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Statistical Fact of Students' Background and Academic Achievement in Higher Educational Institution

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Abstract

The differences in academic achievement among students are a topic that has drawn interest of many academic researchers and Malaysian society. This paper describes the results of a detailed statistical analysis relating to the degree classification obtained at the end of their studies (first class, second class upper or second class lower) between undergraduate students and their backgrounds. In this study, students' data from one of the higher educational institution in Malaysia from 1997 to 2006 are used. Visual analysis of categorical data techniques had been applied to reveal the students' academic achievement pattern from various backgrounds. The findings can assist the institution in determining future policy on student admissions and to provide the necessary plans to improve student achievement.

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Keywords: Degree classification; Higher educational institution; Visual analysis of categorical data techniques

1. Introduction

The improvement of students' achievement has becoming the one of the priority goals in education. In the past few decades, researchers and educators have conducted many studies and experiments to determine the factors that affect students' achievement. Socio-demographic characteristics such as age gender, marital status, family status, ethnicity, previous achievement have thus been shown to affect their undergraduate academic performance (Brown and Burkhardt, 1999, Clayton and Cate, 2004, Stevens et al., 2004, Ding et al., 2006, Noor Azina Ismail and Halimah Awang, 2008).

This paper investigates the pattern of university academic achievement of mathematics students from Mathematics Department, at one of the higher educational institution in Malaysia, according to their gender, university academic

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entry channel, age and race. We measure academic achievement using the Cumulative Grade Point Average (CGPA) of students upon graduated.

Upon completing upper secondary education, there are several routes to higher education in Malaysia. The first route is a pre-university or matriculation program and the examination result will be used for entrance to public universities. The second route is a two-year form sixth education program, where students take a centralized examination known as the Malaysian Higher School Certificate (*Sijil Tinggi Pelajaran Malaysia*) or STPM. The third route is for in-service teacher to obtain the bachelor degree. In-service Teacher Education Programme (*Program Khas Pensiswazahan Guru*) or PKPG is joint programme with the Ministry of Education which offering special degree programmes to non-graduate teachers. The fourth route is a special degree programme known as In-service Teachers with Diploma in Special Education Programme (*Program Pensiswazahan Guru-guru lepasan Kursus Diploma Perguruan Khas*) or KDPK. The fifth routes to this higher educational institution are second channel, special case or diploma holder. Each route has its own education system, varying in standard of grading.

The first socio-demographic variable considered in this study is gender. Noor Azina Ismail and Halimah Awang (2008) present that the effects of gender differences are significant in distinguish between the higher and lower achievers or medium and lower achievers with girls are more likely as compared to boys to be in the higher group of achievers but not between the high and medium achievers. Ding et al. (2006) used a longitudinal multilevel modeling to examine overall performance of two school districts in two different states in the United States. The results suggest that both male and female students demonstrated the same growth trend in mathematics performance over time, but females' mathematics grade-point average is significantly higher than males.

Some researchers have done studies to investigate the relationship between race and academic achievement but they show conflicting results. Clayton and Cate (2004) discovered that students from different ethnic backgrounds differed in the levels of academic achievement. They found that Whites and Hispanics students were outperform Asian Americans students in the MBA program at Northern Kentucky University. Study on Hispanic and Caucasian students done by Steven et al. (2004) report a statistically different motivation and performance across ethnicity. On the other hand, Noor Azina Ismail and Halimah Awang (2006) found that the role of ethnicity in explaining the differences in academic performance in three faculties at University of Malaya, Malaysia was not significant.

Findings from previous study on the role of age in influencing the academic achievement are similarly contested. Although Graham (1991) found that the age is insignificantly correlated with academic performance, Peiperl and Trevelyan (1997) discover a negative correlation between age and performance, with younger students performing better than older ones. Archer et al. (1999) and Hayes et al. (1997) agree with Graham (1991) i.e. the older students perform at par with younger students.

2. Methodology

First, we collect 3108 graduated student's data from Mathematics Department at one of the higher educational institution. The students' CGPA upon graduation, intake channel, gender, race group and age were obtained from Academic Department. We convert the students' final CGPA into degree classification (first class (1), second class upper division (2A) or second class lower division (2B)) according to the institution degree classification scale. We re-group five categories of race into two main categories: Bumiputra (Malay and Bumiputra Sabah/Sarawak) and Non-Bumiputra (Chinese, Indian and others). We also converted the student age into four categories. Students who enter the institution at or below age 29 were in group 1 (AG1), age 30 – 39 were in group 2 (AG2), age 40 to 49 were in group 3 (AG3) and age 50 and above were in group 4 (AG4). The background data of the Mathematics students are shown in Table 1.

Table 1: Background of Students

Variables	Percentage
Gender	
Male	29.0
Female	71.0
Race Group	
Bumiputra	87.8
Non-Bumiputra	12.2
Age Group	
29 or below (AG1)	47.2
30 – 39 (AG2)	31.4
40 – 49 (AG3)	17.7
50 and above (AG4)	3.7
Intake Channel	
Diploma	7.6
KDPK	5.3
Special Case/Diploma	9.5
Matriculation	41.0
PKPG	26.0
Second Channel	7.3
STPM	3.3
Degree Classification	
First Class (1)	0.5
Second Class Upper (2A)	41.9
Second Class Lower (2B)	57.6

We use R language to construct the mosaic plots. Mosaic plot (Friendly, 1994, Hartigan and Kleiner, 1981) is a graphical method for visualizing an n -way contingency table. The frequencies in a contingency table are represented as a collection of rectangular “tile” whose areas are proportional to the cell frequencies.

The mosaic plot starts as a square with length one. The square is then divided into horizontal bars whose widths are proportional to the probabilities associated with the first variable. The probability is calculated as

$$p_{i+} = \frac{n_{i+}}{n_{++}} \quad (1)$$

where n_{i+} is the marginal count and n_{++} is the total count.

Next, each bar is divided vertically into “tiles” that are proportional to the conditional probabilities of the second variable, which is calculated as

$$p_{j|i} = \frac{n_{ij}}{n_{i+}} \quad (2)$$

n_{ij} is the number of objects belong to the cell with row i and column j .

Additional division can be made if we wanted to include the third, fourth variable, etc.

3. Results and Discussions

3.1 Performance According to Gender

Figure 1 provides the distribution of degree performance among mathematics students according to their gender. The mosaic plot shows that females were the majority group and they also perform better than males. Out of 0.5 percent of the total students received first class degree, 88 percent are females and only 12 percent are males. The similar trend is also shown for the second class upper division where out of 41.9 percent of the total students, 81 percent are females while the remaining 19 percent are males. The performance gap between males and females are smaller for the second class lower division where out of 57.6 percent of the total students, 63 percent are females and 37 percent are males.

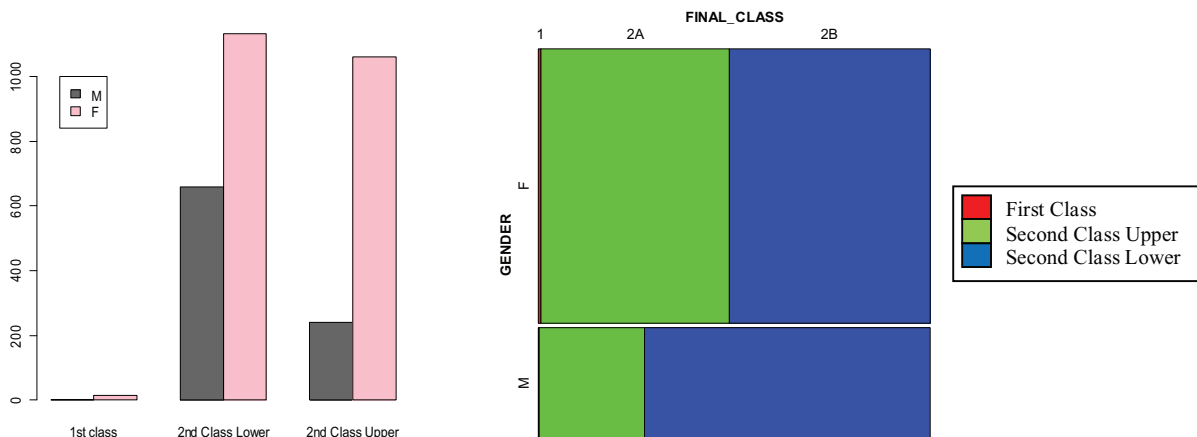


Figure 1: Degree Classification by Gender; Bar Chart (left) and Mosaic Plot (right)

3.2 Performance According to Gender and Intake Channel

Figure 2 shows the performance related to gender and qualifications at entry. The majority or 41 percent of the student are from matriculation, 26 percent are from PKPG, 10 percent are from special case, 8 percent are diploma holder, 7 percent are from second channel, 5 percent are from KDPK program and the remaining 3 percent are STPM holder. Matriculation and PKPG students are the majority group in the institution with composition of 67 percent out of total students. Even though STPM students are the minority group for both genders, they outperform other groups. Out of 88 percent of the female students receive first class degree, 67 percent are STPM holders, 27 percent were either from matriculation or PKPG and 6 percent are diploma holders. Out of 12 percent of the male students received first class degree, they are either from diploma or STPM.

Academic achievements for all other groups except STPM of male students are almost equal. However, the differences among female students are not consistent for various category of entry channel. Matriculation students achieve at the same level as diploma students while PKPG and KDPK are slightly lower. For the female group, second channel achieve the worst.

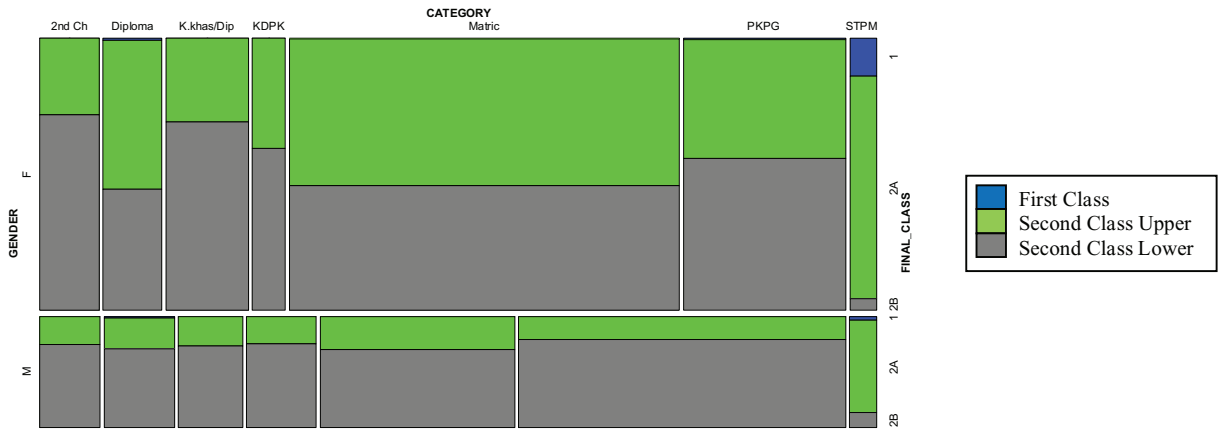


Figure 2: Mosaic Plot of Degree Classification by Intake Channel and Gender

3.3 Performance According to Race and Intake Channel

In Figure 3, achievement for Bumiputra students across intake channel shows the similar pattern as in female students shown in Figure 2. As expected, out of 82 percent of the total Non-Bumiputra students receive first class degree, 79 percent are STPM holders and 21 percent are either from diploma, matriculation or PKPG. For the second class upper degree, 47 percent are PKPG intake, followed by STPM with 30 percent and 10 percent of KDPK intake. Percentage for each of other channels is less than 10 percent. Second class lower division degree is dominated by PKPG students with 75 percent out of total 48 percent of the Non-Bumiputra students receive second class lower division degree. Percentage for each of other channels is less than 10 percent.

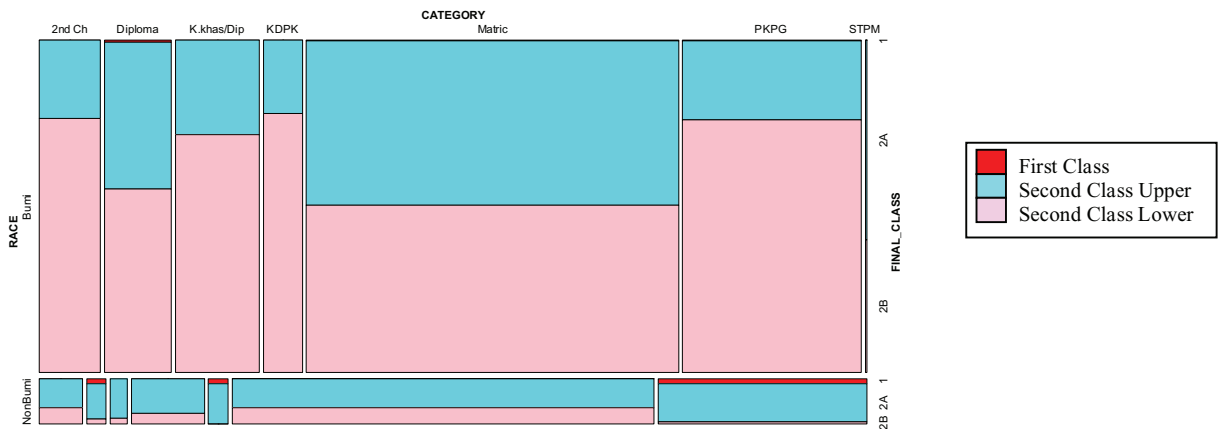


Figure 3: Mosaic Plot of Degree Classification by Intake Channel and Race

3.4 Performance According to Gender and Age Group

In terms of age, 47 percent of the students begin their study at this institution at the age of 29 or younger. Thirty one percent are between 30 and 39, 18 percent between 40 and 49, and the remaining 4 percent are 50 or above. Figure 4 shows that in general, older students perform at a level equal to younger students.

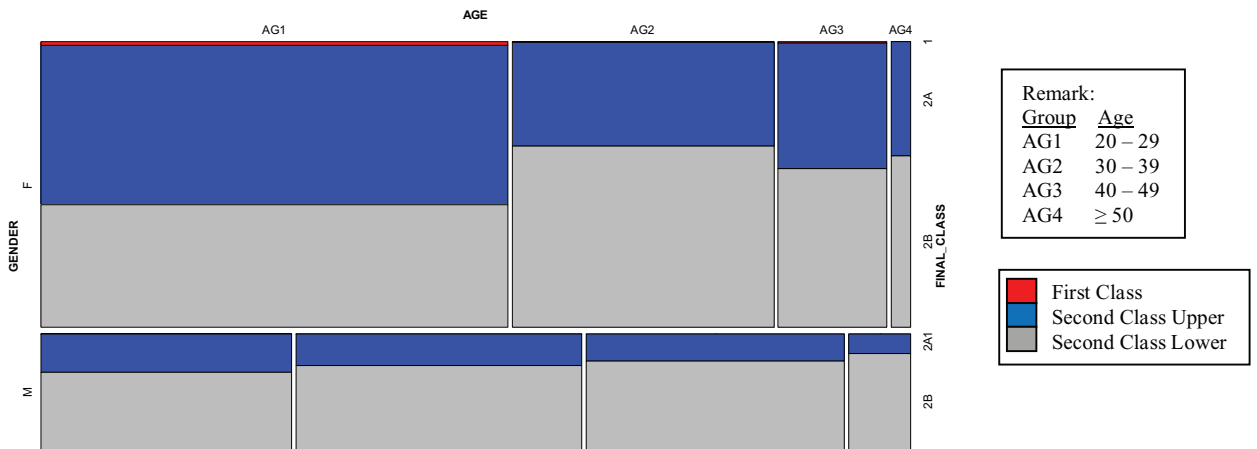


Figure 4: Mosaic Plots of Degree Classification by Age Group and Gender

4. Conclusion

The entry channel is a major factor in influencing success for students in higher education institution. Statistical results also reveal the importance of gender and race group in explaining differences in student achievement at the University level which gives support to previous research findings with regard to gender and race differences.

It is expected that this preliminary work will serve as the basis of a more detailed and elaborate study in understanding achievement trends of students of various background. This study can be extended to reveal the pattern of students' achievement at others institutions.

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