Ranking Sri Lankan Universities Based on Study Program Cut-offs

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Abstract: Since 2015, the University Grants Commission has been releasing separate district-wise cut-off Z-scores for various universities across different study programs. This allows for a comparison of universities based on student preferences for each program. However, there hasn't been much statistical study conducted on these cut-off Z-scores. The primary aim of this research is to statistically analyze the cut-off Z-scores for the engineering and medical faculties and rank those faculties based on the preferences of G.C.E. (A/L) students. The sample comprises cut-off Z-scores from 2015 to 2021. The average cut-off Z-scores across the 25 districts are calculated for these two study programs. For this analysis, the one-way analysis of variance and linear regression analysis techniques have been employed. The study's results indicate significant differences among universities for both study programs. Further analysis using the Least Significant Difference test has been utilized to rank the universities for both study programs. The University of Colombo is ranked as the most demanding university for medicine, while the University of Moratuwa is ranked as the most demanding university for the engineering program. It appears that students generally prefer universities located closer to the capital city, Colombo. Moreover, the study reveals a significant positive correlation between the cut-off Z-scores and the years for the medicine study program. This suggests that the competition for admission to medicine has intensified over the years.

Keywords: *Z-score, LSD test, ANOVA, Correlation, Regression.*

1. INTRODUCTION

The results of the state examination in Sri Lanka, known as the General Certificate of Examination (G.C.E.) Advanced Level (A/L), have been utilized for selecting students for state universities in the country. Since 2000, the Z-score has served as the scaling method for the G.C.E. (A/L) examinations. Annually, the University Grants Commission (UGC) releases the minimum Z-score (Cut-off Z-Score) for each study program at state universities in Sri Lanka. Before 2015, district-wise cut-off Z-scores were released for study programs. However, starting from 2015, separate district-wise cut-offs have been released for different universities across all study programs. This implies that, for any study program, the cut-off Z-scores are determined not only by district but also by the specific university. This facilitates comparisons among state universities regarding student preferences for each study program.

The study programs of Medicine and Engineering are the two popular and professional courses in Sri Lanka. The primary objective of this research is to statistically analyze the cut-off Z-scores for the engineering and medical faculties and rank those faculties based on the preferences of G.C.E. (A/L) students. The seven years cut-off Z-scores from 2015 to 2021 have been chosen as the sample for this study.

The formula for the Z-score is Z-score = (raw marks – measure of location) / measure of dispersion. In this context, the mean and standard deviation are used as measures of location and dispersion, respectively. Arivalzahan and Muraleetharan (2011) have proposed a Median Centered Score (MCS) by reinstating the median and interquartile deviation instead of the traditional mean and standard deviation, as they are less sensitive to non-symmetric distributions. Kanisda *et al.* (2014) pointed out that Mean Absolute Deviation (MAD) is a more stable measure of dispersion than the standard deviation. Yatapanna and Sooriarachchi (2006) proposed an alternative method to the Z-score, based on

the currency conversion technique. Senarathna and Wijekoon (2016) have introduced a new selection index called the Skewness-based Common Currency Index (SCCI), addressing both within-course competition and between-course competitions.

However, there hasn't been extensive statistical study on the cut-off Z-score for university admissions. The objective of this study is to determine whether there exists a statistically significant difference in the average cut-off Z-scores among the universities offering Medicine and Engineering study programs in Sri Lanka.

2. METHODOLOY

Before 2015, within a particular district and for a specific study program, there existed only one specific cut-off. However, post-2015, within the same district and for a particular study program, there are now different cut-offs for various universities offering that study program. Consequently, each study program at a specific university will have twenty-five different cut-offs corresponding to the twenty-five districts. Hence, the university wise average cut-off Z-scores for both study program across the 25 districts, are being calculated for the years 2015 to 2021.

The objective of the study is to determine whether there is a statistically significant difference in the average cut-off Z-scores among the universities for each study program. To achieve this, the one-way ANOVA technique (see, inter alia, Montgomery, 2017) has been employed. Further analysis using the Fisher's Least Significant Difference (LSD) test has been utilized to rank the universities for both study programs. Further, Multiple Regression Analysis method with dummy variables (see, inter alia, Montgomery et al., 2013) has also been employed for the same purpose. Our sample comprises cut-off Z-scores from 2015 to 2021.

Moreover, the Pearson correlation coefficient between the year and the cut-off Z-score has been calculated to determine whether there is an increasing or decreasing trend in the cut-off Z-score for both study programs.

3. RESULTS AND DISCUSSION

For each study program, university wise average cut-off Z-scores across the 25 districts are being calculated for the years 2015 to 2021. Figure 1 displays multiple bar charts representing the average cut-off Z-scores for both study programs, categorized by both year and university. Figure 2 shows box plots of the average cut-off Z-scores for the same study programs, categorized by university. Both figures clearly demonstrate the differences in cut-off Z-scores among the universities for both study programs. Notably, peripheral universities such as Jaffna, Eastern and South Eastern have lower cut-off Z-scores compared to universities located near the capital city, Colombo. This observation motivated us to investigate whether these differences are statistically significant.

3.1 Study Program Medicine

We considered eight universities that offer the study program medicine from 2015 to 2021. One-way ANOVA test has been conducted to determine the statistical significance of the difference among the eight medical faculties. Table 1 displays the ANOVA table. As the F-test revealed a highly significance difference among the eight medical faculties, pairwise comparisons using Fisher's LSD test were conducted to determine which medical faculties are equal and which ones are not. Using the LSD test results, the universities can be ranked and grouped. The LSD test results showed that a significant difference exists among all pairs, at the 5% level of significance. Table 2 presents the ranking order and grouping of the universities. The average cut-off Z-scores of universities that do not share an alphabet letter are significantly different. The average cut-off for Colombo medical faculty is significantly higher than that of Peradeniya, and Peradeniya is significantly higher than Sri Jayewardenepura (SJP), and so on.
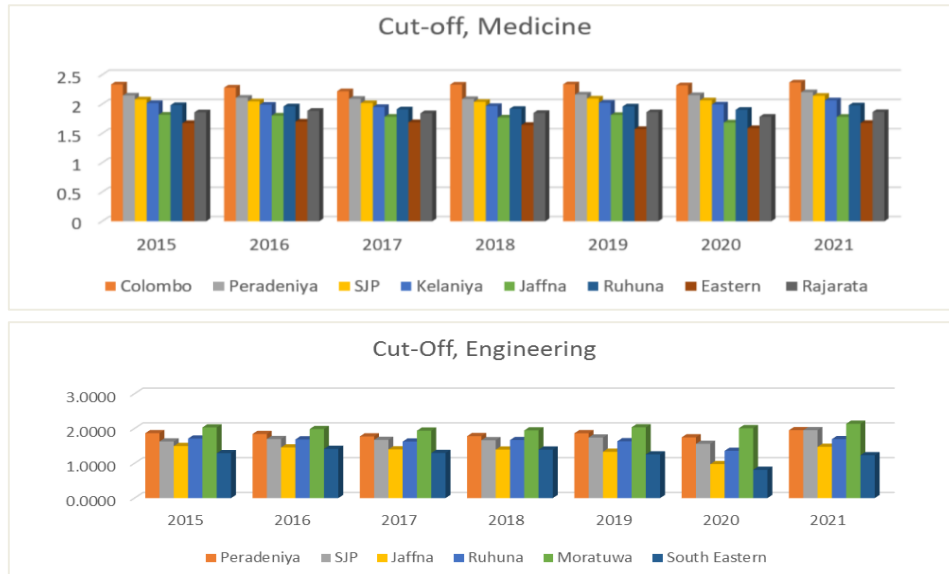
Figure 1: Average cut-off Z-scores for both study programs, categorized by both year and university
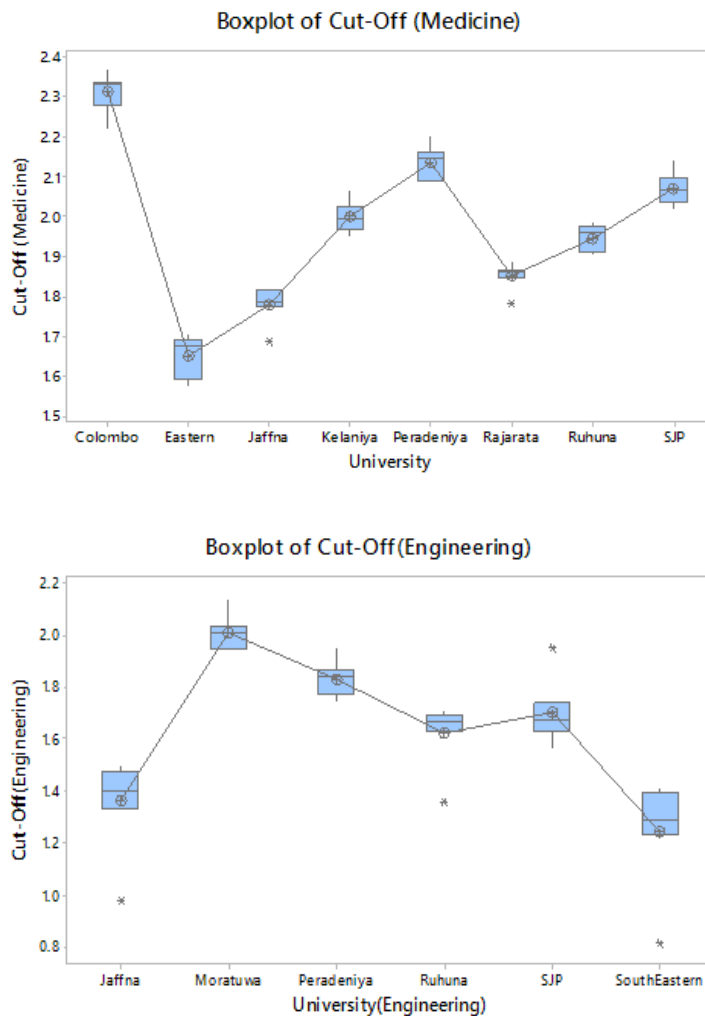

Figure 2: Average Cut-off Z-scores for both study programs categorized by university

Table 1: ANOVA table (Medicine)

Source	DF	SS	MS	F-value	P-value
University	7	2.1686	0.3098	175.92	0.000
Error	48	0.08453	0.001761		
Total	55	2.25313			

Table 2: Fisher's LSD test Grouping (Medicine)

University	Sample Size	Mean	Grouping
Colombo	7	2.3138	A
Peradeniya	7	2.1357	B
Sri Jayewardenepura	7	2.0688	C
Kelaniya	7	2.0011	D
Ruhuna	7	1.9477	E
Rajarata	7	1.8497	F
Jaffna	7	1.7799	G
Eastern	7	1.6503	H

The Eastern University medical faculty is significantly lower than rest of the seven medical faculties. It appears that the students prefer universities located closer to the capital city Colombo.

Moreover, a regression model has been established for the response variable, which represents the cut-off value for admission into the medical faculty. The explanatory variables consist of eight medical faculties, using seven dummy variables with the Eastern University medical faculty as the reference level. The formulated model is as follows:

*Cut-off (medicine) = 1.6503 + 0.6635 * University of Colombo + 0.4854 * University of Peradeniya + 0.4184 * University of SJP + 0.3508 * University of Kelaniya + 0.2944 * University of Ruhuna + 0.1944 * University of Rajarata + 0.1296 * University of Jaffna.*

All seven-slope coefficients are statistically significant with a p-value of 0.000. The interpretation of the slope coefficients is as follows: the average cut-off Z-score for the Colombo medical faculty is 0.6635 higher than that of the Eastern University Medical faculty. Likewise, the average cut-off Z-scores for the Peradeniya, SJP, Kelaniya, Ruhuna, Rajarata, and Jaffna Universities are 0.4854, 0.4184,

0.3508, 0.2944, 0.1944, and 0.1296 higher than Eastern University, respectively. 1.6503 is the average minimum cut-off Z-score to enter a medical faculty in Sri Lanka, which is the average cut-off Z-score for the Eastern University medical faculty. The regression model mentioned above exhibits a remarkably high coefficient of determination, as 0.957.

We can observe that both linear models yield identical results. According to the LSD test, a significant difference exists among all pairs, and consequently, all the slope coefficients of the regression model are significant. It is noteworthy that Eastern University, which is significantly lower than the rest of the universities, has been considered as the reference level for the dummy variables in the regression model.

The sample Pearson correlation coefficient between the year and cut-off Z-score for medicine was found to be 0.782, with a p-value of 0.003. Thus, a significant strong positive correlation exists between the cut-off Z-scores and the years for the medical faculty, indicating an increasing trend in the cut-off Z-scores over the years. This suggests a growing competition over the years for medical faculty admissions.

3.2 Study Program Engineering

We considered six universities that offer the study program engineering from 2015 to 2021. One-way ANOVA test has been conducted to determine the statistical significance of the difference among the six engineering faculties. Table 2 displays the ANOVA table. As the F-test revealed a highly significance difference among the six engineering faculties, pairwise comparisons using Fisher's LSD test were conducted to determine which engineering faculties are equal and which ones are not, at the 5% level of significance. Table 3 shows the ranking order or grouping of the universities using alphabet letters. The average cut-off Z-scores of universities that do not share an alphabet letter are significantly different. Significant differences were found among all pairs except for the three pairs: Peradeniya and SJP, SJP and Ruhuna, and Jaffna and South Eastern. Thus, Moratuwa is significantly higher than all the others, followed by Peradeniya. There is no significant difference between Peradeniya and SJP, and there is no significant difference between SJP and Ruhuna. However, there is a significant difference between Peradeniya and Ruhuna. All four engineering faculties mentioned above are significantly higher than Jaffna and South Eastern, and there is no significant difference between the Jaffna and South Eastern engineering faculties. It appears that peripheral engineering faculties have significantly lower cut-off Z-scores compared to faculties located near the capital city Colombo.

A regression model has also been established for the response variable, representing the cut-off value for admission into the engineering faculty. The explanatory variables consist of six engineering faculties, employing five dummy variables. The South Eastern University engineering faculty, significantly lower than the rest of the engineering faculties except Jaffna, serves as the reference level. The formulated model is as follows:

Cut-off (engineering) = 1.2416 + 0.7696 * University of Moratuwa + 0.59 * University of Peradeniya + 0.4597 * University of SJP + 0.3827 * University of Ruhuna + 0.1191 * University of Jaffna.

Five of the slope coefficients, except for the University of Jaffna, are statistically significant with a p-value of 0.000. The slope coefficient of the University of Jaffna has a p-value of 0.111. The interpretation of the slope coefficients is as follows: the average cut-off Z-score for the Moratuwa engineering faculty is 0.7696 higher than that of the South Eastern University Engineering faculty. Likewise, the average cut-off Z-scores for the Peradeniya, SJP, Ruhuna, and Jaffna Universities are 0.59, 0.4597, 0.3827, and 0.1197 higher than the South Eastern University, respectively. The difference in the average cut-off Z-score between Jaffna and the South Eastern University is not statistically significant. The estimated value of the slope coefficient 1.2416 is the average minimum cut-off value to enter an engineering faculty in Sri Lanka, which is the average cut-off Z-score for the South Eastern University engineering faculty. The regression model mentioned above exhibits a high coefficient of determination, at 0.7859.

Here again, both linear models yield identical results. It is important to note that, according to the LSD test results, there is no significant difference between Jaffna and South Eastern Engineering faculties. Consequently, the slope coefficient of Jaffna is not significant when South Eastern is used as the reference level.

The sample Pearson correlation coefficient between the year and cut-off Z-score for engineering was found to be 0.314, with a p-value of 0.321. Thus, the weak positive correlation between the cut-off Z-scores and years for the engineering faculty is not significant. As the correlation is weak and not significant, there will be neither an increasing nor a decreasing trend in the engineering faculty cut-off Z-scores over the years. This suggests that there is no significant increase in competition over the years for admissions to the Engineering faculty.

Table 3: ANOVA table (Engineering)

Source	DF	SS	MS	F-value	P-value
University	5	2.9011	0.58021	31.1	0.0000
Error	36	0.6717	0.01866		
Total	41	3.5727			

Table 4: Fisher's LSD test Grouping (Engineering)

University	Sample Size	Mean	Grouping
Moratuwa	7	2.0112	A
Peradeniya	7	1.8316	B
Sri Jayewardenepura	7	1.7013	B, C
Ruhuna	7	1.6243	C
Jaffna	7	1.3607	D
South Eastern	7	1.2416	D

4. CONCLUSION

A significant difference exists in student preferences among the universities for both study programs. We observe that both linear models yield identical results. According to the statistical models, the University of Moratuwa and the University of Colombo are ranked as the best universities for the study programs of Engineering and Medicine, respectively. For both study programs, the University of Peradeniya is ranked as the second-best university.

The average minimum cutoff values to enter the Medicine and Engineering faculties in Sri Lanka are 1.6503 and 1.2416, respectively. These values represent the average cut-off Z-scores for the Eastern University medical faculty and the South Eastern University engineering faculty, respectively. It seems that peripheral universities have significantly lower cut-off Z-scores compared to universities located near the capital city, Colombo. It appears that, in general, students prefer universities located closer to the capital city, Colombo.

Furthermore, there seems to be a significant increasing trend (positive correlation) in the cut-off Z-scores over the years for the study program Medicine. The increasing trend in cut-off Z-scores highlights the growing competition for admission in that field. There is neither a significantly increasing nor decreasing trend in cut-off Z-scores over the years for the study program Engineering. This suggests that there is no significant increase in competition over the years for admissions to the engineering faculties.

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