J. Sci. Univ. Kelaniya 1 (2003): 49-61

AN EVALUATION OF THE PERFORMANCE OF UNDERGRADUATE STUDENTS AT THE UNIVERSITY EXAMINATIONS IN RELATION TO SELECTION CRITERIA – A CASE STUDY IN STATISTICS AT THE UNIVERSITY OF KELANIYA.

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ABSTRACT

Students are selected to follow Statistics and Computer Science as a subject at the University of Kelaniya on the same criteria used by the University Grants Commission to select students to Science based streams of the Universities. As such 40% of the students are selected on island wide merit on their performance at the G. C. E (Advanced Level) examination, 55% on district basis and 5% from the underprivileged districts. The G. C. E (Advanced Level) aggregate mark or the z-score is high in the first group of students and is low in the last group of students. The objectives of the present study were to determine whether the students who were selected on merit basis do better in the university examinations than the other students and to determine whether the students selected from underprivileged districts do not perform as good as the other students at the university examinations with respect to Statistics course units. The statistical analyses were performed using one way ANOVA, multiple regressions and simple linear correlations. The results indicated that there is no significant correlation between G. C. E.(Advanced Level) results and the performance at the subsequent university examinations in Statistics course units. The low performance of the students of underprivileged districts at the G. C. E (Advanced Level) examination appears to be due to low facilities for education prevailing in these districts. Given the same facilities and opportunities the students from underprivileged districts perform equally well at the university examinations of Statistics course units as the students who get better results at the G.C.E. (Advanced Level) examination.

Key words : Selection criteria, District basis, Island wide merit, Underprivileged districts, Examination performance.

INTRODUCTION

It is a well known fact that gaining entry in to a Sri Lankan University is highly competitive. Only about 16% of the students who satisfy the basic entry qualifications for University entrance at the G.C.E (Advanced Level) examination are admitted to Sri Lankan Universities annually (U.G.C., 2000). Although merit is the only criterion used by the University Grants Commission (U.G.C.) to select students to the Arts streams of the Sri Lankan Universities, a combination of criteria is used to select students to Science based streams such as Medicine, Engineering, Dental Science, Agriculture, Veterinary Science, Bio Science, Physical Science and Applied Science. Only 40% of the vacancies in these streams are filled based on merit while 55% of the vacancies are filled on district basis where the number of students selected from a particular district is determined according to the population of that district. The remaining 5% of the vacancies are filled from the districts which are considered to be under-privileged when the facilities available for education are considered. These include thirteen districts namely Nuwara Eliya, Hambantota, Jaffna, Kilinochchi, Mannar, Mullaitivu, Vavunia, Trincomalee, Ampara, Anuradhapura, Polonnaruwa, Badulla and Moneragala (U.G.C., 2000).

For some of the courses, the students are selected based on the performance at an aptitude test conducted by the University. These include the B.Sc. (Built Environment), B. Design, B.Sc. (Quantity Surveying), B.Sc. (Information Technology) and National Diploma in Technology courses offered by the University of Moratuwa (Wijeyesekara & Yatapana, 2003) and the B.Sc. (Management and Information Technology) course offered by the University of Kelaniya (Anon., 2003). At the Faculty of Science of the University of Kelaniya, a limited number of students are selected for some subjects too. In the Physical Science stream, these include Statistics & Computer Science, Electronics, Computer Studies and Chemistry while in the Biological Science stream these include Microbiology, Molecular Biology & Plant Biotechnology, Computer Studies and Biochemistry. The selection of students for these limited enrolment subjects is carried out using the same criteria as those used by the U.G.C. to select students to Sri Lankan Universities, i.e., 40% on merit, 55% on district basis and 5% from under–privileged districts (Anon., 2003) .

Several studies on the performance of students in university examinations have been carried out in some of the Science based faculties (Kottahachchi, 2000, Wijeyesekara & Yatapana, 2003). In the Medical faculties, it has been shown that the results of the second year examination is the most significant factor that predicts the performances at the final examination (Kottahachchi, 2000). Studies carried out at the University of Moratuwa have shown that the performance of the students at the aptitude test for the selection of students to follow B.Sc. (Built Environment) and B. Design courses have no significant effect on the performances at subsequent examinations (Wijeyesekara & Yatapana, 2003).

However, no published data are available on comparative studies carried out on the performance of students selected on the three criteria used by the U.G.C. for admission to Sri Lankan universities. As such, this study was carried out with the aim of investigating whether the performance of students at the university examinations is related to the category of selection.

The hypotheses that were to be tested were; (a) there is no significant difference in the performance of the students selected on different criteria at the university examinations and (b) there is no significant difference between the ratios of the three groups of students following Statistics course units in the B.Sc.(General) degree and B.Sc.(Special) degree programmes at the University of Kelaniya.

MATERIALS AND METHODS

The students used for this study are those who were recruited to the Faculty of Science of the University of Kelaniya in January 2000 and selected to follow Statistics & Computer Science as a subject. This batch of students consisted two groups of students, i.e. those who sat for their G.C.E (Advanced Level) examination in 1997 and 1998. Therefore, they were considered as those who were recruited in the 1998/1999 and 1999/2000 academic years respectively. They were selected to follow Statistics & Computer Science as a subject based on the criteria adopted by the U.G.C. to select students to the universities. The numbers of students in each category are given in Table 1.

The aggregate of marks at the G.C.E (Advanced Level) examination of these students were obtained from their records sent by the U.G.C. which were available at the Dean's office of the Faculty of Science, University of Kelaniya and the results for the compulsory Statistics course units in the first year, second year and third year of the B.Sc. (General) degree programme were obtained from the Department of Statistics & Computer Science of the University of Kelaniya .

Box-and-whisker plots on the descriptive statistics for the G.C.E. (Advanced Level) aggregate marks and the marks for the three compulsory course units in Statistics offered during the three years of the B.Sc. (General) degree programme were obtained in order to get information about the central tendencies, dispersions and the shapes of the marks distributions.

Applying Central Limit Theorem and assuming independence, two sample tests were carried out between the students of the two academic years in order to test whether their performances at the university examinations were significantly different from each other. As there were no significant differences, in subsequent analyses, these two batches were pooled together. In order to test whether the method of selection has any effect on the performances of students at the university examinations, analysis of variance tests were carried for the marks obtained by the students of the three categories, namely the category selected on merit, category selected on district basis, and the category selected from under–privileged districts, at the examinations of the compulsory Statistics course units.

Pearson's correlation coefficients between the G.C.E. (Advanced Level) aggregate marks and the marks obtained for the three compulsory course units in Statistics in the three years of the B.Sc. (General) degree programme were also calculated. As significant correlations existed among the performances at the university examinations, in order to examine the proportion of the total variations explained by the regressions equations, multiple linear regressions were fitted using the method of least squares considering the examination marks obtained during the third year as the dependent variable and the marks obtained during the first two years as predictor variables. These regression analyses were conducted for the category selected on merit

as well as for the category selected on district basis. However, due to the small sample size, the group from underprivileged districts was not subjected to the regression analysis.

Kolmogorov - Simirnov test was carried out to determine whether the ratio of the three categories of students following Statistics course units in the B.Sc. (General) degree programme was significantly different from the ratio of three categories of students in the B.Sc. (Special) degree programme following Statistics course units.

RESULTS AND DISCUSSION

Students selected to follow Statistics & Computer Science at the University of Kelaniya as a compulsory subject are required to follow course units in Statistics as well as in Computer Science during their undergraduate career. However, at the time of getting admitted to the university after their G.C.E (Advanced Level) Examination, most of the students have followed courses in Computer Science and Information Technology and have a basic knowledge in these fields. As these students do not follow extra courses in Statistics, and only the G.C.E. (Advanced Level) aggregate marks were considered for university admissions, the results of Computer Science course units were not used in the present study. Only the results for the compulsory Statistics course units offered during their three year undergraduate career were used for the present study.

As there were no sufficient number of students to be selected from underprivileged districts in the 1998/99 batch, only one was selected from this category and the remaining 3 positions were filled from the district basis category. Therefore, the % of students from the latter category in the two academic years when considered together was slightly higher than 55% while the % for the underprivileged districts was slightly lower than 5% (Figure 1).

The results of the tests carried out between the examination marks of the two batches of students are given in Table 2. The students selected from underprivileged districts were not used in this analysis due to low numbers. Results indicate that there are no significant differences in the marks scored by the students of the two batches in the university examinations although in the merit category the mean marks for all three years, and in the district basis category the mean marks for the first year and second year are higher in the 1999/2000 batch than those in the 1998/1999 batch (Table 2). Hence, the lengths of the time period between sitting for G.C.E. (Advanced Level) examination and getting entry to the university appears to have no significant influence on the performance in the university examinations even during the first year. Therefore, in further analyses these two batches were pooled together.

Table 1 - The numbers of students in each category selected from 1998/1999 and 1999/2000 batches to follow Statistics & Computer Science as a subject at the University of Kelaniya

Category	1998/1999 batch	1999/2000 batch	total
Merit	28	28	56
District Basis	41	38	79
Underprivileged	1	4	5
Total	70	70	140

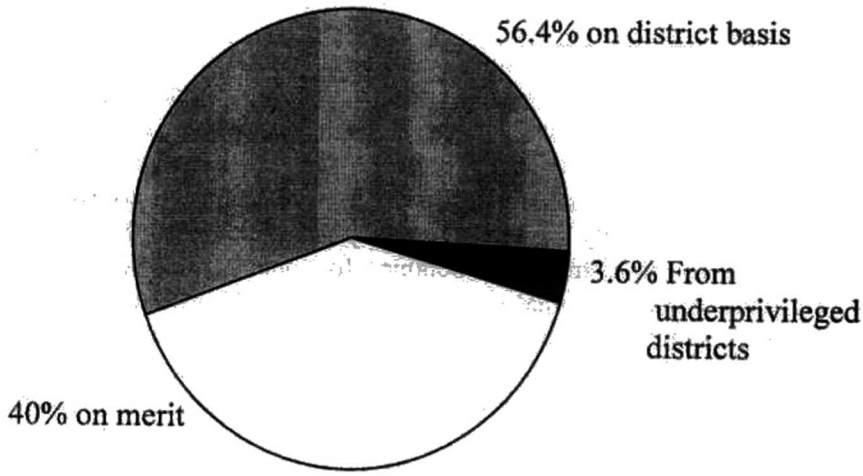


Figure 1 - Percentages of students in each category.

Table 2 – Results of the tests carried out between the 1998/1999 batch and the 1999/2000 batch of students for the three examinations of Statistics course units.

	1998/1999 batch mean ±std. error	1999/2000 batch mean ± std. error	degrees of freedom	p value
merit category				
First year	48.7 ± 3.7	56.6 ± 3.3	48	0.11
Second year	46.9 ± 4.0	47.7 ± 3.3	34	0.88
Third year	49.0 ± 4.0	52.5 ± 2.8	34	0.48
District basis category				
First year	47.6 ± 3.0	51.5 ± 2.6	63	0.32
Second year	41.1 ± 3.0	43.1 ± 2.9	60	0.62
Third year	48.4 ± 2.9	45.9 ± 2.6	60	0.53

The box and whisker plot is used to provide more information about the data while keeping the graphic image simple and easy to interpret (Runyon *et al.*, 1996). The box and whisker plot diagrams obtained for the three student categories revealed that the marks distributions obtained for the Statistics course units at the university examinations are not similar in shape (Figure 2). The distributions obtained for the first year marks for the category selected on merit as well as for the category selected on district basis were negatively skewed with a majority of scores at the upper end of the distribution whereas the distributions obtained for most of the second and third year marks were found to be somewhat symmetrical (Figure 2). Although outliers (*) were identified in the examination results obtained for the third year merit category as well as for the third year district basis category, they were not removed from the data as it was found that these outliers do not lead to misleading inferences (Anderson *et al.*, 1991).

The results of the one way analysis of variance carried out on the performance of students of the three categories at the examinations of Statistics course units in the three years of the undergraduate career are given in Table 3. These results revealed that there are no significant differences among the performances of the three students categories ($p>0.05$).

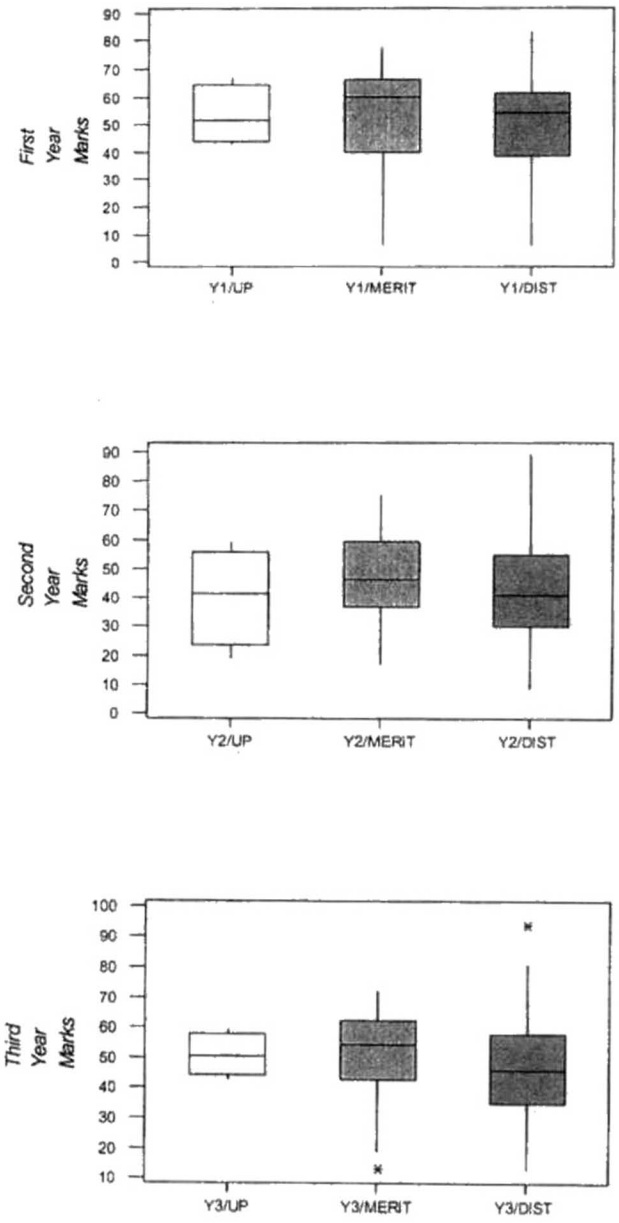


Figure 2 – Box and whisker plot diagrams for the performances of the three student categories during their undergraduate career (UP – students selected from underprivileged districts, MERIT- students selected on merit basis, DIST – students selected on district basis,Y1 - 1st year,Y2 - 2nd year,Y3 - 3rd year)

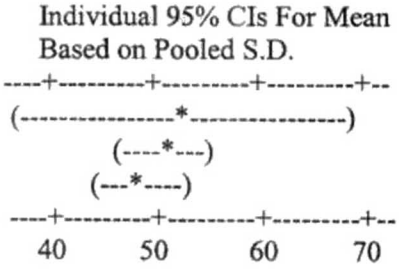
Table 3 – Results of the one-way analysis of variance on results of the examinations in Statistics course units (UP–students selected from underprivileged districts, MERIT- students selected on merit basis, DIST – students selected on district basis, Y1 - 1st year, Y2 - 2nd year, Y3 - 3rd year)

First Year

Source	DF	SS	MS	F	P
Factor	2	305	152	0.53	0.590
Error	118	33976	288		
Total	120	34280			

Level	N	Mean	S.D.
Y1/UP	4	53.25	10.97
Y1/MERIT	51	52.57	18.04
Y1/DIST	66	49.44	16.34

Pooled S.D. = 16.97

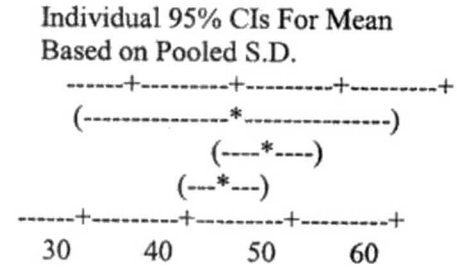


Second Year

Source	DF	SS	MS	F	P
Factor	2	757	378	1.43	0.244
Error	104	27502	264		
Total	106	28259			

Level	N	Mean	S.D.
Y2/UP	4	40.25	16.80
Y2/MERIT	40	47.35	15.89
Y2/DIST	63	42.00	16.47

Pooled S.D. = 16.26



Third Year

Source	DF	SS	MS	F	P
Factor	2	338	169	0.73	0.484
Error	106	24561	232		
Total	108	24899			

Level	N	Mean	S.D.
Y3/UP	4	50.75	7.14
Y3/MERIT	42	50.81	15.36
Y3/DIST	63	47.24	15.42

Pooled S.D. = 15.22

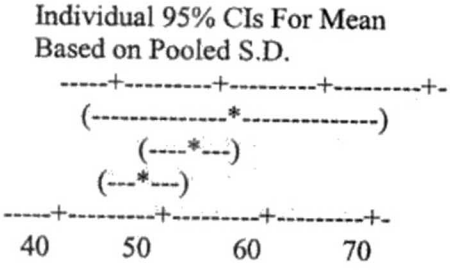


Table 4 – Correlations between the G . E . C (Advanced Level) aggregate mark and the marks scored for the Statistics course units by the students of the three categories in the 1 st year, 2 nd year and 3 rd year of their undergraduate career. (The values that are significant at 5% level are indicated by*.)

Students selected on merit

	G. C .E. (A. L.)	1 st year	2 nd year
1 st year	-0.16		
2 nd year	0.01	0.59*	
3 rd year	-0.08	0.73*	0.81*

Students selected on district basis

	G. C. E. (A. L.)	1 st year	2 nd year
1 st year	0.12		
2 nd year	0.26	0.57*	
3 rd year	0.24	0.64*	0.76*

Students selected from under–privileged districts

	G. C .E. (A. L.)	1 st year	2 nd year
1 st year	0.49		
2 nd year	- 0.39	0.61	
3 rd year	0.19	0.94	0.79

Pearson's correlation coefficients calculated between the G.C.E.(Advanced Level) aggregate marks and the marks of course unit examinations in Statistics in the three years of undergraduate career are given in Table 4. The correlation coefficients between the Advance Level aggregate marks and the marks obtained for subsequent university examinations of Statistics course units were not significantly different from zero for all three categories of students. Significant correlations were found among the results of the university examinations in the categories of students who were selected on district basis as well as those who were selected on merit (Table 4). However, as the number of students selected from underprivileged districts are less than twelve, the estimated correlations for this category could not be considered as reliable as suggested by Chatfield and Collins (1980).

Table 5 - Results of the multiple linear regression analyses between the marks of the 3rd year Statistics course unit (dependent variable) and those of the 1st and 2nd year Statistics course units (predictor variables).
(Y1 - First year marks, Y2 – Second year marks, Y3 - Third year marks)

Merit group

The regression equation is
Y3 = 8.75 + 0.265 Y1 + 0.597 Y2

Predictor	Coef	S.D.	T	P
Constant	8.748	6.048	1.45	0.157
Y1	0.265	0.135	1.97	0.057
Y2	0.597	0.107	5.59	0.000

S = 7.492 R-Sq = 72.2% R-Sq(adj) = 70.7%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	5111.6	2555.8	45.54	0.000
Error	35	1964.3	56.1		
Total	37	7075.9			

District basis group

The regression equation is
Y3 = 9.06 + 0.283 Y1 + 0.572 Y2

Predictor	Coef	S.D.	T	P
Constant	9.064	4.375	2.07	0.043
Y1	0.283	0.115	2.45	0.017
Y2	0.572	0.101	5.64	0.000

S = 9.346 R-Sq = 66.0% R-Sq(adj) = 64.8%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	9662.2	4831.1	55.31	0.000
Error	57	4978.8	87.3		
Total	59	14641.0			

Table 6 -The results of the Kolmogorov Simrnov test carried out to determine the significance of the differences in ratios among the three categories of students in the B.Sc. (General) and B.Sc. (Special) degree programmes {O_i = No. of students in the B.Sc. (General) degree programme, E_i = No. of students in the B.Sc. (Special) degree programme}

	district basis	merit	underprivileged
O_i	79	56	5
$P(O_i)$	0.56	0.40	0.04
$F(O_i)$	0.56	0.99	1.00
E_i	10	7	1
$P(E_i)$	0.56	0.39	0.05
$F(E_i)$	0.56	0.95	1.00
d	0.00	0.04	0.00

As significant positive correlations exist among the marks obtained in the Statistics course units during the university career, there is a high possibility that the students who obtained high scores at the Statistics course unit examination in the 1st year will score high marks for the Statistics course unit examinations in the 2nd and 3rd years. On the other hand it is not possible to expect good results at the examination of the final year Statistics course unit from those who did not perform well in the previous examinations of the Statistics course units in the first two years.

The results of the multiple linear regressions carried out considering the marks of the examination of the 3rd year Statistics course unit as the dependent variable and those of the examinations of the 2nd year and 1st year Statistics course units as predictor variables are given in Table 5. Since the R^2 values were >65%, results indicated that for both merit and district basis categories, more than 65% of the total variation in the third year examination results could be explained by the estimated regression equations (Montgomery, 2000). As the correlation coefficients calculated between the first and second year Statistics marks did not exceed 0.70, using the rule of thumb test, problems caused by the multicollinearity of the independent variables were ignored when calculating the multiple linear regressions.

It is clear from these results that there is an interdependence among the compulsory Statistics course units offered by the undergraduate students at the University of Kelaniya. The first year course unit in Statistics is a pre-requisite for the course units in Statistics offered during their 2nd and 3rd years of the undergraduate career (Anon., 2003). Further, in order to follow the third year course unit in Statistics successfully, the students require the knowledge they gained in the two course units offered in the 1st and 2nd years of their undergraduate career.

Results of the Kolmogorv Simrnov test given in Table 6 indicate that there is no significant difference between the ratios of the three categories of students in the B.Sc.(General) and B.Sc. (Special) degree programmes offering Statistics course units (d_{max}=0.04, n=140 , p> 0.05).

The G.C.E (Advanced Level) aggregate marks of the students who are selected on merit are higher than those of the other two categories while the aggregate marks of those selected from the under–privileged districts are the lowest. The results of the present study indicate that the performance at the G.C.E (Advanced Level)

examination has no significant effect on the performance of students in the subsequent university examinations in Statistics course units. Similar observations have been made by Wijeyesekara and Yatapana (2003) for the university examinations in B.Sc. (Built Environment) and B. Design courses at the University of Moratuwa.

The results of the present study, therefore, justifies the selection of students to the universities based on the three criteria used at present. If only the merit is used as the selection criteria, most of the students who get selected based on district basis and underprivileged districts may not get selected because of their low performance at the G.C.E (Advanced Level) examination. However, when these students are given equal opportunities as for those of the group with high G.C.E. (Advanced Level) aggregate, they perform equally well. Therefore, the low performance of students from underprivileged districts at the G. C. E. (Advanced Level) examination appears to be due to low facilities available for education in those districts.

ACKNOWLEDGEMENTS

The author is grateful to the Dean of the Faculty Science and the Head of the Department of Statistics and Computer Science of the University of Kelaniya for providing the data required for this study.

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