# Distribution of Subjects Grades and Relationships among Subjects of the G.C.E. (A/L) Examination.

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## Abstract

The quality of higher education is determined by the performance of the students who have the opportunity to receive higher education. At present, the raw aggregate marks of the G.C.E. (A/L) examination is used as the selection criteria of students for universities. Whether raw aggregate marks can represent the performance of students at G.C.E. (A/L) examination is a question that is currently debated on.

This study was carried out to investigate the correlation among subject grades, to find out whether mean aggregate differences exist between (a) districts, (b) repeat and first attempt students and (c) male and female. It also investigates the distribution of grades in different subjects.

For this study G.C.E. (A/L) results (Science subjects) of 1995 and 1996 were used. Univariate Analysis, Chi-square (contingency table analysis), ANOVA and Analysis of Means procedure were used for analysis of data.

High degrees of correlation among subject grades were observed in the results. Most of the time mean aggregates of different districts were significantly different. No significant difference was observed in repeat and first attempt students while male to female difference was greater in Physical Science subjects. Distributions of grades in different subjects are different to each other. In the same subject stream, some subjects showed left skewed distributions while other subjects showed right skewed distributions. In this context it can be concluded that adding of raw subject marks to form raw aggregate, which is the current practice, as a basis for admission to the universities is not a proper method of selection of students for university education. Some type of scaling for location dispersion of the distribution of marks is needed instead of using the aggregate marks as an indicator of performance.

## Introduction

## Background

The level of education of people is one of the most important factors, which determines the development of a country. Eventhough Sri Lanka is still a developing country, it has a higher rate of literacy.

At present, Sri Lanka is capable of producing the country's requirement of intellectual resources such as doctors, engineers, scientists, agriculturists, teachers, and managers etc. The Sri Lankan government spends about 12% of the final consumption expenditure on education and higher education annually. (Statistical Abstract, 1997)

## Past and Present Status in University Admission

The present selection process of students for higher education in universities is based on the performance of students at the G.C.E. (A/L) examination. The

selection criterion for university admission is the aggregate marks obtain of the G.C.E. (A L) The G.C.E. (A L) examination is one of the most competitive examinations in the present education system. It is only about $2\%$ of students who enter schools, are capable of entering university today. Table 1 shows the extent of competitiveness of the university admission process and gives the details of the G.C.E. (A/L) Examinations between 1991 and 1998. During this period, although 30-51% of those who sat for the G.C.E. (A/L) examination qualified to enter the University, only 6% - 8% was admitted to national universities based on the facilities and vacancies available. Because the facilities in universities are limited, a limited number of students are selected for university education from among those who obtain the minimum requirement for university admission. At present an aggregate of 180 marks (minimum three passes and at least 25% for the fourth subject at once and the same A/L examination) for the old syllabus and an aggregate not less than 135 marks and the common General Paper with a mark of not less than 30% under the new scheme are the minimum requirement.

**Table 01: University Admissions**

| Year | No. Sat (Appx.) for G.C.E. A/L | No. Qualified | No. Admitted |
|---|---|---|---|
| 91/92 | 120000 | 42454 (35.4%) | 8900 (7.4%) |
| 93/94 | 132000 | 55126 (41.8%) | 8851 (6.7%) |
| 95/96 | 126000 | 56740 (45.0%) | 9787 (7.8%) |
| 97/98 | 141000 | 71840 (51.0%) | 11462 (8.1%) |

Source: Dept. of Examinations, University Grants Commission

A particular cut-off mark for university admission is given for each educational district depending on the number of vacancies available in respect of each subject stream. In the present admission system, one student can sit for the G.C.E. (A/L) examination a maximum of three times. To enter the university, the student should have the aggregate marks above the cut-off point given for the district for the given year within one of three attempts. A specific quota is available for each district. Thus, within a district there are students entering the university on 'all island merits' basis as well as on 'district quota' basis.

**District Quota System.**

The quota system is presently used in the selection process to ensure that districts with poor facilities can also send a certain number of students to the university. After realizing that the uneven distribution of facilities lead to educational disparities among districts, the government in 1974, introduced a scheme of admissions on the basis of a district quota. The national planning committee proposed that 70% of students admitted to the universities should be on merit basis while the balance 30% should be on a district quota. After several changes in 1984, the percentage was raised to 65% for district based entrants of which 5% was reserved for under privileged districts (Thattil, & Tharmalingam, 1992).

According to the current scheme, admissions are made on dual criteria (Gunawardane, 1999) - (a) all island merit (40%) and (b) merit on district basis (55%) with an additional quota (5%) is allocated for 13 educationally

disadvantaged districts for each stream except for Arts stream where admission is 100% on all island merit. In the present university admission scheme, the district of any candidate is the district where the person has studied during a major part of the five year period immediately preceding the G.C.E. (A/L) examination. The district quota (55%) is allocated to the 25 administrative districts in proportion to the ratio of the district population to the population in the country.

## Objectives

This study was carried out using the G.C.E. (A/L) results of the years 1995 and 1996. The study was restricted to students who obtained the minimum requirement for university admission in Science stream subjects. The main objectives are as follows.
1. · To find out the distribution of grades in different subjects within same subject streams.
2. To investigate the correlation among subject grades.
3. To find out whether mean aggregate differences exist between (a) districts (b) repeat and first attempt students and (c) males and females.

## Methodology

### Source of Data

Data was obtained from the University Grants Commission (UGC) of Sri Lanka. Data consisted of aggregate marks, district rank, overall rank, subject grades and subject codes of the students of 1995 and 1996 G.C.E. (A/L) examination.

### Analysis of Data

Univariate analysis was used to find out the distribution of grades in each subject of G.C.E. (A/L) results in 1995 and 1996.

Categorical data (contingency table) analysis was performed to study the relationships between subject grades. For Physical Science students, test of association was done for grades for Pure Mathematics verses grades for Applied Mathematics. For Bio Science students, it was done for Physics grades verses Zoology, · Botany and Chemistry grades. Grades for Agriculture were tested against grades for Zoology, Botany and Chemistry.

The procedure of Analysis of Variance (ANOVA) was carried out using aggregate marks to test differences across districts, by sex and by repeat and first attempt students, for each of the subject streams.

The procedure of Means was carried out to find the average aggregate marks for each district, minimum and maximum aggregate marks and number of students obtained the minimum requirement for university admission for each subject stream of 1995 and 1996 G.C.E. (A/L) results.

# Results and Discussion

## Univariate Analysis

Table 2 shows the details of the distribution of grades for each subject in G.C.E. (A/L) examinations in 1995 and 1996. According to these results, the percentage of 'A' grades range approximately 1% to 14% for each subject in both years. The lowest percentage of 'A' grades was observed in Zoology while higher percentages are observed in Botany, Agriculture and Chemistry. The percentage of B grades for different subjects range from about 8% to nearly about 50%. Lower percentages are observed for Applied Mathematics, Pure Mathematics, Physics and Zoology while Botany, Chemistry and Agriculture have higher percentages in both years. The distribution pattern of percentage of A grades and B grades observed in these subjects are similar. Subjects which have higher percentage of A grades also have a higher percentage of B grades and vice versa. Percentage of A's for Zoology, Chemistry, Physics, Pure Mathematics and Agriculture is about 50% for both years, while 26.15% and 36.56% for Applied Mathematics in 1995 and Botany in 1996 respectively. Subjects such as Botany and Agriculture have a much lower percentage of failures ('F' grades) than other subjects. The highest percentage of failures is in Physics (about 7%).

## Table 02: Distribution of Grades

| Subjects & Year of G.C.E. (A/L) Exam | | Grades | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | A | B | C | S | F | |
| Chemistry | 1995 | 1204 (8.02) | 3199 (21.33) | 6033 (40.23) | 4111 (27.41) | 447 (3.01) | 14994 |
| | 1996 | 1533 (10.15) | 3447 (22.81) | 6590 (43.62) | 3224 (21.34) | 315 (2.08) | 15109 |
| Physics | 1995 | 519 (3.78) | 1834 (13.34) | 5741 (41.76) | 4646 (33.80) | 1007 (7.33) | 13747 |
| | 1996 | 456 (3.32) | 1184 (8.61) | 4039 (29.38) | 2112 (15.36) | 1039 (7.56) | 8830 |
| Applied Mat. | 1995 | 132 (3.37) | 356 (9.09) | 1024 (26.15) | 2186 (55.82) | 208 (5.31) | 3916 |
| | 1996 | 280 (6.59) | 614 (14.45) | 1953 (45.95) | 1340 (31.53) | 63 (1.48) | 4250 |
| Pure Mat. | 1995 | 189 (4.83) | 446 (11.39) | 1854 (47.34) | 1396 (35.65) | 31 (0.79) | 3916 |
| | 1996 | 272 (6.40) | 697 (16.40) | 2158 (50.78) | 1089 (25.62) | 34 (0.08) | 4250 |
| Zoology | 1995 | 165 (1.49) | 1603 (14.47) | 5144 (46.43) | 4112 (37.12) | 54 (0.49) | 11078 |
| | 1996 | 195 (1.80) | 1748 (16.10) | 5034 (46.36) | 3829 (35.26) | 53 (0.49) | 10859 |
| Botany | 1995 | 1318 (11.90) | 4804 (43.37) | 4661 (41.89) | 292 (2.64) | 3 (0.03) | 11078 |
| | 1996 | 1614 (14.86) | 5041 (46.42) | 3970 (36.56) | 233 (2.15) | 1 (0.01) | 10859 |
| Agriculture | 1995 | 108 (8.66) | 405 (32.48) | 632 (50.68) | 99 (7.94) | 3 (0.24) | 1247 |
| | 1996 | 184 (12.44) | 493 (33.33) | 694 (46.92) | 108 (7.30) | 0 (0.00) | 1479 |

Note: Row percentages are given within parentheses.

Figure 01 and figure 02 present the distribution curves of grades for subjects Physics and Agriculture. It is clearly seen that, distribution of grads for Physics is always right skewed while for Agriculture it is left skewed. Thus, to enter the university, students can take Agriculture instead of Physics to obtain higher aggregate marks.

**Figure 01: Distribution of Grades for Physics and Agriculture in 1995**
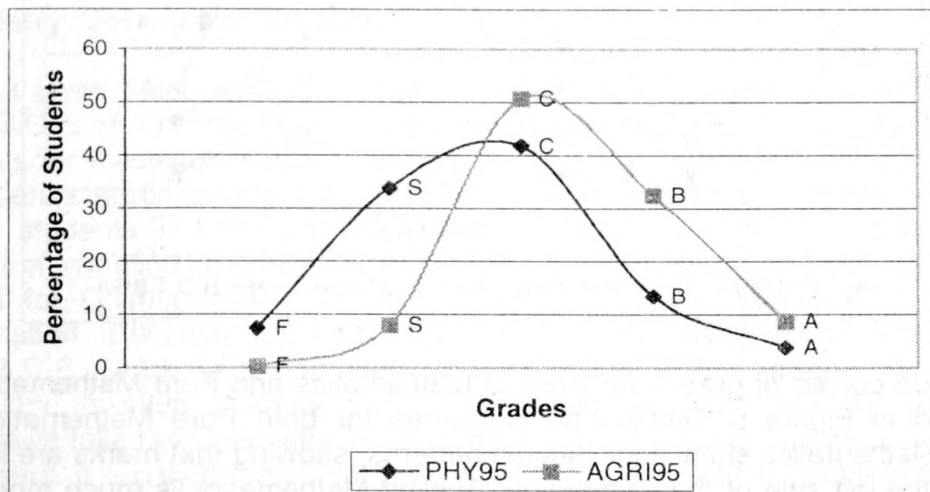


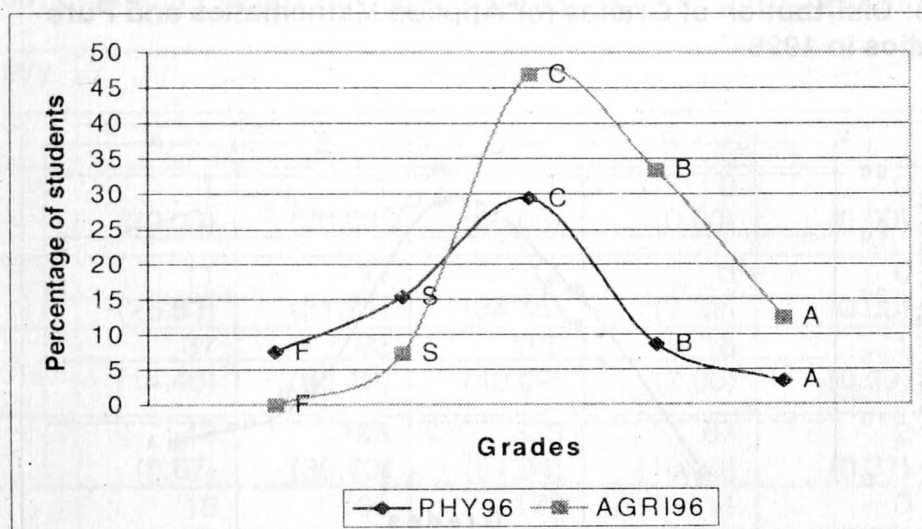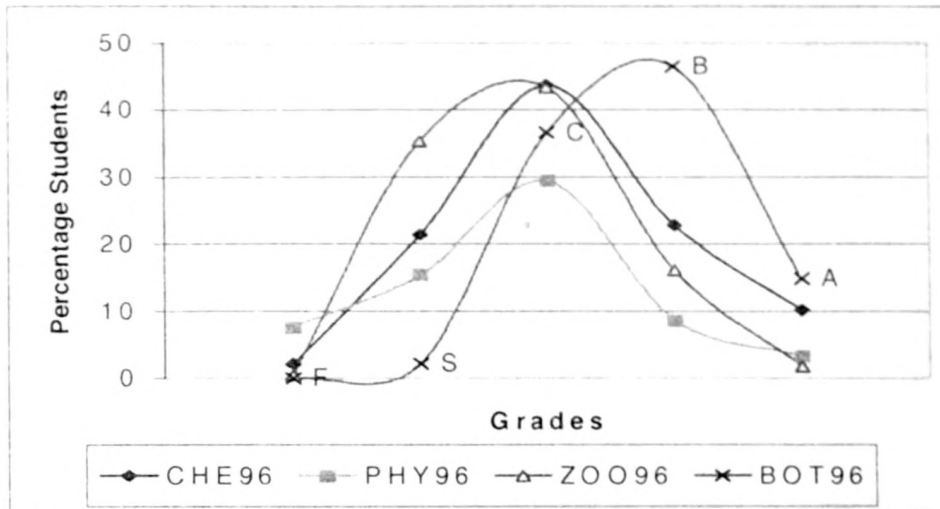**Figure 02: Distribution of Grades for Physics and Agriculture in 1996**



Figure 3 shows the distributions of grades for Chemistry, Physics, Zoology and Botany. Distribution of grades for Botany is left skewed and distribution of grades for Chemistry is more or less symmetric compared to other subjects. Distribution of grades for Zoology and Physics are right skewed implying that these two subjects are more difficult for students in Bio Science subject stream.

## Figure 03: Distribution of Grades for Chemistry, Physics, Zoology and Botany in 1996



Distribution curves of grades for Applied Mathematics and Pure Mathematics are presented in Figure 5. Distribution of grades for both Pure Mathematics and Applied Mathematics show right skewed patterns, showing that marks are located more to the left side of the distribution. Applied Mathematics is much more right skewed compared to Pure Mathematics. Therefor in Physical Science stream, Applied Mathematics is a more difficult subject compared to Pure Mathematics.

## Figure 05: Distribution of Grades for Applied Mathematics and Pure Mathematics in 1996
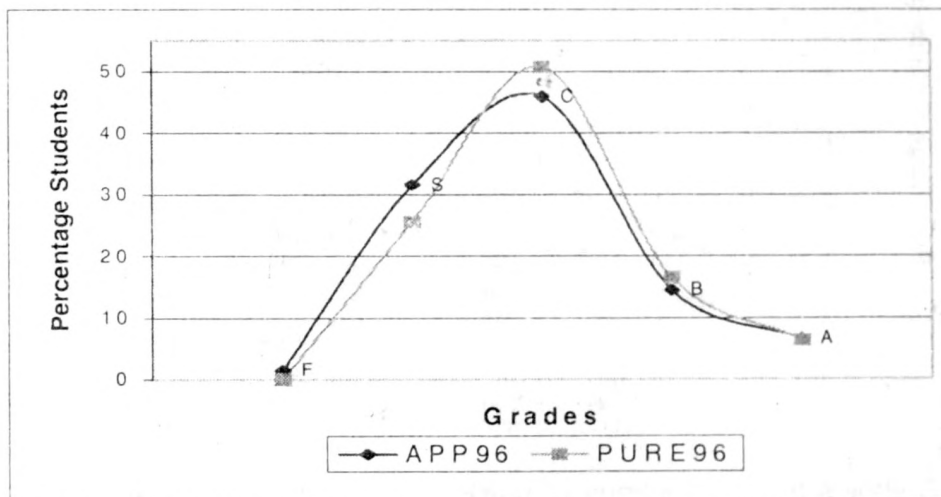


In this context, we can see the danger of adding raw subject marks of different subjects, which have different distributions to form raw aggregate marks to be used for university admission. We can notice that marks of several subjects (eg: Agriculture, Botany) are always located more to the right side of the range while in other subjects (eg: Physics, Applied Mathematics), marks are located at the left side of the range. Thus, a student can get a high aggregate by simply taking subjects in which the marks are located more to the right side of the range.

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## Categorical Data (Contingency Table) Analysis

Contingency table analysis was performed to investigate the relationships between different subjects in each subject stream for G.C.E. (A/L) results in 1995 and 1996.

### Categorical Data Analysis of Grades for Agriculture Vs Grades for Chemistry, Botany and Zoology

Table 3 gives the frequency analysis of grades for Chemistry by Agriculture in 1995 G.C.E. (A/L). The relationships between the patterns of grades obtained by students for these two subjects are highly significant since the probability of the chi-square statistic is very low (P<0.0001). Table 4 gives the similar parameters for the students in 1996 G.C.E. (A/L) examination. In Table 3 and 4, a similar pattern of variation of grades is observed. Only five students have obtained 'A' grades for Chemistry in 1995, while there are seven students in the 1996 examination. It is clear that most of the students who have sat for Agriculture in their G.C.E. (A/L) have not been able to obtain higher grades (A or B) for Chemistry In 1995. About 50% of students who obtained 'C' grades for Agriculture failed in Chemistry in both years. Failures in Agriculture is very low in both years. It is only three students in 1995 and no students in 1996. In fact, there is a very low chance to obtain the minimum requirement to enter the University for the students who failed in Agriculture. It is observed that if a student fails in Agriculture, he might lose on the other subjects as well.

**Table 03: Chemistry Grades by Agriculture Grades of G.C.E. (A/L) in 1995**

| Chemistry | Agriculture | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 1 (20.00) | 1 (20.00) | 3 (60.00) | 0 (0.00) | 0 (0.00) | 5 |
| B | 11 (26.83) | 13 (31.71) | 14 (34.15) | 3 (7.32) | 0 (0.00) | 41 |
| C | 37 (14.40) | 93 (36.19) | 108 (42.02) | 18 (7.00) | 1 (0.39) | 257 |
| S | 43 (6.67) | 198 (30.70) | 335 (51.94) | 67 (10.39) | 2 (0.31) | 645 |
| F | 16 (5.35) | 100 (33.44) | 172 (57.53) | 11 (3.68) | 0 (0.00) | 299 |
| Total | 108 | 405 | 632 | 99 | 3 | 1247 |

Note: Row percentages are given within parentheses

**Table 04: Chemistry Grades by Agriculture Grades of G.C.E. (A/L) in 1996**

| Chemistry | Agriculture | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 1 (14.29) | 4 (57.14) | 2 (58.57) | 0 (0.00) | 0 (0.00) | 7 |
| B | 19 (29.69) | 23 (35.94) | 21 (32.81) | 1 (1.51) | 0 (0.00) | 64 |
| C | 67 (17.09) | 139 (35.46) | 154 (39.29) | 32 (8.16) | 0 (0.00) | 392 |
| S | 77 (10.04) | 225 (29.34) | 397 (51.76) | 68 (8.87) | 0 (0.00) | 767 |
| F | 20 (8.03) | 102 (40.96) | 120 (48.19) | 7 (2.81) | 0 (0.00) | 249 |
| Total | 184 | 493 | 694 | 108 | 0 | 1479 |

Note: Row percentages are given within parentheses

Tables 5 and 6 show the contingency tables of Botany and Agriculture for the years 1995 and 1996 respectively. The association between grades for Agriculture and Botany is highly significant because the test statistics (Chi-square) value lies in very low level of probability ($P<0.0001$). A similar pattern of variation is observed in the frequency of grades for Botany in both years for the students who did Agriculture in their G.C.E. (A/L). In Agriculture, more students have obtained higher grades in Botany with few number of failures in both years.

**Table 05: Botany Grades by Agriculture Grades of G.C.E. (A/L) in 1995**

| Botany | Agriculture | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 3 (11.11) | 10 (37.04) | 14 (51.85) | 0 (0.00) | 0 (0.00) | 27 |
| B | 55 (18.09) | 108 (35.53) | 123 (40.46) | 16 (5.26) | 2 (0.66) | 304 |
| C | 39 (4.98) | 241 (30.78) | 425 (54.28) | 77 (9.83) | 1 (0.13) | 783 |
| S | 10 (7.63) | 45 (34.55) | 70 (53.44) | 6 (4.58) | 0 (0.00) | 131 |
| F | 1 (50.00) | 1 (50.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 2 |
| Total | 108 | 405 | 632 | 99 | 3 | 1247 |

Note: Row percentages are given within parentheses

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## Table 06: Botany Grades by Agriculture Grades of G.C.E. (A/L) in 1996

| Botany | Agriculture | | | | | Total |
|--------|------|------|------|------|------|-------|
| | A | B | C | S | F | |
| A | 17 (47.22) | 10 (27.78) | 9 (25.00) | 0 (0.00) | 0 (0.00) | 36 |
| B | 76 (19.14) | 156 (39.29) | 150 (37.78) | 15 (3.78) | 0 (0.00) | 397 |
| C | 82 (9.26) | 270 (30.47) | 451 (50.90) | 83 (9.37 | 0 (0.00) | 886 |
| S | 9 (5.66) | 57 (35.85) | 83 (52.20) | 10 (6.29) | 0 (0.00) | 159 |
| F | 0 (0.00) | 0 (0.00) | 1 (100.0) | 0 (0.00) | 0 (0.00) | 1 |
| Total | 184 | 493 | 694 | 108 | 0 | 1479 |

Note: Row percentages are given within parentheses

Frequency analysis of grades for Zoology by grades for Agriculture in 1995 and 1996 are presented in Tables 7 and 8 respectively. The associations between grades for Zoology and Agriculture for both years are highly significant since the probability of chi-square statistics is very low (P<0.0001). Only three students have obtained 'A' grades for Zoology from those who have done Agriculture in 1995 and no 'A' grades in 1996. A similar pattern of distribution of students in different grades is observed in 1995 and 1996 years. In 1995, only 33 students have obtained 'B' grades for Zoology while 50 students in 1996 examination. The numbers of students who have 'C' grades for Zoology are 413 in 1995 and 480 in 1996. Nearly 2/3 of the total (1247 in 1995 and 1479 in 1996) number of students who did Agriculture have obtained 'S' grades. Among those who failed in Zoology, three students obtained 'A' grades, six students had 'B' grades and seven students had 'C' grades for Agriculture in 1995, while there are four, seven and nine students respectively in 1996. From the students who have 'A' grades for Agriculture, no students have obtained 'A' grades for Zoology in both years. Only 14 students have 'B' grades, 56 students have 'C' grades and 35 students have 'S' grades in the 1995 examination, while in 1996, 18 students have 'B' grades, 84 have 'C' grades and 78 have 'S' grades. In this context, it is clear that there is a higher tendency to have C's and S's for Zoology among students who took Agriculture in 1995 and 1996 examinations.

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**Table 07: Zoology Grades by Agriculture Grades of G.C.E. (A/L) in 1995**

| Zoology | Agriculture | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 0 (0.00) | 1 (33.33) | 2 (67.67) | 0 (0.00) | 0 (0.00) | 3 |
| B | 14 (42.42) | 8 (24.24) | 11 (33.33) | 0 (0.00) | 0 (0.00) | 33 |
| C | 56 (13.56) | 156 (37.77) | 178 (43.10) | 22 (5.33) | 1 (0.24) | 413 |
| S | 35 (4.48) | 234 (29.92) | 434 (55.50) | 77 (9.85) | 2 (0.26) | 782 |
| F | 3 (18.75) | 6 (37.50) | 7 (43.75) | 0 (0.00) | 0 (0.00) | 16 |
| Total | 108 | 405 | 632 | 99 | 3 | 1247 |

Note: Row percentages are given within parentheses

**Table 08: Zoology Grades by Agriculture Grades of G.C.E. (A/L) in 1996**

| Zoology | Agriculture | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 |
| B | 18 (36.00) | 22 (44.00) | 10 (20.00) | 0 (0.00) | 0 (0.00) | 50 |
| C | 84 (17.50) | 182 (37.92) | 193 (40.21) | 21 (4.37) | 0 (0.00) | 480 |
| S | 78 (8.41) | 282 (30.42) | 482 (52.00) | 85 (9.17) | 0 (0.00) | 927 |
| F | 4 (18.18) | 7 (31.82) | 9 (40.91) | 2 (9.17) | 0 (0.00) | 22 |
| Total | 184 | 493 | 674 | 108 | 0 | 1479 |

Note: Row percentages are given within parentheses

## Contingency Table Analysis of Grades for Physics Vs Chemistry, Botany and Zoology Among of Bio Science Students

The Categorical data analysis was also carried out to investigate the association between performance of Bio-science students for Physics verses Chemistry, Botany and Zoology. Tables 9 and 10 present the results of the contingency table analysis of grades for Physics by grades for Chemistry of Bio Science students in 1995 and 1996 examinations. Only 152 students have obtained 'A' grades for Physics in 1995, while 154 students obtained in 1996 from the total (more than 9000 students). Out of 152 students who obtained 'A' grades for Physics, 112 students have obtained 'A' grades for Chemistry in 1995 and 123 students out of

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154 students in 1996. It is clear that students who perform well in Physics also perform well in Chemistry. Only 100 failures were observed in Chemistry in 1995 while there were 25 failures in 1996. About 1000 students have failed in Physics in both years. Thus, the failures in Physics are nearly 10 times larger than that of in Chemistry. A higher number of A grades was observed in Chemistry compared to Physics (864 A grades in 1995 and 1089 A grades in 1996). This number is about six to seven times greater than that of Physics. More B grades and C grades were obtained in Chemistry for both years (2144 B grades and 4003 C grades in 1995 and 2422 B grades and 4187 C grades in 1996).

### Table 09: Chemistry Grades by Physics Grades of G.C.E. (A/L) in 1995

| Chemistry | Physics | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 112 (12.96) | 319 (36.92) | 393 (45.49) | 37 (4.28) | 3 (0.35) | 864 |
| B | 38 (1.77) | 387 (18.05) | 1259 (58.72) | 431 (20.10) | 29 (1.35) | 2144 |
| C | 2 (0.05) | 116 (2.09) | 1528 (38.17) | 1975 (49.34) | 382 (9.54) | 4003 |
| S | 0 (0.00) | 7 (0.26) | 377 (13.86) | 1748 (64.26) | 588 (21.62) | 2720 |
| F | 0 (0.00) | 0 (0.00) | 20 (20.00) | 80 (80.00) | 0 (0.00) | 100 |
| Total | 152 | 829 | 3577 | 4271 | 1002 | 9831 |

Note: Row percentages are given within parentheses

### Table 10: Chemistry Grades by Physics Grades of G.C.E. (A/L) in 1996

| Chemistry | Physics | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 123 (11.29) | 308 (28.28) | 503 (46.19) | 152 (13.96) | 3 (0.28) | 1089 |
| B | 27 (1.11) | 203 (8.38) | 1071 (44.22) | 1056 (43.60) | 65 (2.68) | 2422 |
| C | 3 (0.07) | 41 (0.98) | 665 (15.88) | 2923 (69.81) | 555 (13.26) | 4187 |
| S | 0 (0.00) | 4 (0.24) | 86 (5.20) | 1178 (71.22) | 386 (23.34) | 1654 |
| F | 1 (3.57) | 2 (7.14) | 1 (3.57) | 24 (85.71) | 0 (0.00) | 28 |
| Total | 154 | 558 | 2326 | 5333 | 1009 | 9380 |

Note: Row percentages are given within parentheses

Tables 11 and 12 are presenting contingency table analyses of grades for Botany by grades for Physics in examinations in 1995 and 1996. There were no failures in Botany in 1996, and one student has failed in 1995. Most of the students have

obtained B grades and C grades for Botany in both years. The numbers of S grades in 1995 were 161, while there were 74 S grades in 1996. Thus, it can be concluded that it is easier to obtain higher grades in Botany than in Physics.

**Table 11: Botany Grades by Physics Grades of G.C.E. (A/L) in 1995**

| Botany | Physics | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 118 (9.14) | 396 (30.67) | 645 (49.96) | 128 (9.91) | 4 (0.31) | 1291 |
| B | 31 (0.69) | 391 (8.69) | 2085 (46.33) | 1688 (37.51) | 305 (6.78) | 4500 |
| C | 3 (0.08) | 41 (1.06) | 818 (21.09) | 2337 (60.26) | 697 (17.51) | 161 |
| S | (0.00) | 1 (0.62) | 28 (17.39) | 118 (73.29) | 14 (8.70) | 161 |
| F | 0 (0.00) | 0 (0.00) | 1 (100.0) | 0 (0.00) | 0 (0.00) | 1 |
| Total | 152 | 829 | 3577 | 4271 | 1002 | 9831 |

Note: Row percentages are given within parentheses

**Table 12: Botany Grades by physics Grades of G.C.E. (A/L) 1996**

| Botany | Physics | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 106 (6.72) | 296 (18.76) | 703 (44.55) | 454 (28.77) | 19 (1.20) | 1578 |
| B | 42 (0.90) | 237 (5.10) | 1275 (27.45) | 2640 (56.85) | 450 (9.69) | 4644 |
| C | 6 (0.19) | 25 (0.81) | 335 (10.86) | 2183 (70.78) | 535 (17.35) | 30.84 |
| S | 0 (0.00) | 0 (0.00) | 13 (17.57) | 56 (75.68) | 5 (6.76) | 74 |
| F | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 |
| Total | 154 | 558 | 2326 | 5333 | 1009 | 9380 |

Note: Row percentages are given within parentheses

Contingency table analysis of grades for Zoology by grades for Physics for Bio Science students in 1995 and 1996 are presented in Tables 13 and 14. The distribution of the number of students who have obtained A's, B's, C's and S's for Zoology in both years show a similar pattern. In 1995, the number of A grades for Zoology is 169 while in 1996 it was 195. Most of the students have obtained C's and S's for Zoology in both years (4731 C's with 3330 S's in 1995, and 4554 C's with 2902 S's in 1996).

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**Table 13: Zoology Grades by Physics Grades of G.C.E. (A/L) in 1995**

| Zoology | Physics | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 51 (31.48) | 61 (37.65) | 44 (27.16) | 6 (3.70) | 0 (0.00) | 162 |
| B | 63 (4.01) | 410 (26.11) | 855 (54.46) | 220 (14.01) | 22 (1.40) | 1570 |
| C | 35 (0.74) | 324 (6.85) | 1982 (41.89) | 1976 (41.77) | 414 (8.75) | 4731 |
| S | 3 (0.09) | 33 (0.99) | 682 (20.48) | 2046 (61.44) | 566 (17.00) | 3330 |
| F | 0 (0.00) | 1 (2.63) | 14 (36.84) | 23 (60.53) | 0 (0.00) | 38 |
| Total | 152 | 829 | 3577 | 4271 | 1002 | 9831 |

Note: Row percentages are given within parentheses

**Table 14: Zoology Grades by Physics Grades of G.C.E. (A/L) in 1996**

| Zoology | Physics | | | | | Total |
|---|---|---|---|---|---|---|
| | A | B | C | S | F | |
| A | 43 (22.05) | 51 (26.15) | 74 (37.95) | 25 (12.82) | 2 (1.03) | 195 |
| B | 66 (3.89) | 278 (16.37) | 767 (45.17) | 552 (32.51) | 35 (2.06) | 1698 |
| C | 38 (0.83) | 199 (4.37) | 1131 (24.84) | 2679 (58.83) | 507 (11.13) | 4554 |
| S | 7 (0.24) | 29 (1.00) | 12 (38.71) | 18 (58.06) | 0 (0.00) | 31 |
| F | 0 (0.00) | 1 (3.23) | 12 (38.71) | 18 (58.06) | 0 (0.00) | 31 |
| Total | 154 | 558 | 2326 | 5333 | 1009 | 9380 |

Note: Row percentages are given within parentheses

## Procedure of Analysis of Variance (ANOVA)

Table 15 gives the significant levels (pr.>F) of each source of variation of aggregate marks in the ANOVA procedure. The effect of districts, sex and attempt on aggregates of 1995 Bio Science students are significant at the probability of 0.0001. Here, we can conclude that the performance of students are different from district to district, male to female and repeating students to first attempt students of Bio Science stream in 1995. The interaction of district and attempt in Bio-Science in 1995 is significant at pr.>F of 0.0001, shows that there is an effect on the aggregate in different districts for repeating and first attempt students. The effect of district and sex on aggregate marks in 1996 Bio Science students are significant at the pr>F of 0.0001 while the interaction of district and sex is significant at pr>F of 0.0215. Here, it is evident that the performance Bio Science

of students in different districts with respect to gender is different from 1996. The effects of district, sex, attempt and district and attempt of the Agriculture students in 1995 are significant at the pr>F of 0.0290, 0.0022, 0.0001 and 0.0421 respectively. Only the effect of districts is significant at the probability of 0.0002 of the Agriculture students in 1996. Here, we can't observe the same results in Agriculture students in 1995 and 1996. In 1995, the performance of Agriculture students is different from district to district, by sex and by attempt, while students in 1996 do not show significantly different performance by sex. However, districts have a significant effect on performance.

**Table 15: Significance Levels of Each Source of Variation of Aggregate Marks.**

| Year of G.C.E. (A/L) Exam | Subject Stream | No. of Students | Source of Variation | Pr>F |
|---|---|---|---|---|
| 1995 | Bio Science | 9831 | District | 0.0001 |
| | | | Sex | 0.0001 |
| | | | Attempt | 0.0001 |
| | | | District*Sex | 0.0542 |
| | | | District*Attempt | 0.0001 |
| | | | Sex*Attempt | 0.2053 |
| | | | District*Sex*Attempt | 0.7888 |
| 1996 | Bio Science | 9380 | District | 0.0001 |
| | | | Sex | 0.0001 |
| | | | District*Sex | 0.0215 |
| 1995 | Agriculture | 1247 | District | 0.0290 |
| | | | Sex | 0.0022 |
| | | | Attempt | 0.0001 |
| | | | District*Sex | 0.5810 |
| | | | District*Attempt | 0.0421 |
| | | | Sex*Attempt | 0.0366 |
| | | | District*Sex*Attempt | 0.1881 |
| 1996 | Agriculture | 1479 | District | 0.0002 |
| | | | Sex | 0.4014 |
| | | | District*Sex | 0.0721 |
| 1995 | Physical Sc. | 3916 | District | 0.0001 |
| | | | Sex | 0.0001 |
| | | | Attempt | 0.0001 |
| | | | District*Sex | 0.4369 |
| | | | District*Attempt | 0.9997 |
| | | | Sex*Attempt | 0.9998 |
| | | | District*Sex*Attempt | 0.5697 |
| 1996 | Physical Sc. | 4250 | District | 0.0001 |
| | | | Sex | 0.0001 |
| | | | District*Sex | 0.0001 |

## Duncan's Multiple Range Test (DMRT)

Table 16 gives the detailed information about the results of DMRT for sex and attempt for mean aggregate marks of each subject streams for the years 1995 and 1996. It is evident that males have a higher aggregate over females excepting Agriculture students in the 1996 examination. In all the other subject streams and years of examinations, males have a higher mean aggregate score, which is significantly different. The difference observed in Bio Science students is about three to four marks, while in Physical Science students, the male to female difference of mean aggregate marks is about 10 marks. Here, we can conclude that the performance of males is significantly higher in Physical Science students than that of Bio Science and Agriculture. A clear pattern of difference can not be observed between the mean aggregate of first attempt and repeating students.

### Table 16: DMRT for Sex and Attempt for the Variable Aggregate Marks

| Year of (A/L) | Subject Stream | Sex | Mean of Aggregate | Remarks | Attempt | Mean of Aggregate | Remarks |
|---|---|---|---|---|---|---|---|
| 1995 | Bio Sc. | M | 230.911 | Significantly different | First | 226.73 | Not Significant |
| | | F | 225.408 | | Repeated | 230.50 | |
| 1996 | Bio Sc. | M | 228.437 | Significantly different | | | |
| | | F | 224.649 | | | | |
| 1995 | Agri. | M | 215.517 | Significantly different | First | 210.577 | Significantly different |
| | | F | 211.318 | | Repeated | 216.432 | |
| 1996 | Agri | M | 213.319 | Not Significant-ant | | | |
| | | F | 214.463 | | | | |
| 1995 | Physical Sc. | M | 225.043 | Significantly different | First | 224.134 | Significantly different |
| | | F | 215.184 | | Repeated | 217.113 | |
| 1996 | Physical Sc. | M | 227.926 | Significantly different | | | |
| | | F | 216.586 | | | | |

Note: M - Male     F - Female

### Analysis of Means Procedure

Table 17 displays the number of students obtaining the minimum requirement to enter the university for each district, mean aggregate and standard deviation of aggregate for Bio Science, Agriculture and Physical Science students.

## Table 17: Mean and Standard Deviation of Aggregate Marks of Districts.

| District | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| Colombo | 2066 | 235.47 | 34.57 | 66 | 213.06 | 26.05 | 1116 | 227.07 | 35.23 |
| Gampaha | 728 | 226.93 | 30.02 | 118 | 217.05 | 23.82 | 327 | 214.44 | 29.14 |
| Kaluthara | 568 | 224.44 | 29.91 | 85 | 218.61 | 26.74 | 226 | 217.87 | 28.56 |
| Matale | 141 | 222.27 | 27.17 | 32 | 205.78 | 15.48 | 52 | 210.59 | 26.11 |
| Kandy | 863 | 224.9 | 30.95 | 160 | 210.15 | 24.04 | 272 | 218.27 | 29.50 |
| Nuwara Eliya | 110 | 214.23 | 25.18 | 14 | 200.42 | 15.20 | 20 | 201.15 | 21.08 |
| Galle | 697 | 231.42 | 32.12 | 90 | 210.94 | 24.97 | 247 | 223.05 | 32.06 |
| Matara | 573 | 233.13 | 33.44 | 66 | 216.74 | 25.25 | 189 | 226.91 | 32.32 |
| Hambantota | 329 | 224.43 | 28.94 | 78 | 216.44 | 22.98 | 89 | 215.59 | 26.21 |
| Jaffna | 896 | 230.88 | 32.31 | 1 | 216.0 | - | 602 | 234.83 | 37.76 |
| Kilinochchi | 32 | 214.15 | 21.66 | 2 | 201.50 | 0.70 | 11 | 213.90 | 23.23 |
| Mannar | 17 | 217.82 | 16.80 | 0 | 0 | 0 | 9 | 205.66 | 21.30 |
| Mulative | 43 | 214.55 | 24.29 | 7 | 206.42 | 18.89 | 12 | 211.75 | 22.80 |
| Vavunia | 28 | 214.42 | 22.78 | 0 | 0 | 0 | 10 | 221.30 | 41.46 |
| Trincomalee | 75 | 215.33 | 24.75 | 0 | 0 | 0 | 36 | 204.56 | 29.04 |
| Batticaloa | 115 | 217.27 | 27.63 | 25 | 207.84 | 22.08 | 56 | 210.26 | 27.87 |
| Ampara | 197 | 215.46 | 25.81 | 14 | 204.92 | 21.47 | 42 | 211.45 | 26.43 |
| Puttalam | 249 | 223.36 | 30.98 | 13 | 218.46 | 27.22 | 56 | 212.05 | 22.29 |
| Kurunegala | 732 | 227.75 | 31.71 | 133 | 215.67 | 23.94 | 196 | 218.13 | 28.55 |
| Anuradapura | 193 | 215.12 | 25.15 | 72 | 212.30 | 22.97 | 48 | 212.12 | 33.35 |
| Polnnaruwa | 85 | 217.76 | 24.40 | 15 | 219.53 | 24.65 | 14 | 195.57 | 12.15 |
| Badulla | 293 | 223.59 | 29.67 | 49 | 205.26 | 21.58 | 85 | 213.64 | 25.68 |
| Monaragala | 86 | 216.37 | 25.61 | 8 | 203.87 | 11.63 | 14 | 207.00 | 18.02 |
| Kegalle | 387 | 224.75 | 29.34 | 115 | 212.26 | 25.31 | 97 | 215.41 | 26.08 |
| Ratnapura | 328 | 223.40 | 27.10 | 84 | 212.67 | 24.56 | 90 | 215.17 | 26.84 |

Note:  A - Number eligible for Bio Sc.
B- Mean aggregate of Bio Sc. students
C- Standard deviation of aggregate of Bio Sc. students
D- Number eligible for Agriculture
E- Mean aggregate of Agriculture students
F- Standard deviation of aggregate of Agriculture students
G- Number eligible for Physical Sc.
H- Mean aggregate of Physical Sc. Students
I- Standard deviation of aggregate of Physical Sc. Students

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In the Colombo district, more students have obtained the minimum requirement to enter the university for Bio Science and Physical Science subject streams than in the other districts. A comparatively a lower number of students in Agriculture subject stream in Colombo district have obtained the minimum requirement to enter the university. The reason for this is that a lower proportion of students in Colombo district take Agriculture instead of Physics as a subject in the Bio science subject stream. The next leading districts, which have more students with minimum requirement, are Jaffna, Kandy, Gampaha, Kaluthara, Kurunegala, Galle and Matara for Bio Science and Physical Science subject streams. The more prominent districts which have a higher number of Agriculture students are, Gampaha, Kaluthara, Kandy, Kurunegala and Kegalle. In the Colombo district, the standard deviation of aggregate marks is always higher than that of other districts. The standard deviation of aggregate also remains at higher levels in some of the districts which are categorized as privileged districts. These higher standard deviations in privileged districts may indicate that, there is a uneven distribution of facilities even within the same (privileged) district, even though it is called so.

## Conclusions

1.  A higher degree of association is present among grades for subject in each subject stream.
2.  Mean aggregate marks in G.C.E. (A/L) examination are significantly different from district to district, male to female, while it is not significantly different between first attempt students and repeat students.
3.  Higher standard deviations of aggregate marks that exist in districts where the mean aggregate marks are high, shows the severe disparity existing in these so called 'privileged' districts.
4.  Distribution of grades for subject in each subject is different from each other. Agriculture and Botany show left skewed distribution while Physics, Zoology, Pure Mathematics and Applied Mathematics show right skewed distribution. Subjects such as Zoology, Pure Mathematics, Applied Mathematics and Physics are difficult compared to Botany and Agriculture.

## Future Areas of Research

### Standardization of G.C.E. (A/L) Marks

It has already been shown that raw aggregate marks is not a suitable criteria to select students for university admission, because raw aggregate marks are formed by adding raw subject marks which have different distribution patterns. So, future research has to be done to formulate a standardized scoring system using raw subject marks, to be used as a basis for university admission.

### Investigation of Factors Affecting Performance of Students in Different Districts

Performance of students at G.C.E. (A/L) examination is always different from district to district. In some districts, students always perform better at G.C.E. (A/L) examination while there are districts in which performance of students is extremely poor. Thus, future research has to be carried out to investigate the most probable

factors that affect performance of students at the G.C.E. (A/L) examination. This kind of research will help improve conditions which affect the performance of students at G.C.E. (A/L) examination in different districts.

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