

A COMPARISON OF THE PERFORMANCE OF STUDENTS IN PRE-DEGREE AND UNIVERSITY MATRICULATION EXAMINATION (UME) CLASSES IN A UNIVERSITY SYSTEM: A DISCRIMINANT ANALYSIS APPROACH

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ABSTRACT

In this paper, discriminant analysis was used to compare the performance of students who gained admission into the University system through Pre-degree programme and those who passed through the University matriculation examination (UME). The discriminant linear function which discriminate between the two groups better than any other linear function was employed. It was observed that there is no difference in the performance of UME and Pre-degree students on the average at 5% level of significance. This result was further confirmed with the used of F-transformation of Hotelling's T^2 Statistic.

KEYWORDS: Hotelling T^2 , Mahalanobis distance, Linear discriminant function, Discriminant weight, Mean vector, F-transformation

1 INTRODUCTION

The performance of Pre-degree and University Matriculation Examination (UME) students in our various tertiary institutions is of great interest and concern to many researchers. The first school of thought believed that the Pre-degree or Remedial students are usually more intelligent or brilliant than their colleague in

the UME while the reverse is the case for the second school. Over the years, painstaking effort have been put into conducting research by researchers in trying to find out the performance of students and/or what is naturally responsible for high failure rate of students in our various institutions of higher learning. [1] carried out a study on classification of students into various departments on the basis of their cumulative results for a one year Pre-National Diploma (Pre-ND) in polytechnic system; [2] conducted a research to predict the class or degree for graduating students in a university system. [3] carried out a study to determine if a differentiation or separation among students graduating, withdrawing or failing could be identified. [4] applied the T-Statistic to investigate how predictable the final year result would be, using the first year result or Grade Point Average (GPA) of some selected university graduates.

According to [2], in the past 25 years, researches in academic prediction has centered on graduation, withdrawal, failure and selection of students on the basis of either their collegiate success or cumulative results of Remedial or Pre-ND; and available literature to date suggests no loss of interest.

In this study, our major task is to compare the performance of students who gained admission into the university system through Pre-degree programme with that of students who passed through the University Matriculation Examination (UME), using their Grade Point Average (GPA) for 2005/06 and 2006/07 academic session. Many statistical techniques were consulted, but it was observed that discriminant analysis was used for this study because we have two groups and the Fisher Linear Discriminant Function, [5] will discriminate between the two groups better than any other linear function [6].

Research involving prediction models is concerned majorly with two issues; classification and selection. For example, in selecting people for advance training, a larger estimated value on a measure of achievement in the training programme

might lead to selection. But the issue of classification involves to which group of analysis is to determine the degree to which an individual's profile of scores on a set of X measures (the independent variables) corresponds to or resembles the typical profile of each of a given set of discrete classes. The problem therefore is that of analyzing the independent set (X 's) in such a way as to test the hypothesis that a particular profile based on the X measures resembles that of the members of a category, say A more closely than that of another category say B . According to [7], Discriminant Analysis and Classification are multivariate techniques concerned with separating disjoint sets of objects (or observations) and with alerting new objects (observations) to previous defined groups. Discriminant Analysis is rather exploratory in nature, as separating procedure, it is often employed on a one time basis to investigate observed differences when causal relationships are not well understood. While classification procedures are less exploratory in the sense that they lead to well-defined rules, which can be used for assigning new objects. In summary, classification ordinary requires more problem structure than discrimination.

2 METHODOLOGY

The data used in this study are from students' academic records for graduating students of 2005/2006 academic session and 2006/2007 academic sessions in the department of mathematics and Statistics in the University of Calabar, Calabar, Cross River State, Nigeria, as shown in Appendix A. The sampling method used in data collection is the simple random sampling for both academic sessions. For 2005/2006 session, a simple random sample of 40 graduating students was drawn from a population of 50 graduating students, while

in 2006/2007 session; a simple random sample of 30 graduating students was selected from a population of 40 graduating students for this study. The overall Grade Point Average (GPA) for two groups of graduating students (one group of those who gained admission through UME and the other group through Pre-degree programme) were formed using the available data in the department of Mathematics/Statistics in University of Calabar.

3 Data Analysis

Based on the students' overall GPA for the two groups, we draw up a procedure which enables us to compare the performance of these groups of students. For the two groups; Fisher Linear Discriminant function was used in this study, because it discriminates between the two groups better than any other linear function.

Using the Fisher Linear Discriminant function;

$$Z = U_1 X_1 + U_2 X_2 \dots \dots \dots (1)$$

The variance covariance matrices for the groups are given as:

$$S^{(1)} = \begin{pmatrix} 18.38 & 0.15 \\ 0.15 & 45.74 \end{pmatrix}, \quad S^{(2)} = \begin{pmatrix} 14.65 & -0.0002 \\ -0.0002 & 31.52 \end{pmatrix}$$

The vector of discriminant weight, U in equation (1) can be determined by computing:

- (i) The pooled sum of squares and cross product matrix W,

$$W = (N_1 - I)S^{(1)} + (N_2 - 1)S^{(2)} = \begin{pmatrix} 1141.67 & 5.8442 \\ 5.8442 & 2697.94 \end{pmatrix}$$

(ii) The inverse of matrix W,

$$W^{-1} = \frac{1}{|W|} C^T = \begin{pmatrix} 0.000875909 & -0.000001897 \\ -0.000001897 & 0.000370653 \end{pmatrix}$$

(iii) Mean Vector, d: The deviation of mean vectors of Group II from Group

I is:

$$d = \begin{pmatrix} \bar{X}_1 - \bar{X}_1 \\ \bar{X}_2 - \bar{X}_2 \end{pmatrix} = \begin{pmatrix} 0.21 \\ 0.39 \end{pmatrix}$$

So that:

$$U = w^{-1}d = \begin{pmatrix} 0.000183201 \\ 0.000144156 \end{pmatrix}$$

By substituting these values of the discriminant weights, U in equation (1), yields:

$$Z = 0.000183201(UME) + 0.000144156(PREDEGREE).....(2)$$

Also by substituting the means of UME and Pre-degree for each of the two groups, in the linear discriminant function, we obtain:

$$\bar{Z}_1 = 0.000884611$$

and

$$\bar{Z}_2 = 0.000789918$$

Then, the mahalanobis distance, D

$$D = \bar{Z}_1 - \bar{Z}_2 = 0.000094693$$

Problems arising in multivariate populations are direct generalization from the univariate case. Thus, we shall now test whether mahalanobis distance (D) is statistically significance. To do this, we shall adopt a method analogous to the univariate ANOVA test of hypothesis.

The hypothesis of interest is:

$$H_0: U_1 - U_2 = 0 \text{ Vs } H_1: U_1 - U_2 \neq 0$$

The ANOVA table is as follows:

SV	SS	d.f.	MS	F
Between Groups	$\frac{n_1 n_2 D^2}{n_1 + n_2}$	P	$\frac{SSB}{P}$	$\frac{MSB}{MSW}$
Within Groups	D	$n_1 n_2 - P - 1$	$\frac{SSW}{n_1 n_2 - p - 1}$	

H_0 is rejected if $F_{Cal} > F_{P, N_1+N_2-P-1, 1-\alpha}$

At 5% level of significance, we accepted the hypothesis of difference in group means, and conclude that there is no difference in the means of the two groups.

The hypothesis of interest using equality of group means is:

$$H_1: U_1 = U_2 \text{ Vs } H_2: U_1 \neq U_2$$

Using F-transformation of Hotelling's T^2 as our test statistic

$$F = \frac{N_1 + N_2 - P - 1}{(N_1 + N_2)P} T^2$$

Where

$$T^2 = \frac{N_1 + N_2}{N_1 + N_2} D^2 \quad \text{and} \quad D^2 = \text{Mahalanobis distance}$$

H_0 is rejected if $F_{Cal} > F_{N_1+N_2-P-1, 1-\alpha}$

At 5% level of significance, we also accept the hypothesis of equality of group means. This analysis shows that the equality of means assumption required when using Hotelling's T^2 statistics and univariate ANOVA test of hypothesis is obtainable.

4 Conclusion

Having justified the use of discriminant analysis in the comparison of the performance of students who gained admission into the university system through the University Matriculation Examination (UME), by employing the Fisher Linear discriminant function which discriminate between the two groups better than any other linear function. It was observed that there is no difference in the mean of UME and Pre-degree group when tested at 5% level of significance. This result was further confirmed when using F-transformation of Hotelling's T^2 statistic, where it was also found that the mean of UME group of students is equal to the mean of Pre-degree group of students, this means that the performance of students

who gained admission into the university system through UME is not better than those who gained admission through pre-degree student. Hence, we can rightly conclude that the analysis in this study provides vital information on the performance of students in the university system and lay to rest the question of which group? Is it the Pre-degree or UME that is more brilliant?

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APPENDIX A

Values of GPA for two Groups in Maths/Stats Department for 2005/2006 Academic Session ($N_1=40$)

S/N	UME	PRE-DEGREE
1	2.80	3.57
2	2.27	3.22
3	1.08	4.19
4	2.78	3.19
5	2.51	2.00
6	2.18	4.77
7	2.17	2.00
8	2.87	4.42
9	2.56	3.29
10	1.85	4.17
11	3.01	4.00
12	1.71	4.79
13	3.37	2.42
14	2.23	4.76
15	2.63	2.68
16	1.73	3.89
17	1.85	2.35
18	1.98	4.56
19	1.39	2.13
20	2.64	4.86
21	1.58	2.18
22	2.70	2.22
23	1.40	4.77

24	2.00	3.20
25	2.75	1.97
26	2.57	1.90
27	4.14	2.23
28	2.14	2.31
29	2.77	3.13
30	1.64	4.20
31	1.40	1.94
32	2.68	2.38
33	2.30	2.24
34	2.02	4.41
35	3.66	1.71
36	1.45	4.50
37	2.42	1.92
38	2.70	2.83
39	2.88	4.50
40	3.26	1.92

Values of GPA for two Groups in Maths/Stats Department for 2006/2007 Academic Session ($N_1=30$)

S/N	UME	PRE-DEGREE
1	2.69	4.23
2	1.02	2.33
3	1.96	1.93
4	2.66	2.82
5	2.29	1.84
6	2.04	4.38
7	2.06	2.25
8	3.00	1.61
9	2.33	1.59
10	1.63	4.14
11	3.04	1.74
12	1.20	4.42
13	3.25	2.02
14	2.12	1.69
15	2.44	1.78
16	1.32	2.28
17	1.63	3.50
18	1.99	1.93
19	1.38	3.15
20	2.62	4.59
21	1.76	1.85
22	2.40	3.92
23	1.23	2.34
24	1.86	1.81

25	2.75	3.61
26	1.95	4.52
27	4.03	2.04
28	2.54	2.49
29	1.36	2.37
30	1.28	3.72

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