A COMPARISON OF THE Z-SCORE METHOD AND THE AGGREGATE RAW MARKS METHOD: A CASE STUDY

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Abstract

The currently used z-score method to select candidates to state universities in Sri Lanka was introduced in 2001 as a solution to the problem of undue competitive advantage that may accrue to some candidates by offering easy subjects, when the aggregate method was used. The expected effect of the z-score method was to provide a higher chance of selection for a student who has got *x* marks for a difficult subject than for a student who has got the same marks for an easy subject. The objective of this study was to explore whether this expectation has been realized in selecting candidates to biological science degree program. The chances of candidates being selected to the biological science degree program from the two competing combinations "Chemistry, Biology, Physics (CBP)" and "Chemistry, Biology, Agriculture (CBA)" based on the z-score method and the aggregate raw marks method were compared using the raw marks from 2014 to 2018, obtained from the Department of Examinations. The aggregate marks and z-scores were calculated for all the candidates in the above two combinations. Assuming 35 as the pass mark for all the subjects, those who failed at least one subject were omitted. Since the students in CBP could apply for medical, dental and veterinary sciences, the top *n* students were omitted from that combination. The remaining students in both combinations were combined into one group and the top *m* students were selected for the biological sciences, separately based on the aggregate marks and z-scores. The numbers *n* and *m* were obtained from the documents published by the university grants commission of Sri Lanka. Physics is generally considered as more difficult than Agriculture. However, the z-score method has reduced the chance of those in CBP by 0.032% and increased the chance of those in CBA by 0.234%, on average. This shows that the z-score method has failed to deliver the expected outcome. Instead, it has delivered the opposite of what was expected. This is the first time this adverse effect of the z-score method is pointed out using the real data.

Keywords: University selection, competitive advantage, chance of selection
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INTRODUCTION

In Sri Lanka, the education in state universities is free of charge. However, only a limited number of students are selected to state universities based on the GCE Advanced Level (A/L) examination. Therefore, the method of selection must be fair and accurate. In 2001, the z-score method was introduced by the university grants commission (UGC) of Sri Lanka as a solution to a problem associated with the previously used aggregate raw marks method; namely, the undue competitive advantage that may accrue to some candidates by offering easy subjects (UGC Sri Lanka, 2001). Thattil (2012) has claimed the responsibility for introducing the z-score as a basis for ranking A/L students. According to UGC Sri Lanka (2001), "it has been observed over the years that students consistently score higher marks in some subjects than in others. For example, students can qualify to read for a degree in the biological science by offering at the G.C.E. A/L Examination one of two possible combinations of subjects. One combination is Chemistry, Biology and Physics (CBP). The other combination is Chemistry, Biology and Agriculture (CBA). There is evidence that more students are able to obtain higher marks in Agriculture than in Physics. Therefore, offering Agriculture instead of Physics improves the chances of gaining entrance to universities". The z-score method has been introduced by the university grants commission (UGC) of Sri Lanka as a universally accepted solution to the above problem (UGC Sri Lanka, 2001).

Several authors (Yatapana and Sooriyarachchi, 2006, 2014; Warnapala and Silva, 2011) have pointed out some weaknesses of the z-score method and one has suggested an alternative method called 'common currency method'. However, it seems that the ideas in those articles have not been taken seriously by the stakeholders. Yatapana and Sooriyarachchi (2006, 2014) have used simulated data, disregarding the correlations between the marks of different subjects. Warnapala and Silva (2011) have implicitly assumed that z-scores have a standard normal distribution, which is wrong.

The expected effect of the z-score method was to provide a higher chance of selection for a student who has got x marks for a difficult subject than for a student who has got the same marks for an easy subject. The objective of this study was to explore whether this expectation has been realized in selecting candidates to biological science degree program. We compared the chances of candidates in selecting to the biological science degree programs from the two competing combinations CBP and CBA from 2014 to 2018 based on the z-score method and the aggregate raw marks method. Since Physics is generally considered as more difficult than Agriculture (UGC Sri Lanka, 2001), the objective of this study was to explore whether the z-score method has given a higher chance of selection to the biological science degree programs for those who did

Physics than for those who did Agriculture. This is the first time that the actual raw marks of A/L students are used for an investigation related to the z-score method in Sri Lanka.

METHODOLOGY

For this study, we have used the actual raw marks obtained by all the advanced level students in the island for the subjects of Physics, Chemistry, Biology and Agriculture from 2014 to 2018. The data were available for all the candidates and hence treated as the populations rather than a samples. The aggregate raw marks as well as the average z-score were calculated individually for all the students who have taken the combinations CBP and CBA. After that, the marks of the students who have not obtained at least 35 marks for all the 3 subjects were omitted from each group. Normally, one should score at least 30% for the common general paper to apply for a state university but we have not considered the marks of that since majority of students can pass that paper. Generally, for a lot of degree programs including the Biological Science degree programs, 40% of students are admitted by the all island merit basis, 55% of the students are admitted by the district quota basis and the remaining quota of 5% from the 16 educationally disadvantaged districts (UGC Sri Lanka, 2021). However, for our study we have considered only the all island merit basis since district-wise marks were not available.

Normally, all the passed students in both groups can apply for the undergraduate degree program in "Biological Science". However, the students in the CBP group can apply for medical, dental and veterinary sciences as well. Therefore, the top "n" students from the CBP group were omitted. Then, assuming that the top "m" students are selected each year to follow the biological science degree program from all the eligible students, the cut off aggregate raw marks and the cut off average z-scores were obtained treating both the groups as a whole. The numbers n and m were obtained from the documents published by the University Grants Commission of Sri Lanka (2014, 2015, 2016, 2017, 2018). They are shown in Table 1. The actual m values considered in our study had to be larger than those *m* values because when using the aggregate raw marks method, there were several candidates with the same cut-off marks and all those had to be considered as qualified. To do a meaningful comparison, the number qualified from raw marks method was used for Z-score method as well.

Year	2014	2015	2016	2017	2018
n	1434	1428	1466	1643	1674
m	1625	1488	1817	1600	1623

Table 1: The values of n and m

After that, the number of students qualified to follow the biological science degree from each method were determined from 2014 to 2018 according to the cut-off values. Next, the number of student (%) who qualified from each group was determined separately for the two methods. The software package R (R Core Team, 2022) was used for all the calculations.

RESULTS AND DISCUSSION

Table 2 shows the number of students qualified from each group according to raw marks and z-score methods from 2014 to 2018 for the degree program Biological science.

Year	Population		No of Students (%) qualified from raw marks method		No of Students (%) qualified from Z-score method	
	CBP	CBA	CBP	CBA	CBP	CBA
2014	38616 (87.8)	5364 (12.2)	1720(4.45)	3(0.06)	1701 (4.40)	22 (0.41)
2015	40858 (87.72)	5722 (12.28)	1536(3.76)	14(0.24)	1525(3.73)	25(0.44)
2016	41480 (88.53)	5374 (11.47)	1896(4.57)	7(0.13)	1883(4.54)	20 (0.37)
2017	39295 (88.73)	4992 (11.27)	1665(4.24)	5(0.10)	1655(4.21)	15(0.30)
2018	40774 (88.18)	5468 (11.82)	1631(4.00)	8(0.15)	1621(3.98)	18(0.33)
Mean percentage	88.192	11.808	4.204	0.136	4.17	0.37

Table 2: No of students (%) qualified from each method

According to the above table, approximately 88% of students have offered the subject combination CBP and 12% of students have offered the subject combination CBA every year. According to the raw marks method, on average 4.20% of all students who had offered the subject combination CBP would have been qualified for the above mentioned degree program while on average 0.14% of all students who had offered the subject combination CBA would have been qualified. When it comes to Z-score method, on average 4.17% of all students who had offered the subject combination CBP would have been qualified for the Biological science program while on average 0.37% of all students who had offered subject combination CBA would have been qualified.

In this study we obtained the raw marks from the Department of Examinations under an agreement of confidentiality. Usually, the marks of exams are strictly confidential and the recent data are not provided by the Department of Examinations. We had to use the data that the Department of Examinations agreed to provide. This is the first time anybody has analysed actual raw marks. Even though the data are old (2014-2018) we do not expect any substantial change in the existing patterns.

CONCLUSIONS/RECOMMENDATIONS

According to the above analysis, the chance of a student who has offered the subject combination CBP has decreased under the z-score method and on the other hand the

chance of a student who has offered the subject combination CBA has increased under the z-score method. Since Physics is generally considered as more difficult than Agriculture the expected outcome was to give a higher chance for the students who offer physics under the currently used Z-score method. However, this analysis shows that the z-score method has failed to deliver the expected outcome. Instead, it has actually delivered the opposite of what was expected.

We have analysed the data in other streams and observed similar adverse effects of the z-score method. This shows the need for an alternative method and invites researchers to join the effort of finding a fair and better method to select candidates to state universities of Sri Lanka. We are currently exploring few such methods.

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CONFLICT OF INTEREST STATEMENT

The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.