ,     34 ,     78 ,    112
                     ,   8.44 ,  19.35 ,  27.79
                     ,  30.36 ,  69.64 ,
                     ,  19.32 ,  34.36 ,
       ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
       Total              176      227      403
                        43.67    56.33   100.00

                Frequency Missing = 6

                  The FREQ Procedure

  Statistics for Association of math_grp by GENDER

Statistic                     DF       Value      Prob
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square                     1     11.1790    0.0008
Likelihood Ratio Chi-Square    1     11.4573    0.0007
Continuity Adj. Chi-Square     1     10.4420    0.0012
Mantel-Haenszel Chi-Square     1     11.1513    0.0008
Phi Coefficient                       0.1666
Contingency Coefficient               0.1643
Cramer's V                            0.1666


                 Fisher's Exact Test
          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
          Cell (1,1) Frequency (F)       142
          Left-sided Pr <= F          0.9998
          Right-sided Pr >= F      5.458E-04

          Table Probability (P)    3.103E-04
          Two-sided Pr <= P           0.0011

             Effective Sample Size = 403
                Frequency Missing = 6
```

Table A35

```
  Association of immediate by GENDER

     immediate         GENDER(GENDER)

     Frequency        ,
     Percent          ,
     Row Pct          ,
     Col Pct          ,FEMALE  ,MALE    ,  Total
     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
     NOT DIRECTLY AFT ,     59 ,    112 ,    171
     ER SCHOOL        ,  14.43 ,  27.38 ,  41.81
                      ,  34.50 ,  65.50 ,
                      ,  33.33 ,  48.28 ,
     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
     DIRECTLY AFTER S ,    118 ,    120 ,    238
     CHOOL            ,  28.85 ,  29.34 ,  58.19
                      ,  49.58 ,  50.42 ,
                      ,  66.67 ,  51.72 ,
     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
     Total                 177      232      409
                         43.28    56.72   100.00

                  The FREQ Procedure

  Statistics for Association of immediate by GENDER

Statistic                     DF       Value      Prob
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square                     1      9.2142    0.0024
Likelihood Ratio Chi-Square    1      9.2988    0.0023
Continuity Adj. Chi-Square     1      8.6103    0.0033
Mantel-Haenszel Chi-Square     1      9.1917    0.0024
Phi Coefficient                      -0.1501
Contingency Coefficient               0.1484
Cramer's V                           -0.1501


                 Fisher's Exact Test
          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
          Cell (1,1) Frequency (F)        59
          Left-sided Pr <= F          0.0016
          Right-sided Pr >= F         0.9992

          Table Probability (P)    7.959E-04
          Two-sided Pr <= P           0.0025

                  Sample Size = 409
```

```
Table A36              Association of year_cov by GENDER

                          year_cov          GENDER(GENDER)

                          Frequency        ,
                          Percent          ,
                          Row Pct          ,
                          Col Pct          ,FEMALE  ,MALE    ,  Total
                          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                          PRE-ELECTION YEA ,     76 ,    120 ,    196
                          RS               ,  18.58 ,  29.34 ,  47.92
                                           ,  38.78 ,  61.22 ,
                                           ,  42.94 ,  51.72 ,
                          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                          POST-ELECTION YE ,    101 ,    112 ,    213
                          ARS              ,  24.69 ,  27.38 ,  52.08
                                           ,  47.42 ,  52.58 ,
                                           ,  57.06 ,  48.28 ,
                          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                          Total                 177      232      409
                                              43.28    56.72   100.00

                                         The FREQ Procedure

                       Statistics for Association of year_cov by GENDER

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1      3.1057    0.0780
                     Likelihood Ratio Chi-Square    1      3.1120    0.0777
                     Continuity Adj. Chi-Square     1      2.7636    0.0964
                     Mantel-Haenszel Chi-Square     1      3.0981    0.0784
                     Phi Coefficient                      -0.0871
                     Contingency Coefficient               0.0868
                     Cramer's V                           -0.0871


                                        Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)        76
                               Left-sided Pr <= F          0.0481
                               Right-sided Pr >= F         0.9688

                               Table Probability (P)       0.0169
                               Two-sided Pr <= P           0.0896

                                         Sample Size = 409
```

```
Table A37              Association of african by english

                             african      english

                             Frequency   ,
                             Percent     ,
                             Row Pct     ,
                             Col Pct     ,NON-ENGL,ENGLISH ,  Total
                                         ,ISH     ,        ,
                             ƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                             NON-AFRICAN ,     54 ,    125 ,    179
                                         ,  13.20 ,  30.56 ,  43.77
                                         ,  30.17 ,  69.83 ,
                                         ,  19.15 ,  98.43 ,
                             ƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                             AFRICAN     ,    228 ,      2 ,    230
                                         ,  55.75 ,   0.49 ,  56.23
                                         ,  99.13 ,   0.87 ,
                                         ,  80.85 ,   1.57 ,
                             ƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                             Total            282      127      409
                                            68.95    31.05   100.00

                                       The FREQ Procedure

                       Statistics for Association of african by english

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1    223.6050    <.0001
                     Likelihood Ratio Chi-Square    1    264.6022    <.0001
                     Continuity Adj. Chi-Square     1    220.3955    <.0001
                     Mantel-Haenszel Chi-Square     1    223.0583    <.0001
                     Phi Coefficient                      -0.7394
                     Contingency Coefficient               0.5945
                     Cramer's V                           -0.7394


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)        54
                               Left-sided Pr <= F       1.448E-58
                               Right-sided Pr >= F         1.0000

                               Table Probability (P)    1.443E-58
                               Two-sided Pr <= P        1.448E-58

                                       Sample Size = 409
```

```
Table A38              Association of agg_grp by african

                            agg_grp        african

                            Frequency     ,
                            Percent       ,
                            Row Pct       ,
                            Col Pct       ,NON-AFRI,AFRICAN ,  Total
                                          ,CAN     ,        ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            BELOW 60%     ,     74 ,    196 ,    270
                                          ,  18.32 ,  48.51 ,  66.83
                                          ,  27.41 ,  72.59 ,
                                          ,  41.34 ,  87.11 ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            60% AND ABOVE ,    105 ,     29 ,    134
                                          ,  25.99 ,   7.18 ,  33.17
                                          ,  78.36 ,  21.64 ,
                                          ,  58.66 ,  12.89 ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            Total              179      225      404
                                             44.31    55.69   100.00

                                     Frequency Missing = 5

                                       The FREQ Procedure

                       Statistics for Association of agg_grp by african

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1     94.2142    <.0001
                     Likelihood Ratio Chi-Square    1     97.7024    <.0001
                     Continuity Adj. Chi-Square     1     92.1607    <.0001
                     Mantel-Haenszel Chi-Square     1     93.9810    <.0001
                     Phi Coefficient                     -0.4829
                     Contingency Coefficient              0.4349
                     Cramer's V                          -0.4829


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)        74
                               Left-sided Pr <= F       7.696E-23
                               Right-sided Pr >= F         1.0000

                               Table Probability (P)    6.911E-23
                               Two-sided Pr <= P        1.209E-22

                                  Effective Sample Size = 404
                                     Frequency Missing = 5
```

```
Table A39              Association of math_grp by african

                            math_grp       african

                            Frequency     ,
                            Percent       ,
                            Row Pct       ,
                            Col Pct       ,NON-AFRI,AFRICAN ,  Total
                                          ,CAN     ,        ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            BELOW 60%     ,     97 ,    194 ,    291
                                          ,  24.07 ,  48.14 ,  72.21
                                          ,  33.33 ,  66.67 ,
                                          ,  55.11 ,  85.46 ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            60% AND ABOVE ,     79 ,     33 ,    112
                                          ,  19.60 ,   8.19 ,  27.79
                                          ,  70.54 ,  29.46 ,
                                          ,  44.89 ,  14.54 ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            Total              176      227      403
                                             43.67    56.33   100.00

                                     Frequency Missing = 6

                                       The FREQ Procedure

                       Statistics for Association of math_grp by african

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1     45.5008    <.0001
                     Likelihood Ratio Chi-Square    1     45.9525    <.0001
                     Continuity Adj. Chi-Square     1     44.0010    <.0001
                     Mantel-Haenszel Chi-Square     1     45.3879    <.0001
                     Phi Coefficient                      -0.3360
                     Contingency Coefficient               0.3185
                     Cramer's V                           -0.3360


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)        97
                               Left-sided Pr <= F       1.344E-11
                               Right-sided Pr >= F         1.0000

                               Table Probability (P)    1.072E-11
                               Two-sided Pr <= P        1.734E-11

                                  Effective Sample Size = 403
                                     Frequency Missing = 6
```

```
Table A40              Association of immediate by african

                          immediate         african

                          Frequency        ,
                          Percent          ,
                          Row Pct          ,
                          Col Pct          ,NON-AFRI,AFRICAN ,  Total
                                           ,CAN     ,        ,
                          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                          NOT DIRECTLY AFT ,     57 ,    114 ,    171
                          ER SCHOOL        ,  13.94 ,  27.87 ,  41.81
                                           ,  33.33 ,  66.67 ,
                                           ,  31.84 ,  49.57 ,
                          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                          DIRECTLY AFTER S ,    122 ,    116 ,    238
                          CHOOL            ,  29.83 ,  28.36 ,  58.19
                                           ,  51.26 ,  48.74 ,
                                           ,  68.16 ,  50.43 ,
                          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                          Total                 179      230      409
                                              43.77    56.23   100.00

                                       The FREQ Procedure

                       Statistics for Association of immediate by african

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1     12.9939    0.0003
                     Likelihood Ratio Chi-Square    1     13.1438    0.0003
                     Continuity Adj. Chi-Square     1     12.2757    0.0005
                     Mantel-Haenszel Chi-Square     1     12.9621    0.0003
                     Phi Coefficient                      -0.1782
                     Contingency Coefficient               0.1755
                     Cramer's V                           -0.1782


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)         57
                               Left-sided Pr <= F        2.147E-04
                               Right-sided Pr >= F          0.9999

                               Table Probability (P)     1.176E-04
                               Two-sided Pr <= P         3.927E-04

                                       Sample Size = 409
```

Table A41 Association of year_cov by african

```
   year_cov          african

   Frequency        ,
   Percent          ,
   Row Pct          ,
   Col Pct          ,NON-AFRI,AFRICAN ,  Total
                    ,CAN     ,        ,
   ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
   PRE-ELECTION YEA ,     94 ,    102 ,    196
   RS               ,  22.98 ,  24.94 ,  47.92
                    ,  47.96 ,  52.04 ,
                    ,  52.51 ,  44.35 ,
   ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
   POST-ELECTION YE ,     85 ,    128 ,    213
   ARS              ,  20.78 ,  31.30 ,  52.08
                    ,  39.91 ,  60.09 ,
                    ,  47.49 ,  55.65 ,
   ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
   Total                 179      230      409
                       43.77    56.23   100.00

                   The FREQ Procedure

 Statistics for Association of year_cov by african

Statistic                     DF       Value      Prob
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square                     1      2.6897    0.1010
Likelihood Ratio Chi-Square    1      2.6913    0.1009
Continuity Adj. Chi-Square     1      2.3724    0.1235
Mantel-Haenszel Chi-Square     1      2.6831    0.1014
Phi Coefficient                       0.0811
Contingency Coefficient               0.0808
Cramer's V                            0.0811


                  Fisher's Exact Test
          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
          Cell (1,1) Frequency (F)        94
          Left-sided Pr <= F          0.9591
          Right-sided Pr >= F         0.0617

          Table Probability (P)       0.0208
          Two-sided Pr <= P           0.1109

                  Sample Size = 409
```

```
Table A42              Association of agg_grp by english

                            agg_grp        english

                            Frequency     ,
                            Percent       ,
                            Row Pct       ,
                            Col Pct       ,NON-ENGL,ENGLISH ,  Total
                                          ,ISH     ,        ,
                            ffffffffffffffˆffffffffˆffffffffˆ
                            BELOW 60%     ,    213 ,     57 ,    270
                                          ,  52.72 ,  14.11 ,  66.83
                                          ,  78.89 ,  21.11 ,
                                          ,  76.90 ,  44.88 ,
                            ffffffffffffffˆffffffffˆffffffffˆ
                            60% AND ABOVE ,     64 ,     70 ,    134
                                          ,  15.84 ,  17.33 ,  33.17
                                          ,  47.76 ,  52.24 ,
                                          ,  23.10 ,  55.12 ,
                            ffffffffffffffˆffffffffˆffffffffˆ
                            Total              277      127      404
                                             68.56    31.44   100.00

                                     Frequency Missing = 5

                                       The FREQ Procedure

                       Statistics for Association of agg_grp by english

                     Statistic                     DF       Value      Prob
                     ffffffffffffffffffffffffffffffffffffffffffffffffffffff
                     Chi-Square                     1     40.2588    <.0001
                     Likelihood Ratio Chi-Square    1     39.1898    <.0001
                     Continuity Adj. Chi-Square     1     38.8275    <.0001
                     Mantel-Haenszel Chi-Square     1     40.1591    <.0001
                     Phi Coefficient                       0.3157
                     Contingency Coefficient               0.3010
                     Cramer's V                            0.3157


                                      Fisher's Exact Test
                               ffffffffffffffffffffffffffffffffff
                               Cell (1,1) Frequency (F)       213
                               Left-sided Pr <= F          1.0000
                               Right-sided Pr >= F      3.876E-10

                               Table Probability (P)    2.960E-10
                               Two-sided Pr <= P        4.708E-10

                                  Effective Sample Size = 404
                                     Frequency Missing = 5
```

```
Table A43              Association of math_grp by english

                            math_grp       english

                            Frequency     ‚
                            Percent       ‚
                            Row Pct       ‚
                            Col Pct       ‚NON-ENGL‚ENGLISH ‚  Total
                                          ‚ISH     ‚        ‚
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            BELOW 60%     ‚    212 ‚     79 ‚     291
                                          ‚  52.61 ‚  19.60 ‚  72.21
                                          ‚  72.85 ‚  27.15 ‚
                                          ‚  76.53 ‚  62.70 ‚
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            60% AND ABOVE ‚     65 ‚     47 ‚     112
                                          ‚  16.13 ‚  11.66 ‚  27.79
                                          ‚  58.04 ‚  41.96 ‚
                                          ‚  23.47 ‚  37.30 ‚
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            Total              277      126      403
                                             68.73    31.27   100.00

                                     Frequency Missing = 6

                                       The FREQ Procedure

                       Statistics for Association of math_grp by english

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1      8.2615    0.0040
                     Likelihood Ratio Chi-Square    1      8.0258    0.0046
                     Continuity Adj. Chi-Square     1      7.5864    0.0059
                     Mantel-Haenszel Chi-Square     1      8.2410    0.0041
                     Phi Coefficient                       0.1432
                     Contingency Coefficient               0.1417
                     Cramer's V                            0.1432


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)       212
                               Left-sided Pr <= F          0.9984
                               Right-sided Pr >= F         0.0033

                               Table Probability (P)       0.0017
                               Two-sided Pr <= P           0.0056

                                  Effective Sample Size = 403
                                     Frequency Missing = 6
```

```
Table A44              Association of immediate by english

                          immediate         english

                          Frequency        ,
                          Percent          ,
                          Row Pct          ,
                          Col Pct          ,NON-ENGL,ENGLISH ,  Total
                                           ,ISH     ,        ,
                          ffffffffffffffffˆffffffffˆffffffffˆ
                          NOT DIRECTLY AFT ,    127 ,     44 ,    171
                          ER SCHOOL        ,  31.05 ,  10.76 ,  41.81
                                           ,  74.27 ,  25.73 ,
                                           ,  45.04 ,  34.65 ,
                          ffffffffffffffffˆffffffffˆffffffffˆ
                          DIRECTLY AFTER S ,    155 ,     83 ,    238
                          CHOOL            ,  37.90 ,  20.29 ,  58.19
                                           ,  65.13 ,  34.87 ,
                                           ,  54.96 ,  65.35 ,
                          ffffffffffffffffˆffffffffˆffffffffˆ
                          Total                 282      127      409
                                              68.95    31.05   100.00

                                       The FREQ Procedure

                       Statistics for Association of immediate by english

                     Statistic                     DF       Value      Prob
                     ffffffffffffffffffffffffffffffffffffffffffffffffffffff
                     Chi-Square                     1      3.8852    0.0487
                     Likelihood Ratio Chi-Square    1      3.9316    0.0474
                     Continuity Adj. Chi-Square     1      3.4699    0.0625
                     Mantel-Haenszel Chi-Square     1      3.8757    0.0490
                     Phi Coefficient                       0.0975
                     Contingency Coefficient               0.0970
                     Cramer's V                            0.0975


                                      Fisher's Exact Test
                               ffffffffffffffffffffffffffffffffff
                               Cell (1,1) Frequency (F)       127
                               Left-sided Pr <= F          0.9817
                               Right-sided Pr >= F         0.0307

                               Table Probability (P)       0.0124
                               Two-sided Pr <= P           0.0518

                                       Sample Size = 409
```

Table A45 Association of year_cov by english

```
     year_cov          english

     Frequency        ,
     Percent          ,
     Row Pct          ,
     Col Pct          ,NON-ENGL,ENGLISH ,  Total
                      ,ISH     ,        ,
     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
     PRE-ELECTION YEA ,    132 ,     64 ,    196
     RS               ,  32.27 ,  15.65 ,  47.92
                      ,  67.35 ,  32.65 ,
                      ,  46.81 ,  50.39 ,
     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
     POST-ELECTION YE ,    150 ,     63 ,    213
     ARS              ,  36.67 ,  15.40 ,  52.08
                      ,  70.42 ,  29.58 ,
                      ,  53.19 ,  49.61 ,
     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
     Total                 282      127      409
                         68.95    31.05   100.00

                  The FREQ Procedure

  Statistics for Association of year_cov by english

Statistic                     DF       Value      Prob
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square                     1      0.4510    0.5019
Likelihood Ratio Chi-Square    1      0.4508    0.5020
Continuity Adj. Chi-Square     1      0.3188    0.5723
Mantel-Haenszel Chi-Square     1      0.4499    0.5024
Phi Coefficient                      -0.0332
Contingency Coefficient               0.0332
Cramer's V                           -0.0332


                 Fisher's Exact Test
          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
          Cell (1,1) Frequency (F)       132
          Left-sided Pr <= F          0.2861
          Right-sided Pr >= F         0.7819

          Table Probability (P)       0.0680
          Two-sided Pr <= P           0.5223

                  Sample Size = 409
```

```
Table A46            Association of agg_grp by math_grp

                           agg_grp        math_grp

                           Frequency     ,
                           Percent       ,
                           Row Pct       ,
                           Col Pct       ,BELOW 60,60% AND ,  Total
                                         ,%       ,ABOVE   ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           BELOW 60%     ,    222 ,     43 ,    265
                                         ,  55.78 ,  10.80 ,  66.58
                                         ,  83.77 ,  16.23 ,
                                         ,  77.62 ,  38.39 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           60% AND ABOVE ,     64 ,     69 ,    133
                                         ,  16.08 ,  17.34 ,  33.42
                                         ,  48.12 ,  51.88 ,
                                         ,  22.38 ,  61.61 ,
                           ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                           Total              286      112      398
                                            71.86    28.14   100.00

                                    Frequency Missing = 11

                                      The FREQ Procedure

                      Statistics for Association of agg_grp by math_grp

                    Statistic                     DF       Value      Prob
                    ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                    Chi-Square                     1     55.6667    <.0001
                    Likelihood Ratio Chi-Square    1     53.8508    <.0001
                    Continuity Adj. Chi-Square     1     53.9176    <.0001
                    Mantel-Haenszel Chi-Square     1     55.5269    <.0001
                    Phi Coefficient                       0.3740
                    Contingency Coefficient               0.3503
                    Cramer's V                            0.3740


                                     Fisher's Exact Test
                              ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                              Cell (1,1) Frequency (F)       222
                              Left-sided Pr <= F          1.0000
                              Right-sided Pr >= F      2.530E-13

                              Table Probability (P)    2.089E-13
                              Two-sided Pr <= P        3.103E-13

                                 Effective Sample Size = 398
                                    Frequency Missing = 11
```

```
Table A47              Association of agg_grp by immediate

                            agg_grp        immediate

                            Frequency     ,
                            Percent       ,
                            Row Pct       ,
                            Col Pct       ,NOT DIRE,DIRECTLY,  Total
                                          ,CTLY AFT, AFTER S,
                                          ,ER SCHOO,CHOOL   ,
                                          ,L       ,        ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            BELOW 60%     ,    116 ,    154 ,    270
                                          ,  28.71 ,  38.12 ,  66.83
                                          ,  42.96 ,  57.04 ,
                                          ,  68.24 ,  65.81 ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            60% AND ABOVE ,     54 ,     80 ,    134
                                          ,  13.37 ,  19.80 ,  33.17
                                          ,  40.30 ,  59.70 ,
                                          ,  31.76 ,  34.19 ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            Total              170      234      404
                                             42.08    57.92   100.00

                                     Frequency Missing = 5

                                       The FREQ Procedure

                       Statistics for Association of agg_grp by immediate

                     Statistic                     DF       Value      Prob
                     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                     Chi-Square                     1      0.2609    0.6095
                     Likelihood Ratio Chi-Square    1      0.2614    0.6092
                     Continuity Adj. Chi-Square     1      0.1630    0.6864
                     Mantel-Haenszel Chi-Square     1      0.2602    0.6100
                     Phi Coefficient                       0.0254
                     Contingency Coefficient               0.0254
                     Cramer's V                            0.0254


                                      Fisher's Exact Test
                               ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                               Cell (1,1) Frequency (F)       116
                               Left-sided Pr <= F          0.7312
                               Right-sided Pr >= F         0.3438

                               Table Probability (P)       0.0750
                               Two-sided Pr <= P           0.6688

                                  Effective Sample Size = 404
                                     Frequency Missing = 5
```

```
Table A48              Association of agg_grp by year_cov

                            agg_grp        year_cov

                            Frequency     ,
                            Percent       ,
                            Row Pct       ,
                            Col Pct       ,PRE-ELEC,POST-ELE,  Total
                                          ,TION YEA,CTION YE,
                                          ,RS      ,ARS     ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            BELOW 60%     ,    131 ,    139 ,    270
                                          ,  32.43 ,  34.41 ,  66.83
                                          ,  48.52 ,  51.48 ,
                                          ,  68.59 ,  65.26 ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            60% AND ABOVE ,     60 ,     74 ,    134
                                          ,  14.85 ,  18.32 ,  33.17
                                          ,  44.78 ,  55.22 ,
                                          ,  31.41 ,  34.74 ,
                            ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
                            Total              191      213      404
                                             47.28    52.72   100.00
```

```
                 Frequency Missing = 5

                   The FREQ Procedure

   Statistics for Association of agg_grp by year_cov

 Statistic                     DF       Value      Prob
 ffffffffffffffffffffffffffffffffffffffffffffffffffffff
 Chi-Square                     1      0.5032    0.4781
 Likelihood Ratio Chi-Square    1      0.5038    0.4778
 Continuity Adj. Chi-Square     1      0.3643    0.5462
 Mantel-Haenszel Chi-Square     1      0.5020    0.4786
 Phi Coefficient                       0.0353
 Contingency Coefficient               0.0353
 Cramer's V                            0.0353


                  Fisher's Exact Test
           ffffffffffffffffffffffffffffffffff
           Cell (1,1) Frequency (F)       131
           Left-sided Pr <= F          0.7924
           Right-sided Pr >= F         0.2733

           Table Probability (P)       0.0657
           Two-sided Pr <= P           0.5258

              Effective Sample Size = 404
                 Frequency Missing = 5
```

```
Table A49             Association of math_grp by immediate

                           math_grp       immediate

                           Frequency     ,
                           Percent       ,
                           Row Pct       ,
                           Col Pct       ,NOT DIRE,DIRECTLY,  Total
                                         ,CTLY AFT, AFTER S,
                                         ,ER SCHOO,CHOOL   ,
                                         ,L       ,        ,
                           ffffffffffffffˆffffffffˆffffffffˆ
                           BELOW 60%     ,    127 ,    164 ,    291
                                         ,  31.51 ,  40.69 ,  72.21
                                         ,  43.64 ,  56.36 ,
                                         ,  75.60 ,  69.79 ,
                           ffffffffffffffˆffffffffˆffffffffˆ
                           60% AND ABOVE ,     41 ,     71 ,    112
                                         ,  10.17 ,  17.62 ,  27.79
                                         ,  36.61 ,  63.39 ,
                                         ,  24.40 ,  30.21 ,
                           ffffffffffffffˆffffffffˆffffffffˆ
                           Total              168      235      403
                                            41.69    58.31   100.00

                                  Frequency Missing = 6

                                    The FREQ Procedure

                    Statistics for Association of math_grp by immediate

                  Statistic                     DF       Value      Prob
                  ffffffffffffffffffffffffffffffffffffffffffffffffffffff
                  Chi-Square                     1      1.6467    0.1994
                  Likelihood Ratio Chi-Square    1      1.6611    0.1975
                  Continuity Adj. Chi-Square     1      1.3700    0.2418
                  Mantel-Haenszel Chi-Square     1      1.6427    0.2000
                  Phi Coefficient                       0.0639
                  Contingency Coefficient               0.0638
                  Cramer's V                            0.0639


                                   Fisher's Exact Test
                            ffffffffffffffffffffffffffffffffff
                            Cell (1,1) Frequency (F)       127
                            Left-sided Pr <= F          0.9191
                            Right-sided Pr >= F         0.1207
```

```
          Table Probability (P)       0.0398
          Two-sided Pr <= P           0.2160

             Effective Sample Size = 403
                Frequency Missing = 6
```

```
Table A50               Association of math_grp by year_cov

       math_grp       year_cov

       Frequency     ‚
       Percent       ‚
       Row Pct       ‚
       Col Pct       ‚PRE-ELEC‚POST-ELE‚  Total
                     ‚TION YEA‚CTION YE‚
                     ‚RS      ‚ARS     ‚
       ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
       BELOW 60%     ‚    130 ‚    161 ‚    291
                     ‚  32.26 ‚  39.95 ‚  72.21
                     ‚  44.67 ‚  55.33 ‚
                     ‚  68.42 ‚  75.59 ‚
       ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
       60% AND ABOVE ‚     60 ‚     52 ‚    112
                     ‚  14.89 ‚  12.90 ‚  27.79
                     ‚  53.57 ‚  46.43 ‚
                     ‚  31.58 ‚  24.41 ‚
       ƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
       Total              190      213      403
                        47.15    52.85   100.00

                Frequency Missing = 6

                  The FREQ Procedure

  Statistics for Association of math_grp by year_cov

Statistic                     DF       Value      Prob
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square                     1      2.5695    0.1089
Likelihood Ratio Chi-Square    1      2.5672    0.1091
Continuity Adj. Chi-Square     1      2.2249    0.1358
Mantel-Haenszel Chi-Square     1      2.5632    0.1094
Phi Coefficient                      -0.0799
Contingency Coefficient               0.0796
Cramer's V                           -0.0799


                 Fisher's Exact Test
          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
          Cell (1,1) Frequency (F)       130
          Left-sided Pr <= F          0.0680
          Right-sided Pr >= F         0.9567

          Table Probability (P)       0.0247
          Two-sided Pr <= P           0.1195

             Effective Sample Size = 403
                Frequency Missing = 6
```

```
Table A51               Association of immediate by year_cov

     immediate         year_cov

     Frequency        ‚
     Percent          ‚
     Row Pct          ‚
     Col Pct          ‚PRE-ELEC‚POST-ELE‚  Total
                      ‚TION YEA‚CTION YE‚
                      ‚RS      ‚ARS     ‚
     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
     NOT DIRECTLY AFT ‚     92 ‚     79 ‚    171
     ER SCHOOL        ‚  22.49 ‚  19.32 ‚  41.81
```

```
                      ,  53.80 ,  46.20 ,
                      ,  46.94 ,  37.09 ,
     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
     DIRECTLY AFTER S ,    104 ,    134 ,    238
     CHOOL            ,  25.43 ,  32.76 ,  58.19
                      ,  43.70 ,  56.30 ,
                      ,  53.06 ,  62.91 ,
     ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒˆ
     Total                 196      213      409
                         47.92    52.08   100.00

                  The FREQ Procedure

  Statistics for Association of immediate by year_cov

Statistic                     DF        Value      Prob
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
Chi-Square                     1       4.0702    0.0436
Likelihood Ratio Chi-Square    1       4.0740    0.0435
Continuity Adj. Chi-Square     1       3.6755    0.0552
Mantel-Haenszel Chi-Square     1       4.0603    0.0439
Phi Coefficient                        0.0998
Contingency Coefficient                0.0993
Cramer's V                             0.0998


                 Fisher's Exact Test
          ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
          Cell (1,1) Frequency (F)        92
          Left-sided Pr <= F          0.9829
          Right-sided Pr >= F         0.0276

          Table Probability (P)       0.0105
          Two-sided Pr <= P           0.0455

                  Sample Size = 409
```

Appendix B

B1 Gender logistic regression model

```
Table B1                              GENDER
                                 The LOGISTIC Procedure

                                       Model Information

                         Data Set                      COM.ALL
                         Response Variable             through
                         Number of Response Levels     2
                         Number of Observations        409
                         Model                         binary logit
                         Optimization Technique        Fisher's scoring


                                        Response Profile

                            Ordered                            Total
                              Value     through            Frequency

                                  1     THROUGHPUT                86
                                  2     NON-THROUGHPUT           323

                          Probability modeled is through='THROUGHPUT'.


                                    Class Level Information

                                                       Design
                                                     Variables

                                Class      Value             1

                                GENDER     FEMALE            1
                                           MALE             -1


                                    Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.


                                     Model Fit Statistics

                                                          Intercept
                                           Intercept         and
                            Criterion        Only        Covariates

                            AIC             422.708         421.534
                            SC              426.722         429.562
                            -2 Log L        420.708         417.534
```

```
                    The LOGISTIC Procedure

           Testing Global Null Hypothesis: BETA=0

   Test                 Chi-Square       DF     Pr > ChiSq

   Likelihood Ratio         3.1735        1         0.0748
   Score                    3.1246        1         0.0771
   Wald                     3.0960        1         0.0785


                  Type III Analysis of Effects

                                   Wald
          Effect      DF    Chi-Square    Pr > ChiSq

          GENDER       1        3.0960        0.0785


                   Analysis of Maximum Likelihood Estimates

                                              Standard          Wald
Parameter            DF     Estimate       Error    Chi-Square    Pr > ChiSq

Intercept             1      -1.3671      0.1262      117.4143        <.0001
GENDER    FEMALE      1      -0.2220      0.1262        3.0960        0.0785


                       Odds Ratio Estimates

                                    Point          95% Wald
     Effect                      Estimate      Confidence Limits

     GENDER FEMALE vs MALE          0.641       0.391       1.052


      Association of Predicted Probabilities and Observed Responses

            Percent Concordant     29.6    Somers' D    0.106
            Percent Discordant     19.0    Gamma        0.218
            Percent Tied           51.4    Tau-a        0.035
            Pairs                 27778    c            0.553


            Wald Confidence Interval for Adjusted Odds Ratios

Effect                         Unit     Estimate     95% Confidence Limits

GENDER FEMALE vs MALE        1.0000        0.641        0.391        1.052
```

```
                              The LOGISTIC Procedure

                               Classification Table

          Correct      Incorrect                        Percentages
 Prob          Non-          Non-           Sensi-  Speci-  False  False
Level  Event  Event  Event  Event  Correct  tivity  ficity   POS    NEG

0.160     86      0    323      0     21.0   100.0     0.0   79.0     .
0.180     56    147    176     30     49.6    65.1    45.5   75.9   16.9
0.200     56    147    176     30     49.6    65.1    45.5   75.9   16.9
0.220     56    147    176     30     49.6    65.1    45.5   75.9   16.9
0.240      0    147    176     86     35.9     0.0    45.5  100.0   36.9
0.260      0    323      0     86     79.0     0.0   100.0     .    21.0
```

B2 African logistic regression model

```
Table B2                             AFRICAN
                                 The LOGISTIC Procedure

                                       Model Information

                         Data Set                      COM.ALL
                         Response Variable             through
                         Number of Response Levels     2
                         Number of Observations        409
                         Model                         binary logit
                         Optimization Technique        Fisher's scoring


                                        Response Profile

                            Ordered                              Total
                              Value     through              Frequency

                                  1     THROUGHPUT                  86
                                  2     NON-THROUGHPUT             323

                          Probability modeled is through='THROUGHPUT'.


                                    Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.


                                     Model Fit Statistics

                                                          Intercept
                                           Intercept         and
                            Criterion        Only        Covariates

                            AIC              422.708        420.553
                            SC               426.722        428.581
                            -2 Log L         420.708        416.553


                            Testing Global Null Hypothesis: BETA=0

                    Test                 Chi-Square       DF     Pr > ChiSq

                    Likelihood Ratio         4.1546        1         0.0415
                    Score                    4.1831        1         0.0408
                    Wald                     4.1409        1         0.0419
```

```
                           The LOGISTIC Procedure

                  Analysis of Maximum Likelihood Estimates

                                    Standard          Wald
      Parameter    DF    Estimate      Error    Chi-Square    Pr > ChiSq

      Intercept     1     -1.0616     0.1710       38.5221        <.0001
      african       1     -0.4964     0.2440        4.1409        0.0419


                           Odds Ratio Estimates

                                 Point          95% Wald
                  Effect     Estimate      Confidence Limits

                  african       0.609       0.377       0.982


         Association of Predicted Probabilities and Observed Responses

               Percent Concordant     31.5    Somers' D    0.123
               Percent Discordant     19.2    Gamma        0.243
               Percent Tied           49.4    Tau-a        0.041
               Pairs                 27778    c            0.562


               Wald Confidence Interval for Adjusted Odds Ratios

          Effect          Unit     Estimate     95% Confidence Limits

          african       1.0000        0.609        0.377        0.982


                            Classification Table

               Correct      Incorrect                  Percentages
  Prob             Non-           Non-          Sensi-  Speci-  False  False
 Level   Event   Event   Event   Event  Correct  tivity  ficity   POS    NEG

 0.160      86       0     323       0     21.0   100.0     0.0   79.0      .
 0.180      46     190     133      40     57.7    53.5    58.8   74.3   17.4
 0.200      46     190     133      40     57.7    53.5    58.8   74.3   17.4
 0.220      46     190     133      40     57.7    53.5    58.8   74.3   17.4
 0.240      46     190     133      40     57.7    53.5    58.8   74.3   17.4
 0.260       0     323       0      86     79.0     0.0   100.0      .   21.0
```

B3 English logistic regression model

```
Table B3                             ENGLISH
                                The LOGISTIC Procedure

                                       Model Information

                         Data Set                      COM.ALL
                         Response Variable             through
                         Number of Response Levels     2
                         Number of Observations        409
                         Model                         binary logit
                         Optimization Technique        Fisher's scoring


                                        Response Profile

                            Ordered                               Total
                              Value     through               Frequency

                                  1     THROUGHPUT                   86
                                  2     NON-THROUGHPUT              323

                          Probability modeled is through='THROUGHPUT'.


                                    Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.


                                     Model Fit Statistics

                                                          Intercept
                                           Intercept            and
                            Criterion        Only        Covariates

                            AIC             422.708         418.981
                            SC              426.722         427.008
                            -2 Log L        420.708         414.981


                            Testing Global Null Hypothesis: BETA=0

                    Test                 Chi-Square       DF     Pr > ChiSq

                    Likelihood Ratio         5.7270        1         0.0167
                    Score                    5.9428        1         0.0148
                    Wald                     5.8484        1         0.0156
```

```
                           The LOGISTIC Procedure

                 Analysis of Maximum Likelihood Estimates

                                   Standard          Wald
    Parameter    DF    Estimate       Error    Chi-Square    Pr > ChiSq

    Intercept     1     -1.5347      0.1559       96.8867        <.0001
    english       1      0.6074      0.2512        5.8484        0.0156


                           Odds Ratio Estimates

                              Point          95% Wald
                Effect     Estimate      Confidence Limits

                english       1.836       1.122       3.003


       Association of Predicted Probabilities and Observed Responses

             Percent Concordant    30.1    Somers' D    0.137
             Percent Discordant    16.4    Gamma        0.295
             Percent Tied          53.6    Tau-a        0.046
             Pairs                27778    c            0.568


             Wald Confidence Interval for Adjusted Odds Ratios

        Effect          Unit     Estimate     95% Confidence Limits

        english       1.0000        1.836        1.122        3.003


                            Classification Table

          Correct      Incorrect                Percentages
 Prob          Non-          Non-           Sensi-  Speci-  False  False
Level  Event  Event  Event  Event  Correct  tivity  ficity   POS    NEG

0.160     86      0    323      0     21.0   100.0     0.0    79.0       .
0.180     36    232     91     50     65.5    41.9    71.8    71.7    17.7
0.200     36    232     91     50     65.5    41.9    71.8    71.7    17.7
0.220     36    232     91     50     65.5    41.9    71.8    71.7    17.7
0.240     36    232     91     50     65.5    41.9    71.8    71.7    17.7
0.260     36    232     91     50     65.5    41.9    71.8    71.7    17.7
0.280      0    232     91     86     56.7     0.0    71.8   100.0    27.0
0.300      0    323      0     86     79.0     0.0   100.0      .     21.0
```

B4 Aggregate logistic regression model

```
Table B4                         AGGREAGTE
                              The LOGISTIC Procedure


                                    Model Information

                         Data Set                      COM.ALL
                         Response Variable             through
                         Number of Response Levels     2
                         Number of Observations        404
                         Model                         binary logit
                         Optimization Technique        Fisher's scoring


                                     Response Profile

                            Ordered                            Total
                              Value     through            Frequency

                                  1     THROUGHPUT                86
                                  2     NON-THROUGHPUT           318

                          Probability modeled is through='THROUGHPUT'.

NOTE: 5 observations were deleted due to missing values for the response or
explanatory
       variables


                                 Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.


                                  Model Fit Statistics

                                                        Intercept
                                         Intercept            and
                            Criterion          Only     Covariates

                            AIC             420.331        408.939
                            SC              424.332        416.942
                            -2 Log L        418.331        404.939


                            Testing Global Null Hypothesis: BETA=0

                    Test                 Chi-Square       DF     Pr > ChiSq

                    Likelihood Ratio        13.3920        1         0.0003
                    Score                   13.9637        1         0.0002
                    Wald                    13.4973        1         0.0002
```

```
                       The LOGISTIC Procedure

             Analysis of Maximum Likelihood Estimates

                               Standard          Wald
Parameter    DF    Estimate       Error    Chi-Square    Pr > ChiSq

Intercept     1     -1.6637      0.1663      100.0706        <.0001
agg_grp       1      0.9141      0.2488       13.4973        0.0002


                       Odds Ratio Estimates

                          Point          95% Wald
            Effect     Estimate      Confidence Limits

            agg_grp       2.495       1.532       4.062


   Association of Predicted Probabilities and Observed Responses

         Percent Concordant     35.7    Somers' D    0.214
         Percent Discordant     14.3    Gamma        0.428
         Percent Tied           50.0    Tau-a        0.072
         Pairs                 27348    c            0.607


         Wald Confidence Interval for Adjusted Odds Ratios

    Effect          Unit     Estimate     95% Confidence Limits

    agg_grp       1.0000        2.495        1.532        4.062
```

```
                               Classification Table

          Correct      Incorrect                   Percentages
 Prob          Non-          Non-              Sensi-  Speci-  False  False
Level  Event  Event  Event  Event  Correct  tivity  ficity   POS    NEG

0.140     86      0    318      0     21.3   100.0     0.0   78.7      .
0.160     43    227     91     43     66.8    50.0    71.4   67.9   15.9
0.180     43    227     91     43     66.8    50.0    71.4   67.9   15.9
0.200     43    227     91     43     66.8    50.0    71.4   67.9   15.9
0.220     43    227     91     43     66.8    50.0    71.4   67.9   15.9
0.240     43    227     91     43     66.8    50.0    71.4   67.9   15.9
0.260     43    227     91     43     66.8    50.0    71.4   67.9   15.9
0.280     43    227     91     43     66.8    50.0    71.4   67.9   15.9
0.300     43    227     91     43     66.8    50.0    71.4   67.9   15.9
0.320      0    227     91     86     56.2     0.0    71.4  100.0   27.5
0.340      0    318      0     86     78.7     0.0   100.0      .   21.3
```

B5 Mathematics logistic regression model

```
Table B5                              MATHEMATICS
                                 The LOGISTIC Procedure


                                       Model Information

                         Data Set                      COM.ALL
                         Response Variable             through
                         Number of Response Levels     2
                         Number of Observations        403
                         Model                         binary logit
                         Optimization Technique        Fisher's scoring


                                        Response Profile

                            Ordered                            Total
                              Value     through            Frequency

                                  1     THROUGHPUT                85
                                  2     NON-THROUGHPUT           318

                          Probability modeled is through='THROUGHPUT'.

NOTE: 6 observations were deleted due to missing values for the response or
explanatory
       variables


                                    Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.


                                     Model Fit Statistics

                                                          Intercept
                                           Intercept         and
                            Criterion        Only        Covariates

                            AIC              417.227        414.235
                            SC               421.226        422.233
                            -2 Log L         415.227        410.235


                            Testing Global Null Hypothesis: BETA=0

                    Test                 Chi-Square       DF     Pr > ChiSq

                    Likelihood Ratio         4.9927        1         0.0255
                    Score                    5.2138        1         0.0224
                    Wald                     5.1337        1         0.0235
```

```
                       The LOGISTIC Procedure

             Analysis of Maximum Likelihood Estimates

                               Standard          Wald
Parameter    DF    Estimate       Error    Chi-Square    Pr > ChiSq

Intercept     1     -1.5020      0.1519       97.7884        <.0001
math_grp      1      0.5857      0.2585        5.1337        0.0235


                        Odds Ratio Estimates

                           Point          95% Wald
            Effect      Estimate      Confidence Limits

            math_grp       1.796       1.082       2.981


   Association of Predicted Probabilities and Observed Responses

         Percent Concordant     28.2    Somers' D    0.125
         Percent Discordant     15.7    Gamma        0.285
         Percent Tied           56.1    Tau-a        0.042
         Pairs                 27030    c            0.562


         Wald Confidence Interval for Adjusted Odds Ratios

    Effect           Unit     Estimate     95% Confidence Limits

    math_grp       1.0000        1.796        1.082        2.981


                        Classification Table

            Correct      Incorrect                 Percentages
 Prob          Non-          Non-           Sensi-  Speci-  False  False
Level  Event  Event  Event  Event  Correct  tivity  ficity   POS    NEG

0.160     85      0    318      0     21.1   100.0     0.0   78.9      .
0.180     32      0    318     53      7.9    37.6     0.0   90.9  100.0
0.200     32    238     80     53     67.0    37.6    74.8   71.4   18.2
0.220     32    238     80     53     67.0    37.6    74.8   71.4   18.2
0.240     32    238     80     53     67.0    37.6    74.8   71.4   18.2
0.260     32    238     80     53     67.0    37.6    74.8   71.4   18.2
0.280      0    238     80     85     59.1     0.0    74.8  100.0   26.3
0.300      0    318      0     85     78.9     0.0   100.0      .   21.1
```

B6 Immediately logistic regression model

```
Table B6                             IMMEDIATELY
                                The LOGISTIC Procedure


                                      Model Information

                         Data Set                       COM.ALL
                         Response Variable              through
                         Number of Response Levels      2
                         Number of Observations         409
                         Model                          binary logit
                         Optimization Technique         Fisher's scoring


                                       Response Profile

                            Ordered                             Total
                              Value     through             Frequency

                                  1     THROUGHPUT                 86
                                  2     NON-THROUGHPUT            323

                          Probability modeled is through='THROUGHPUT'.


                                   Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.


                                    Model Fit Statistics

                                                         Intercept
                                           Intercept           and
                            Criterion           Only    Covariates

                            AIC              422.708       422.516
                            SC               426.722       430.544
                            -2 Log L         420.708       418.516


                            Testing Global Null Hypothesis: BETA=0

                    Test                 Chi-Square       DF     Pr > ChiSq

                    Likelihood Ratio         2.1916        1         0.1388
                    Score                    2.2108        1         0.1370
                    Wald                     2.1990        1         0.1381
```

```
                           The LOGISTIC Procedure

                 Analysis of Maximum Likelihood Estimates

                                   Standard          Wald
    Parameter    DF    Estimate       Error    Chi-Square    Pr > ChiSq

    Intercept     1     -1.1221      0.1777       39.8951        <.0001
    immediate     1     -0.3615      0.2438        2.1990        0.1381


                           Odds Ratio Estimates

                               Point          95% Wald
               Effect       Estimate      Confidence Limits

               immediate       0.697       0.432       1.123


       Association of Predicted Probabilities and Observed Responses

             Percent Concordant     29.3    Somers' D    0.089
             Percent Discordant     20.4    Gamma        0.179
             Percent Tied           50.2    Tau-a        0.030
             Pairs                 27778    c            0.544


             Wald Confidence Interval for Adjusted Odds Ratios

       Effect            Unit     Estimate     95% Confidence Limits

       immediate       1.0000        0.697        0.432        1.123


                      Classification Table

             Correct      Incorrect                Percentages
 Prob          Non-          Non-          Sensi-  Speci-  False  False
Level  Event  Event  Event  Event  Correct tivity  ficity   POS    NEG

0.180     86      0    323      0     21.0  100.0     0.0   79.0      .
0.200     42    194    129     44     57.7   48.8    60.1   75.4   18.5
0.220     42    194    129     44     57.7   48.8    60.1   75.4   18.5
0.240     42    194    129     44     57.7   48.8    60.1   75.4   18.5
0.260      0    323      0     86     79.0    0.0   100.0      .   21.0
```

B7 Year covariate logistic regression model

```
Table B7                             YEAR COVARIATE
                                The LOGISTIC Procedure

                                      Model Information

                         Data Set                      COM.ALL
                         Response Variable             through
                         Number of Response Levels     2
                         Number of Observations        409
                         Model                         binary logit
                         Optimization Technique        Fisher's scoring

                                       Response Profile

                            Ordered                          Total
                              Value     through          Frequency

                                  1     THROUGHPUT              86
                                  2     NON-THROUGHPUT         323

                          Probability modeled is through='THROUGHPUT'.

                                   Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.

                                     Model Fit Statistics

                                                         Intercept
                                          Intercept            and
                            Criterion          Only     Covariates

                            AIC             422.708        408.752
                            SC              426.722        416.780
                            -2 Log L        420.708        404.752

                            Testing Global Null Hypothesis: BETA=0

                    Test                 Chi-Square       DF     Pr > ChiSq

                    Likelihood Ratio        15.9555        1         <.0001
                    Score                   15.5076        1         <.0001
                    Wald                    14.8161        1         0.0001
```

```
                         The LOGISTIC Procedure

               Analysis of Maximum Likelihood Estimates

                                  Standard          Wald
Parameter     DF     Estimate        Error    Chi-Square    Pr > ChiSq

Intercept      1      -1.9228       0.2141       80.6384        <.0001
year_cov       1       1.0098       0.2623       14.8161        0.0001


                          Odds Ratio Estimates

                            Point          95% Wald
            Effect      Estimate      Confidence Limits

            year_cov       2.745       1.641       4.590


   Association of Predicted Probabilities and Observed Responses

         Percent Concordant     37.6    Somers' D    0.239
         Percent Discordant     13.7    Gamma        0.466
         Percent Tied           48.8    Tau-a        0.079
         Pairs                 27778    c            0.619


         Wald Confidence Interval for Adjusted Odds Ratios

    Effect           Unit      Estimate     95% Confidence Limits

    year_cov       1.0000         2.745        1.641        4.590


                          Classification Table

            Correct      Incorrect                    Percentages
 Prob          Non-          Non-              Sensi-   Speci-   False   False
Level   Event  Event   Event  Event   Correct  tivity   ficity    POS     NEG

0.120     86      0     323      0      21.0   100.0      0.0    79.0      .
0.140     61    171     152     25      56.7    70.9     52.9    71.4    12.8
0.160     61    171     152     25      56.7    70.9     52.9    71.4    12.8
0.180     61    171     152     25      56.7    70.9     52.9    71.4    12.8
0.200     61    171     152     25      56.7    70.9     52.9    71.4    12.8
0.220     61    171     152     25      56.7    70.9     52.9    71.4    12.8
0.240     61    171     152     25      56.7    70.9     52.9    71.4    12.8
0.260     61    171     152     25      56.7    70.9     52.9    71.4    12.8
0.280     61    171     152     25      56.7    70.9     52.9    71.4    12.8
0.300      0    323       0     86      79.0     0.0    100.0      .     21.0
```

Appendix C

C1 Full logistic regression model with all predictors

```
Table C1                      FULL MODEL WITH ALL PREDICTORS

                                     The LOGISTIC Procedure

                                       Model Information

                         Data Set                      COM.ALL
                         Response Variable             through
                         Number of Response Levels     2
                         Number of Observations        398
                         Model                         binary logit
                         Optimization Technique        Fisher's scoring


                                        Response Profile

                            Ordered                              Total
                              Value     through              Frequency

                                  1     THROUGHPUT                  85
                                  2     NON-THROUGHPUT             313

                          Probability modeled is through='THROUGHPUT'.

NOTE: 11 observations were deleted due to missing values for the response or
explanatory variables


                                    Class Level Information

                                                          Design
                                                        Variables

                                Class      Value              1

                                GENDER     FEMALE             1
                                           MALE              -1

                                    Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.


                                     Model Fit Statistics

                                                           Intercept
                                            Intercept         and
                            Criterion         Only        Covariates

                            AIC             414.842          390.116
                            SC              418.828          422.007
                            -2 Log L        412.842          374.116
```

```
                          The LOGISTIC Procedure

                 Testing Global Null Hypothesis: BETA=0

          Test                 Chi-Square       DF     Pr > ChiSq

          Likelihood Ratio        38.7262        7         <.0001
          Score                   38.1826        7         <.0001
          Wald                    34.0935        7         <.0001


                      Type III Analysis of Effects

                                        Wald
               Effect         DF    Chi-Square    Pr > ChiSq

               GENDER          1        1.9519        0.1624
               african         1        0.2147        0.6431
               english         1        2.1264        0.1448
               agg_grp         1        4.9836        0.0256
               math_grp        1        1.7715        0.1832
               immediate       1        2.5019        0.1137
               year_cov        1       16.4311        <.0001


                   Analysis of Maximum Likelihood Estimates

                                         Standard          Wald
Parameter           DF    Estimate        Error    Chi-Square    Pr > ChiSq

Intercept            1     -2.5021       0.5152       23.5854        <.0001
GENDER    FEMALE     1     -0.1942       0.1390        1.9519        0.1624
african              1      0.2054       0.4432        0.2147        0.6431
english              1      0.5922       0.4061        2.1264        0.1448
agg_grp              1      0.6869       0.3077        4.9836        0.0256
math_grp             1      0.4032       0.3030        1.7715        0.1832
immediate            1     -0.4343       0.2745        2.5019        0.1137
year_cov             1      1.1449       0.2824       16.4311        <.0001


                           Odds Ratio Estimates

                                       Point          95% Wald
      Effect                        Estimate      Confidence Limits

      GENDER    FEMALE vs MALE         0.678       0.393       1.169
      african                          1.228       0.515       2.927
      english                          1.808       0.816       4.008
      agg_grp                          1.987       1.087       3.632
      math_grp                         1.497       0.827       2.710
      immediate                        0.648       0.378       1.109
      year_cov                         3.142       1.806       5.466

                          The LOGISTIC Procedure

      Association of Predicted Probabilities and Observed Responses

            Percent Concordant     69.4    Somers' D    0.417
            Percent Discordant     27.7    Gamma        0.429
            Percent Tied            2.9    Tau-a        0.140
            Pairs                 26605    c            0.708
            Wald Confidence Interval for Adjusted Odds Ratios

Effect                             Unit     Estimate     95% Confidence Limits

GENDER    FEMALE vs MALE         1.0000        0.678        0.393        1.169
african                          1.0000        1.228        0.515        2.927
english                          1.0000        1.808        0.816        4.008
agg_grp                          1.0000        1.987        1.087        3.632
math_grp                         1.0000        1.497        0.827        2.710
immediate                        1.0000        0.648        0.378        1.109
year_cov                         1.0000        3.142        1.806        5.466


                           Classification Table

               Correct      Incorrect            Percentages
Prob            Non-          Non-          Sensi-  Speci-  False  False
Level  Event  Event  Event  Event  Correct  tivity  ficity   POS    NEG

      0.040     85      0    313      0     21.4   100.0     0.0   78.6     .
      0.060     85     16    297      0     25.4   100.0     5.1   77.7    0.0
       0.080    78     56    257      7     33.7    91.8    17.9   76.7   11.1
       0.100    77     61    252      8     34.7    90.6    19.5   76.6   11.6
       0.120    73    105    208     12     44.7    85.9    33.5   74.0   10.3
       0.140    67    114    199     18     45.5    78.8    36.4   74.8   13.6
       0.160    66    158    155     19     56.3    77.6    50.5   70.1   10.7
       0.180    63    169    144     22     58.3    74.1    54.0   69.6   11.5
```

0.200	53	173	140	32	56.8	62.4	55.3	72.5	15.6
0.220	**51**	**221**	**92**	**34**	**68.3**	**60.0**	**70.6**	**64.3**	**13.3**
0.240	49	224	89	36	68.6	57.6	71.6	64.5	13.8
0.260	44	228	85	41	68.3	51.8	72.8	65.9	15.2
0.280	36	249	64	49	71.6	42.4	79.6	64.0	16.4
0.300	36	265	48	49	75.6	42.4	84.7	57.1	15.6
0.320	30	266	47	55	74.4	35.3	85.0	61.0	17.1
0.340	27	272	41	58	75.1	31.8	86.9	60.3	17.6
0.360	19	280	33	66	75.1	22.4	89.5	63.5	19.1
0.380	18	285	28	67	76.1	21.2	91.1	60.9	19.0
0.400	17	286	27	68	76.1	20.0	91.4	61.4	19.2
0.420	12	288	25	73	75.4	14.1	92.0	67.6	20.2
0.440	12	298	15	73	77.9	14.1	95.2	55.6	19.7
0.460	11	302	11	74	78.6	12.9	96.5	50.0	19.7
0.480	11	302	11	74	78.6	12.9	96.5	50.0	19.7
0.500	11	303	10	74	78.9	12.9	96.8	47.6	19.6
0.520	5	305	8	80	77.9	5.9	97.4	61.5	20.8
0.540	5	307	6	80	78.4	5.9	98.1	54.5	20.7
0.560	5	312	1	80	79.6	5.9	99.7	16.7	20.4
0.580	5	312	1	80	79.6	5.9	99.7	16.7	20.4
0.600	5	312	1	80	79.6	5.9	99.7	16.7	20.4
0.620	0	312	1	85	78.4	0.0	99.7	100.0	21.4
0.640	0	312	1	85	78.4	0.0	99.7	100.0	21.4
0.660	0	313	0	85	78.6	0.0	100.0	.	21.4

Appendix D

D1 Full logistic regression model without year covariate

```
Table D1                      FULL MODEL WITHOUT YEAR COVARIATE

                                     The LOGISTIC Procedure

                                       Model Information

                         Data Set                      COM.ALL
                         Response Variable             through
                         Number of Response Levels     2
                         Number of Observations        398
                         Model                         binary logit
                         Optimization Technique        Fisher's scoring


                                        Response Profile

                            Ordered                             Total
                              Value     through             Frequency

                                  1     THROUGHPUT                 85
                                  2     NON-THROUGHPUT            313

                          Probability modeled is through='THROUGHPUT'.

NOTE: 11 observations were deleted due to missing values for the response or
explanatory
       variables


                                    Class Level Information

                                                        Design
                                                      Variables

                                Class      Value              1

                                GENDER     FEMALE             1
                                           MALE              -1


                                    Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.


                                     Model Fit Statistics

                                                              Intercept
                                               Intercept            and
                            Criterion            Only        Covariates

                            AIC                414.842          406.054
                            SC                 418.828          433.959
                            -2 Log L           412.842          392.054
```

```
                         The LOGISTIC Procedure

               Testing Global Null Hypothesis: BETA=0

        Test                 Chi-Square       DF     Pr > ChiSq

        Likelihood Ratio        20.7879        6         0.0020
        Score                   21.5206        6         0.0015
        Wald                    20.2251        6         0.0025


                     Type III Analysis of Effects

                                          Wald
             Effect          DF     Chi-Square    Pr > ChiSq

             GENDER           1         1.8955        0.1686
             african          1         0.7634        0.3823
             english          1         2.3136        0.1282
             agg_grp          1         7.2464        0.0071
             math_grp         1         0.7415        0.3892
             immediate        1         1.2009        0.2731


                      Analysis of Maximum Likelihood Estimates

                                             Standard          Wald
    Parameter           DF    Estimate         Error    Chi-Square    Pr > ChiSq

    Intercept            1     -1.9869        0.4812       17.0510        <.0001
    GENDER    FEMALE     1     -0.1860        0.1351        1.8955        0.1686
    african              1      0.3801        0.4350        0.7634        0.3823
    english              1      0.6022        0.3959        2.3136        0.1282
    agg_grp              1      0.8117        0.3015        7.2464        0.0071
    math_grp             1      0.2545        0.2955        0.7415        0.3892
    immediate            1     -0.2899        0.2645        1.2009        0.2731


                           Odds Ratio Estimates

                                             Point          95% Wald
      Effect                              Estimate      Confidence Limits

      GENDER    FEMALE vs MALE               0.689        0.406       1.171
      african                                1.462        0.623       3.431
      english                                1.826        0.840       3.968
      agg_grp                                2.252        1.247       4.066
      math_grp                               1.290        0.723       2.302
      immediate                              0.748        0.446       1.257


                          The LOGISTIC Procedure

      Association of Predicted Probabilities and Observed Responses

            Percent Concordant     63.0    Somers' D    0.308
            Percent Discordant     32.2    Gamma        0.323
            Percent Tied            4.8    Tau-a        0.104
            Pairs                 26605    c            0.654

            Wald Confidence Interval for Adjusted Odds Ratios

   Effect                              Unit     Estimate     95% Confidence Limits

   GENDER    FEMALE vs MALE          1.0000        0.689        0.406         1.171
   african                           1.0000        1.462        0.623         3.431
   english                           1.0000        1.826        0.840         3.968
   agg_grp                           1.0000        2.252        1.247         4.066
   math_grp                          1.0000        1.290        0.723         2.302
   immediate                         1.0000        0.748        0.446         1.257


                             Classification Table

            Correct      Incorrect                Percentages
   Prob          Non-          Non-           Sensi-  Speci-  False  False
  Level  Event  Event  Event  Event  Correct  tivity  ficity   POS    NEG

  0.060     85      0    313      0     21.4   100.0     0.0   78.6      .
  0.080     85      4    309      0     22.4   100.0     1.3   78.4    0.0
  0.100     85      4    309      0     22.4   100.0     1.3   78.4    0.0
  0.120     80     53    260      5     33.4    94.1    16.9   76.5    8.6
  0.140     67     62    251     18     32.4    78.8    19.8   78.9   22.5
  0.160     63    138    175     22     50.5    74.1    44.1   73.5   13.8
  0.180     56    149    164     29     51.5    65.9    47.6   74.5   16.3
  0.200     46    210    103     39     64.3    54.1    67.1   69.1   15.7
  0.220     42    213    100     43     64.1    49.4    68.1   70.4   16.8
```

```
0.240     40    229     84     45     67.6     47.1     73.2    67.7    16.4
0.260     29    233     80     56     65.8     34.1     74.4    73.4    19.4
0.280     27    253     60     58     70.4     31.8     80.8    69.0    18.6
0.300     25    264     49     60     72.6     29.4     84.3    66.2    18.5
0.320     22    268     45     63     72.9     25.9     85.6    67.2    19.0
0.340     16    275     38     69     73.1     18.8     87.9    70.4    20.1
0.360     15    284     29     70     75.1     17.6     90.7    65.9    19.8
0.380     15    289     24     70     76.4     17.6     92.3    61.5    19.5
0.400      8    293     20     77     75.6      9.4     93.6    71.4    20.8
0.420      8    305      8     77     78.6      9.4     97.4    50.0    20.2
0.440      8    307      6     77     79.1      9.4     98.1    42.9    20.1
0.460      0    307      6     85     77.1      0.0     98.1   100.0    21.7
0.480      0    312      1     85     78.4      0.0     99.7   100.0    21.4
0.500      0    312      1     85     78.4      0.0     99.7   100.0    21.4
0.520      0    312      1     85     78.4      0.0     99.7   100.0    21.4
0.540      0    312      1     85     78.4      0.0     99.7   100.0    21.4
0.560      0    312      1     85     78.4      0.0     99.7   100.0    21.4
0.580      0    312      1     85     78.4      0.0     99.7   100.0    21.4
0.600      0    312      1     85     78.4      0.0     99.7   100.0    21.4
0.620      0    313      0     85     78.6      0.0    100.0       .    21.4
```

Appendix E

E1 Logistic regression - stepwise selection model

```
Table E1                      STEPWISE SELECTION MODEL
                               The LOGISTIC Procedure

                                       Model Information

                         Data Set                      COM.ALL
                         Response Variable             through
                         Number of Response Levels     2
                         Number of Observations        398
                         Model                         binary logit
                         Optimization Technique        Fisher's scoring


                                        Response Profile

                            Ordered                            Total
                              Value     through            Frequency

                                  1     THROUGHPUT                85
                                  2     NON-THROUGHPUT           313

                          Probability modeled is through='THROUGHPUT'.

NOTE: 11 observations were deleted due to missing values for the response or
explanatory
       variables


                                  Stepwise Selection Procedure


                                    Class Level Information

                                                        Design
                                                      Variables

                                Class      Value              1

                                GENDER     FEMALE             1
                                           MALE              -1


Step  0. Intercept entered:

                                    Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.
```

```
                                        The LOGISTIC Procedure

                              Analysis of Maximum Likelihood Estimates

                                                     Standard          Wald
          Parameter            DF     Estimate          Error    Chi-Square    Pr > ChiSq

          Intercept             1      -1.3036         0.1223      113.5892        <.0001


                                     Residual Chi-Square Test

                                 Chi-Square       DF     Pr > ChiSq

                                    38.1826        7         <.0001


                                  Analysis of Effects Not in the Model

                                                       Score
                             Effect          DF    Chi-Square    Pr > ChiSq

                             GENDER           1        4.0491        0.0442
                             african          1        4.2917        0.0383
                             english          1        5.7137        0.0168
                             agg_grp          1       14.3227        0.0002
                             math_grp         1        4.8302        0.0280
                             immediate        1        1.7478        0.1862
                             year_cov         1       14.4664        0.0001


Step  1. Effect year_cov entered:


                                       Model Convergence Status

                             Convergence criterion (GCONV=1E-8) satisfied.


                                        Model Fit Statistics

                                                             Intercept
                                              Intercept            and
                                Criterion          Only     Covariates

                                AIC             414.842        401.897
                                SC              418.828        409.870
                                -2 Log L        412.842        397.897
```

```
                      The LOGISTIC Procedure

               Testing Global Null Hypothesis: BETA=0

       Test                 Chi-Square       DF     Pr > ChiSq

       Likelihood Ratio        14.9448        1         0.0001
       Score                   14.4664        1         0.0001
       Wald                    13.8429        1         0.0002


                    Type III Analysis of Effects

                                        Wald
            Effect         DF     Chi-Square     Pr > ChiSq

            year_cov        1        13.8429         0.0002


               Analysis of Maximum Likelihood Estimates

                                         Standard          Wald
Parameter           DF     Estimate        Error     Chi-Square     Pr > ChiSq

Intercept            1      -1.9033       0.2188        75.6663         <.0001
year_cov             1       0.9903       0.2662        13.8429         0.0002


                        Odds Ratio Estimates

                                       Point          95% Wald
    Effect                          Estimate      Confidence Limits

    year_cov                           2.692       1.598       4.536


    Association of Predicted Probabilities and Observed Responses

          Percent Concordant     36.9    Somers' D    0.232
          Percent Discordant     13.7    Gamma        0.458
          Percent Tied           49.4    Tau-a        0.078
          Pairs                 26605    c            0.616


                     Residual Chi-Square Test

                  Chi-Square       DF     Pr > ChiSq

                     24.4097        6         0.0004
```

```
                                  The LOGISTIC Procedure

                              Analysis of Effects in Model

                                                  Wald
                         Effect         DF    Chi-Square    Pr > ChiSq

                         year_cov        1       13.8429        0.0002


                          Analysis of Effects Not in the Model

                                                 Score
                         Effect         DF    Chi-Square    Pr > ChiSq

                         GENDER          1        5.5714        0.0183
                         african         1        6.1982        0.0128
                         english         1        6.9592        0.0083
                         agg_grp         1       13.9054        0.0002
                         math_grp        1        6.8947        0.0086
                         immediate       1        3.1519        0.0758

Step  2. Effect agg_grp entered:

                                 Model Convergence Status

                         Convergence criterion (GCONV=1E-8) satisfied.

                                  Model Fit Statistics

                                                    Intercept
                                      Intercept        and
                            Criterion          Only     Covariates

                            AIC             414.842        390.499
                            SC              418.828        402.459
                            -2 Log L        412.842        384.499

                            Testing Global Null Hypothesis: BETA=0

                      Test                 Chi-Square       DF     Pr > ChiSq

                      Likelihood Ratio        28.3427        2         <.0001
                      Score                   27.9470        2         <.0001
                      Wald                    25.8763        2         <.0001
```

```
                         The LOGISTIC Procedure

                     Type III Analysis of Effects

                                          Wald
                 Effect          DF    Chi-Square    Pr > ChiSq

                 agg_grp          1       13.4390        0.0002
                 year_cov         1       13.5511        0.0002


               Analysis of Maximum Likelihood Estimates

                                         Standard          Wald
 Parameter           DF     Estimate        Error    Chi-Square    Pr > ChiSq

 Intercept            1      -2.2755       0.2530       80.9047        <.0001
 agg_grp              1       0.9374       0.2557       13.4390        0.0002
 year_cov             1       0.9964       0.2707       13.5511        0.0002


                          Odds Ratio Estimates

                                         Point          95% Wald
         Effect                       Estimate      Confidence Limits

         agg_grp                         2.553       1.547       4.215
         year_cov                        2.709       1.593       4.604


         Association of Predicted Probabilities and Observed Responses

               Percent Concordant     54.8    Somers' D    0.342
               Percent Discordant     20.6    Gamma        0.453
               Percent Tied           24.5    Tau-a        0.115
               Pairs                 26605    c            0.671


                        Residual Chi-Square Test

                    Chi-Square       DF     Pr > ChiSq

                       10.3725        5         0.0653


                     Analysis of Effects in Model

                                          Wald
                 Effect          DF    Chi-Square    Pr > ChiSq

                 agg_grp          1       13.4390        0.0002
                 year_cov         1       13.5511        0.0002
```

```
                              The LOGISTIC Procedure

                         Analysis of Effects Not in the Model

                                                 Score
                      Effect          DF    Chi-Square    Pr > ChiSq

                      GENDER           1        3.8083        0.0510
                      african          1        0.6413        0.4233
                      english          1        2.3402        0.1261
                      math_grp         1        1.8141        0.1780
                      immediate        1        3.3946        0.0654


NOTE: No (additional) effects met the 0.05 significance level for entry into the
model.


                              Summary of Stepwise Selection

            Effect                      Number       Score        Wald                 Variable
 Step   Entered     Removed     DF          In  Chi-Square  Chi-Square  Pr > ChiSq   Label

    1   year_cov                 1           1     14.4664           .       0.0001
    2   agg_grp                  1           2     13.9054           .           0.0002


                   Wald Confidence Interval for Adjusted Odds Ratios

         Effect                                   Unit      Estimate      95% Confidence Limits

         agg_grp                                1.0000         2.553         1.547         4.215
         year_cov                               1.0000         2.709         1.593         4.604


                                  Classification Table

                    Correct      Incorrect                  Percentages
          Prob           Non-          Non-             Sensi-  Speci-   False   False
          Level   Event  Event  Event  Event  Correct   tivity  ficity    POS     NEG

          0.080     85      0    313      0     21.4    100.0     0.0    78.6      .
          0.100     72    113    200     13     46.5     84.7    36.1    73.5    10.3
          0.120     72    113    200     13     46.5     84.7    36.1    73.5    10.3
          0.140     72    113    200     13     46.5     84.7    36.1    73.5    10.3
          0.160     72    113    200     13     46.5     84.7    36.1    73.5    10.3
          0.180     72    113    200     13     46.5     84.7    36.1    73.5    10.3
          0.200     61    113    200     24     43.7     71.8    36.1    76.6    17.5
          0.220     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.240     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.260     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.280     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.300     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.320     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.340     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.360     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.380     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.400     32    271     42     53     76.1     37.6    86.6    56.8    16.4
          0.420      0    271     42     85     68.1      0.0    86.6   100.0    23.9
          0.440      0    313      0     85     78.6      0.0   100.0      .     21.4
```