University of Pretoria

First Year Student Academic Risk Profile and the Determinants of Risk Profile: Cluster analysis.

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Presentation outline

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Background/Introduction

- Student success as a strategic goal

- UP CARES

  - Measurement of student academic readiness

  - Academic risk clusters

  - Measurement of first-year experience

  - Longitudinal study of student drop-out

Intervention programmes

Aim

Make data driven decisions that are actionable to improve student success:

- Academic success

- Retention/ persistence

- Learning experience

- Individual development

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Methodology

- Study design

The study involved 12542 First Year students at UP in 2014. The data were divided into SET and HUM students. Backward elimination regression analysis on 2013 first year students was used to determine the predictors for success in the second semester. Cluster analysis was then applied to the 2014 cohort based on the same predictor variables that were found statistically significant on the regression analysis in 2013.

Profiles of surveyed students		Frequency	Percentage
Ethnicity	Black	5613	44.8%
	White	5771	46.0%
	Asian	690	5.5%
	Coloured	304	2.4%
	Other	85	0.7%
	Undisclosed	79	0.6%
	Total	**12542**	**100.0%**
Gender	Female	6953	55.4%
	Male	5589	44.6%
	Total	12542	100.0%
School	HUM	5327	42.5%
	SET	7215	57.5%
	Total	**12542**	**100.0%**

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Methodology

- ## Statistical techniques

  Backward elimination regression analysis
  - Enables you to investigate the relationship between the response variable (Y) and several predictor variables (Xs).
  - It begins with the full model. Next, the variable that is least significant, given other variables, is removed from the model based on the largest p-value for all independent variables. This process continues until all remaining variables have a p-value < 0.05.

- ## Variables:

  - Outcome variable
    - Second semester average
  - Predictor variables
    - Ratio Credit Fail – credits of modules failed as the ratio of totally credits enrolled for.
    - First semester average.
    - Ratio poor module - A ratio calculated using the number of modules failed/discontinued from total number of modules registered for.
    - Grade 12 average.

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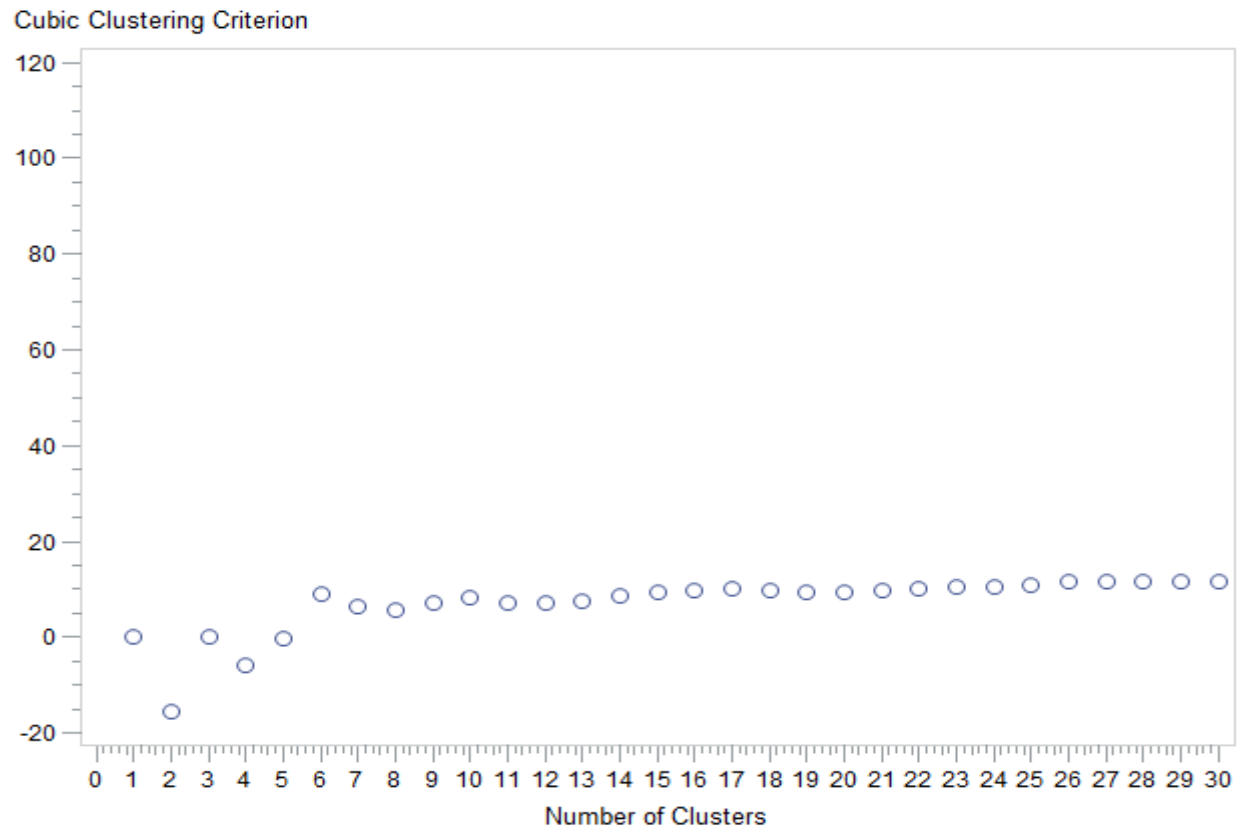Denkleiers • Leading Minds • Dikgopolo tša Dihlalefi

Methodology cont.: Cluster analysis

- **Cluster analysis** is a technique of grouping a set of objects in such a way that objects in the same group (called a **cluster**) are more similar to each other than to those in other groups (**clusters**).
- **Purpose of cluster analysis**
    - Discover and investigate relationships in order to decide if the data can be presented by small number of clusters of similar objects.
- **Two stage sequence of analysis occurs as follows:**
    - Ward method was used to determine the number of clusters applying Euclidean Distances as the distance or similar measure. This helps to determine the optimum number of clusters using Cubic clustering criterion plot and pseudo F plot.
    - The next stage is to rerun cluster analysis with our selected number of clusters, which helps to allocate every case in the data to a particular cluster.
- **Variables**
    - Ratio credit fail
    - First semester average

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Results: Cluster Analysis

Figure 1 : Plot of CCC vs. NCL

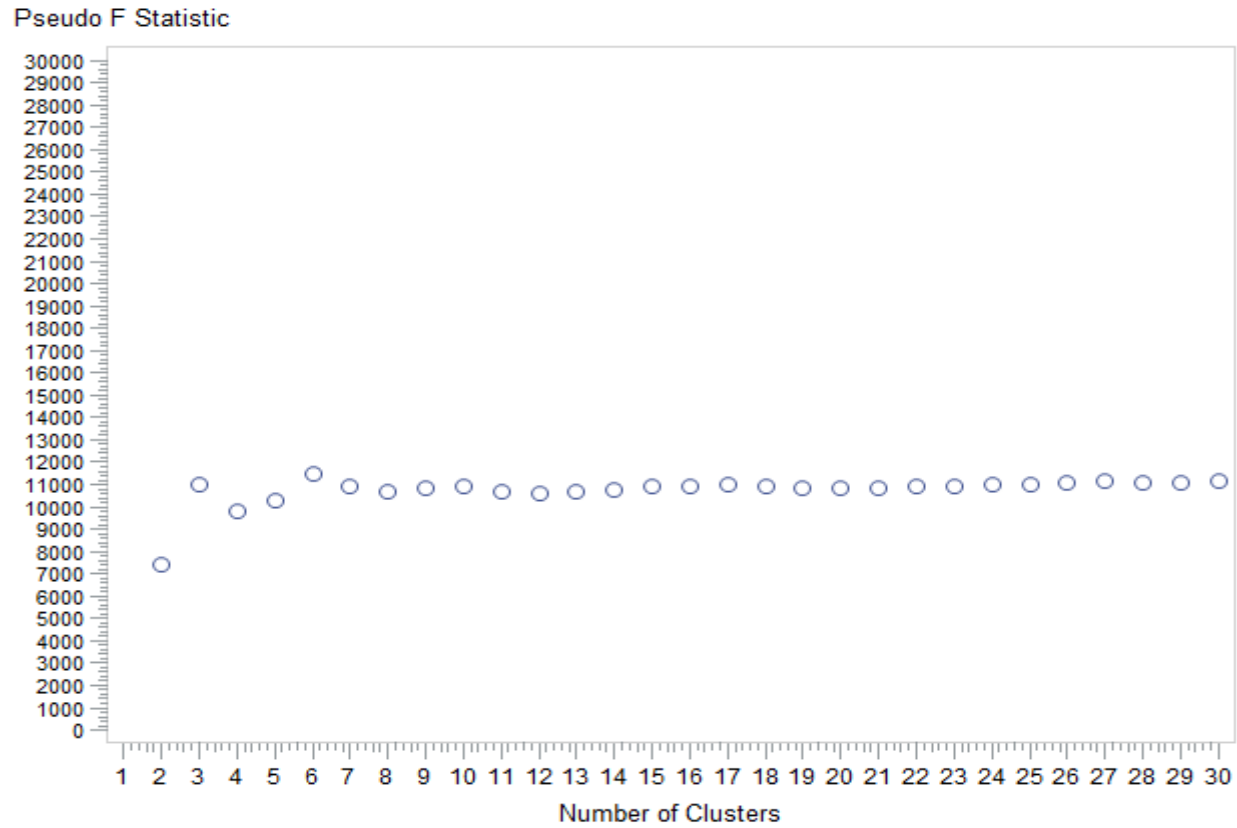Cubic Clustering Criterion

The Cubic Clustering Criterion (CCC) has reached its optimum at 3 and 6 clusters, then it stabilizes.
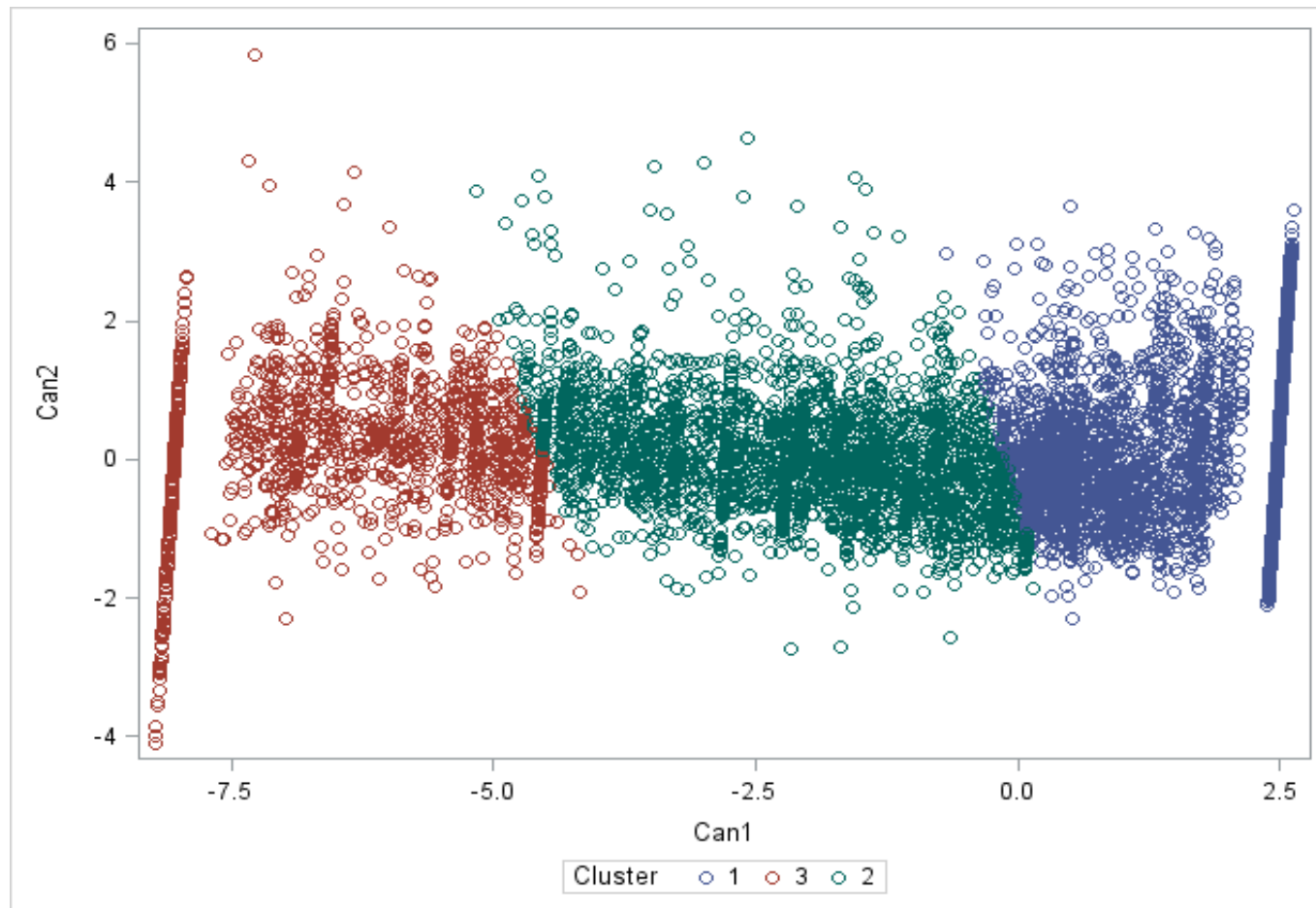
Results

Figure 2 : Plot of CCC vs. NCL

The Pseudo F Statistic also indicates 3 and 6 clusters .

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Results

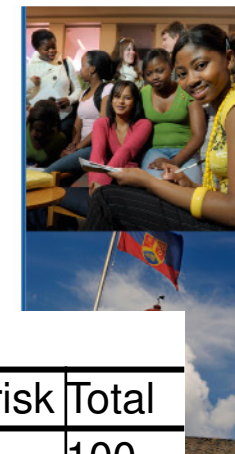**Figure 3 : Canonical cluster presentation**

Results

Figure 4 : Mean of clusters

Means of clusters

	Average first semester	ratio credit fail
Not at risk	65,86	2,54
Border line	53,51	36,31
At risk	40,76	80,95
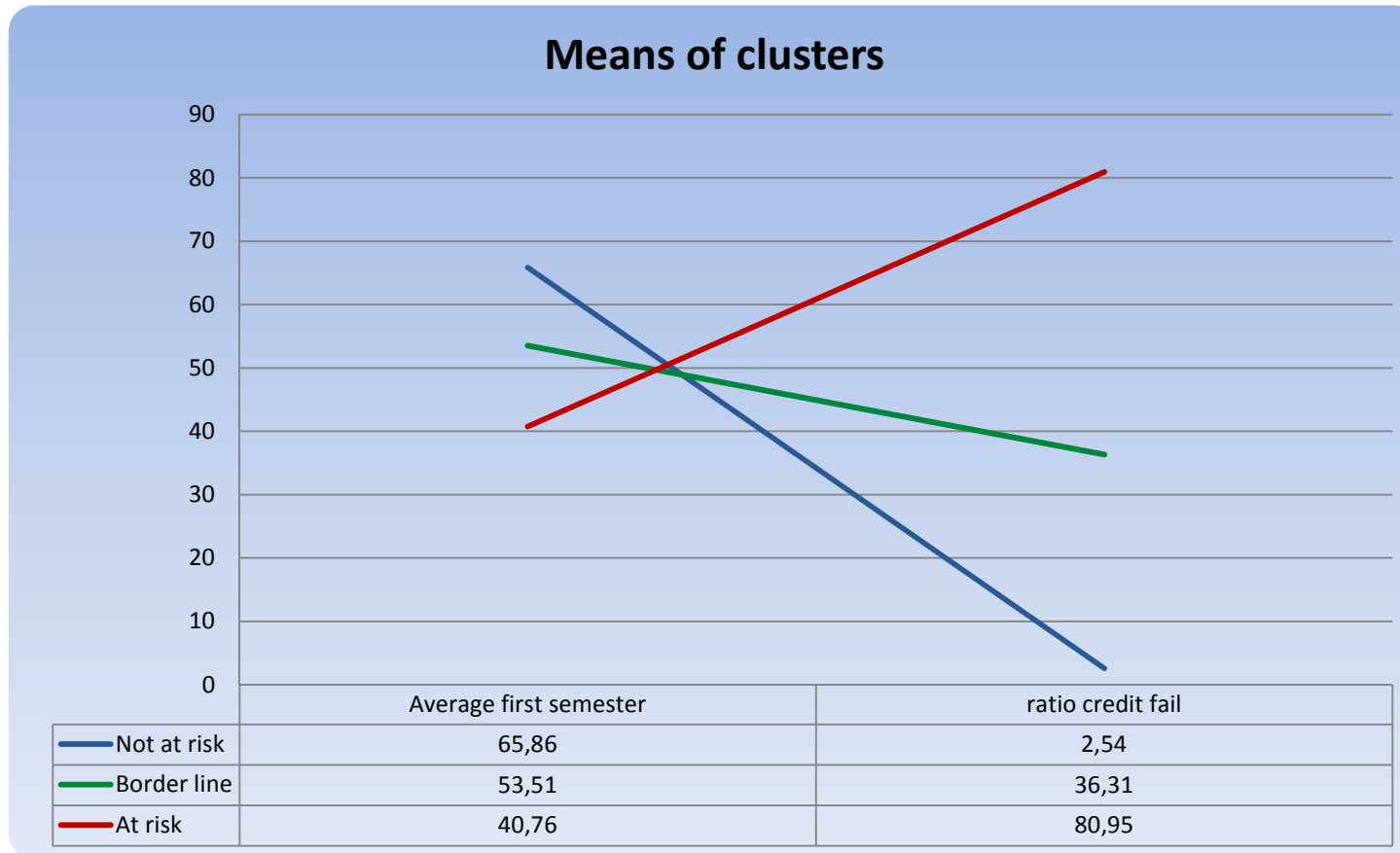
Results

Table 2: Frequency distribution of students by faculty and the risk types

Faculty	Frequency	Percent	% At risk	% Border line	% Not at risk	Total
Humanities	1616	12.9	13	26	61	100
Natural Agricultural Sciences	2287	18.2	19	26	55	100
Law	491	3.9	7	17	76	100
Theology	75	0.6	17	33	50	100
Economic Management	2104	16.8	9	22	69	100
Veterinary Sciences	173	1.4	6	6	88	100
Education	1041	8.3	9	31	60	100
Health Sciences	1497	11.9	14	20	66	100
Engineering	3258	26.0	21	32	47	100
Total	**12542**	**100.0**				

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Results

Table 3. Academic Risk type by gender// Residence status

Table 3. Academic Risk type by gender & (Residence status by Gender)

Gender	Risk type	Frequency	Percent	University residence	Further than 31 km
Female	Not at risk	4447	64.0		
	At risk	856	12.3	16%	5%
	Border line	1650	23.7		
	Total	**6953**	**100.0**		
Male	Not at risk	2949	52.8		
	At risk	1005	18.0	10%	4%
	Border line	1635	29.3		.
	Total	**5589**	**100.0**		

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Results

Table 4. Pearson's correlations by Gender

Females	r	p-value
Academic risk		
Home language	-0.10	< 0.00
Ethnic category	0.17	< 0.00
Distance stayed from campus	-0.11	< 0.00
Ratio credit failed	-0.95	< 0.00
Average first semester mark	0.74	< 0.00
Males	**r**	**p-value**
Academic risk		
Home language	-0.06	< 0.00
Ethnic category	0.10	< 0.00
Distance stayed from campus	-0.08	< 0.00
Ratio credit failed	-0.94	< 0.00
Average first semester mark	-0.78	< 0.00

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Results

Table 5. ANOVA testing differences risk type between groups

Risk types	F statistic	p-value
Home language	28.3	< 0.001
Ethnic category	66.4	< 0.001
Distance stayed from campus	17.5	< 0.001
Gender	164.3	< 0.001

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Results:

Table 6:ANOVA with a Bonferroni testing difference in risk types by Home language

Bonferroni Post Hoc test	Mean Difference	p-value
Afrikaans		
English	-0.00681	1.000
Nguni	0.22150	0.000
Sotho	0.15194	0.000
Tshivenda	0.17450	0.002
Xitsonga	0.27003	0.000
Oriental	-0.01070	1.000
European	-0.08282	1.000
Other languages	0.04410	1.000

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Results:

Table 7:ANOVA with a Bonferroni testing difference in risk types by Home language

Bonferroni Post Hoc test	Mean difference	p-value
English		
Afrikaans	0.00681	1.000
Nguni	0.22831	0.000
Sotho	0.15874	0.000
Tshivenda	0.18131	0.001
Xitsonga	0.27684	0.000
Oriental	-0.00389	1.000
European	-0.07601	1.000
Other languages	0.05091	1.000

Results:

Table 8: ANOVA with a Bonferroni testing difference in risk types by Home language

Bonferroni Post Hoc test	Mean difference	p-value
European		
Afrikaans	0.08282	1.000
SA English	0.07601	1.000
Nguni	0.30432	0.000
Sotho	0.23476	0.008
Tshivenda	0.25732	0.020
Xitsonga	0.35285	0.000
Oriental	0.07212	1.000
Other languages	0.12692	1.000

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Results

Table 9: ANOVA with a Bonferroni testing difference in risk types by Ethnic group

Bonferroni Post Hoc test		Mean difference	p- value
Asian	Black	0.05323	0.707
	Coloured	0.04301	1.000
	White	-0.16578	0.000
	Other	-0.05865	1.000
Black	Asian	-0.05323	0.707
	Coloured	-0.01022	1.000
	White	-0.21902	0.000
	Other	-0.11189	1.000
Coloured	Asian	-0.04301	1.000
	Black	0.01022	1.000
	White	-0.20880	0.000
	Other	-0.10166	1.000
White	Asian	0.16578	0.000
	Black	0.21902	0.000
	Coloured	0.20880	0.000
	Other	0.10713	1.000
Other	Asian	0.05865	1.000
	Black	0.11189	1.000
	Coloured	0.10166	1.000
	White	-0.10713	1.000

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Results: Ordinal Regression Model fitting

Table s 10.1; 10.2 & 10.3: Model fitting information; Goodness of fit & Pseudo R-Squared

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	23588.969			
Final	18774.514	4814.454	22	0.000

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	22168.297	22618	0.983
Deviance	18771.742	22618	1.000

Pseudo R-Square

Cox and Snell	0.320
Nagelkerke	0.377
McFadden	0.204

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Results: Ordinal Regression Model parameters

Table 11: Model Parameter Estimates

		Estimate	SE	Wald	df	Sig.	95% CI	
							LB	UB
Threshold	[Risk_type = Not at risk]	0.004	0.386	0.000	1	0.991	-0.752	0.761
	[Risk_type = At risk]	0.971	0.386	6.323	1	0.012	0.214	1.728
Location	Ave_first_Sem	-0.032	0.003	111.347	1	0.000	-0.037	-0.026
	ratio_cred_fail	0.029	0.001	691.760	1	0.000	0.027	0.031
	[Distance=More than 31 km]	0.289	0.110	6.866	1	0.009	0.073	0.505
	[GenCat=.00]	0.124	0.041	9.152	1	0.002	0.044	0.205

Distance OR: 0.75

Gender OR: 0.88

Discussion

- ## More females students than males
  - Agreement with literature (Freeman(2004); Peter, Horn, and Carroll (2005); King, J. E. (2000))
  - University demographics

- ## More white students than blacks, Asians and coloureds
  - Agreement with University of Pretoria demographics

- ## Ratio credit failed and First semester averages good academic predictors

- ## Gender, Distance stayed from campus, Home language and ethnicity
  - Ethnic group & Home language not significant (Hernandez (2007); Kennedy, E., Park, H. (1994)).
  - Gender significant (Freeman(2004) and Peter, Horn, and Carroll (2005))
  - Distance (Naylor (2002); Palmer and Bray (2002); Astin (1973), and Astin (1993); Tang and Wei Tseng (2014) ; Nicpon (2007); López-Turley (2010)

- ## FSA receive cluster analysis data

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Conclusion

- Miller (2007) stressed that it is through the prediction of risk of attrition of individual students that institutions can identify the students in need of an intervention and can employ a specific strategy to enhance those students' chances of success.

- Three clusters (At risk; Borderline and Not at risk) were concluded to describe the student risk profiling adequately.

- Ratio credit failed and First semester marks were concluded to be effective academic predictors of second semester achievement for cluster analysis.

- Gender and Distance stayed from campus, especially if it is more than 31 km, were concluded to be crucial factors for further explaining risk profiling of students.

- Although language and ethnicity showed no significance when modelled in a predictor model, the significant correlations established for these covariates leads to the conclusion that, the association of these variables to academic risk profiling cannot be ignored nor taken lightly.

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Recommendations

From previous research we know that:

- Students who don't use FSA services are highly at risk.

- Students don't do optional.

From latest research:

- Male students and students residing more than 31 km from UP should be regarded as additional indicators of risk.

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