A COMPARATIVE STATISTICAL STUDY OF MAJOR DISCIPLINE CHOICE OF SCIENCE FRESHMAN STUDENTS

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ABSTRACT: *This article compares the preference of freshman students of Addis Ababa University for the disciplines Architecture, Biology, Chemistry, Geology, Mathematics, Pharmacy, Physics, Statistics and Technology under the past socialist and the present market economy systems.*

1. INTRODUCTION

The future of any discipline depends on its ability to attract and train the very best young people (Minton, 1983). However, students career choice is very strongly influenced by the perception of the job market and salaries. The pre-existence of a large market for professionals is not the only requirement for a department to prosper. However Public recognition of some disciplines results in better social status. Since students are deeply rooted in traditional

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social values, a high social status accorded to some disciplines influences the students' choice. There is, for instance, better social status and reward for administrative jobs than for technical jobs. Furthermore, some academic departments make their program more attractive than those of others by making courses interesting and relevant so that students are motivated to seek advanced training.

Generally, students' interest towards a certain discipline reflects the job market and/or the public recognition of the discipline and/or the attractiveness of the instructional process of the department. These factors determine the future of that discipline. Therefore, it is apparent that a study of the career choice of students entering college is useful in planning for a more attractive and efficient academic institution. However, research in this regard is limited.

With this objective in mind, this paper tries to examine the career choice of the students entering the Faculty of Science of Addis Ababa University under the past and present economic systems, the former being the socialist planned-economy system and the later a market-economy system adopted after May 1992.

2. THE DATA

At the end of every freshman program, the Office of the Coordinator of the Faculty of Science Freshmen Program requires freshmen to rank the fields of Biology, Chemistry, Geology, Mathematics, Physics, Statistics, Technology, Pharmacy and Architecture according to their order of preference.

Before 1990, students were advised to choose and rank only the first six fields of their preference. Starting from 1990 students however, are required to rank all from 1 to 9, from the most liked to the least wanted.

The data we consider here are the responses of freshmen of 1990-91 and 1993-94 academic years. The 1990-91 group is assumed to be representative of the past planned-economy system while the 1993-94 group is assumed to be representative of the present market-economy system.

There were 584 freshmen in 1990-91 out of which 25 students did not complete the department choice form as instructed by their advisor and hence they are not included in this study. All the 673 freshmen of the 1993-94 academic year completed the choice form and are included in the study.

3. METHOD

Statistical methods have to be suitable for the type of data to which they are to be applied. The nature of the data requires the use of appropriate nonparametric statistical methods. A nonparametric analog of the parametric two way analysis of variance (Friedman two way analysis of variance by ranks) was run for each group. In the study, discipline has been considered as the treatment and a student as the block. Friedman test statistic under the null hypothesis of no difference between the k treatments is expressed as follows:

$$X_r^2 = \frac{12}{nk(k+1)}\sum_{i=1}^{k} R_i^2 - 3n(k+1)$$

where, k and n are the number of treatments and the number of blocks, respectively; and R_i is the sum of the rank of treatment i.

For all practical purposes χ_r^2 is treated as a chi-square variable with k-1 degrees of freedom (see Gibbons, 1971).

Following the Friedman-test, a multiple comparison procedure was also applied. Using the rank sums of each discipline in each system and the a result of multiple comparison test, the researcher employed Page's test for ordered alternatives. Page's test statistic for ordered alternative is expressed as follows:

$$Z = \frac{L - nk(k+1)^2/4}{\sqrt{n(k^3-k)^2/144(k-1)}}$$

where, $L = \sum_{j=1}^{k} jR_j$

n, k and R_j are as defined in the Friedman-test,
j is the order of the treatment according to the alternative hypothesis which is distributed approximately as the standard normal.

The theories that justify the above methods have been discussed in the literature (Friedman, 1937, 1940; McDonald and Thompson,

1967; Page, 1963; Hollander and Wolfe, 1973; Gibbons, 1971; and Daniel, 1978).

4. RESULTS

The summary of the sum of the rank of each discipline in the two groups is displayed in Table 1.

Table 1
Rank Sum

System	Discipline								
	Biol	Chem	Geol	Math	Phys	Stat	Phar	Tech	Arch
planned economy	4282	3485	2508	2680	3128	1871	2977	1176	3048
market economy	4450	3918	4753	2860	3975	3557	2210	1495	3067

4.1 The Planned Economy System

Our first concern of analysis is to test the hypothesis that all the disciplines are equally attractive against the alternative hypothesis that at least one discipline is more (or less) favourite than others. That is,

H_0 : All disciplines are equally attractive
H_1 : At least one discipline is different from the others.

The value of Friedman test statistic χ_r^2 on the basis of our data is 1542.235. The Chi square test based on eight degrees of freedom leads to rejection of the null hypothesis, p= 0.0000. Therefore, a

significant difference seems to exist in the degrees of attractiveness of the disciplines.

Since the hypothesis of being equally attractive of the disciplines is not found to be tenable, we may ask which of the pairs of disciplines are different. This can be answered by applying a multiple comparison test.

Table 2
Comparison of Pairs of Disciplines for Planned Economy System

Discipline	Bio	Chem	Geol	Math	Phys	Stat	Phar	Tech	Arch
Biol	-	8.704*	19.373*	17.495*	12.602*	26.330*	14.251*	33.920*	13.476*
Chem		-	10.669*	8.791*	3.899*	17.630*	5.558*	25.216*	4.772*
Geol			-	1.878	6.771*	6.956*	5.218*	14.546*	5.897*
Meth				-	4.892*	8.834*	3.243*	16.425*	4.019*
Phys					-	13.727*	1.649	21.317*	0.872
Stat						-	12.078*	7.590*	12.854*
Phar							-	19.668*	0.775
Tech								-	20.443*
Arch									-

Table 2 displays multiple comparison statistic to be compared with
$Z_{a/k(k-1)}$, where a is the overall level of significance for all tests and k is the number of disciplines considered, which is 9 here.

* significant at 5% level of significance

$$Z_{a/k(k-1)} = Z_{0.0006944} = 3.1970$$

From the Table above Geology and Mathematics, Architecture and Physics, Physics and Pharmacy, and Architecture and pharmacy have no significant difference at 5% level of significance. But the remaining 32 pairs of disciplines have shown a significant difference at the specified level of significance. Hence, it is again meaningful to apply Page's test in order to assess the order of attractiveness of the disciplines. The disciplines are arranged on the basis of the rank sums and the hypothesis of interest, now, is

H_{01} : All disciplines are equally attractive
H_{11} : The disciplines are preferred in the following order

$$t_{Tech} \pounds t_{Stat} \pounds t_{Geol} \pounds t_{Math} \pounds t_{Phar} \pounds t_{Arch} \pounds t_{Phys} \pounds t_{Chem} \pounds t_{Biol}$$

where, t_X is the rank order of discipline X.

Under our hypothesis H_{01}, Page's test statistic is distributed as standard normal for a sufficiently large number of observation. The computed Z-value is found to be 32.917. This result favours the alternative hypothesis, p= 0.0000.

4.2 The Market Economy System

Similarly, to test the hypothesis

H_{02} : All disciplines are equally attractive
H_{12} : At least one discipline is different from the others.

The Friedman test statistic χ_r^2 is found to be 1781.73. This figure is again highly significant when compared with tabulated chi-square with eight degrees of freedom, p= 0.0000. Since we reject H_{02} we wish to know specifically which disciplines are different from which ones. Table 3 presents the statistics to be compared with $Z_{a/k(k-1)}$.

Table 3
Comparison of Pairs of Disciplines for Market Economy System

Discipline	Bio	Chem	Geol	Math	Phys	Stat	Phar	Tech	Arch
Biol	-	5.295*	3.016	15.825*	4.726*	8.888*	22.294*	29.411*	13.765*
Chem		-	8.311*	10.530*	0.567	3.593*	16.999*	24.126*	8.470*
Geol			-	18.841*	7.743*	11.704*	25.310*	32.426*	16.780*
Math				-	11.097*	6.937*	6.469*	13.356*	2.060
Phys					-	4.160*	17.567*	24.683*	9.037*
Stat						-	13.406*	20.523*	4.877*
Phar							-	7.116*	8.530*
Tech								-	15.646*
Arch									-

* significant at 5% level of significance
$Z_{a/k(k-1)} = Z_{0.0006944} = 3.1970$

From Table 3, out of 36 possible pairs 33 pairs are different. It is quite reasonable to apply an ordered alternative test. Using Table 1 as a guide the hypothesis of interest becomes:

H_{03} : All disciplines are equally attractive
against
H_{13} : The disciplines are preferred in the following order

$$t_{Tech} \pounds t_{Phar} \pounds t_{Math} \pounds t_{Arch} \pounds t_{Stat} \pounds t_{Chem} \pounds t_{Phys} \pounds t_{Biol} \pounds t_{Geol}$$

where, t_X is the rank order of discipline X.

Under the null hypothesis H_{03}, the computed Page's test statistic for a large number of observations is found to be 5.186. Therefore, we

attractiveness obtained in the study. It rather indicate the popularity of the disciplines to science freshmen. The traditional role of the departments, imparting specific knowledge, will have to be supplemented with techniques that popularize the disciplines.

A university, by its nature, is bound to be subject oriented, irrevocably devoted to the study and development of fundamental truth. However, its performance in its role of reaching the wider society it belongs to has by the public recognition it gets and the power it builds through new discovery.

All countries that lead the world to day have succeeded in marrying intellectual pursuit at the university level with the practical application of that pursuit to the day-to-day needs of their societies. On the contrary, in developing countries like Ethiopia, the shortage of professionals and the lack of public awareness of the disciplines are among of the many bottlenecks of development. Hence, many of the departments considered in the study, except perhaps Technology, should make an effort to be attractive, relevant to train professionals who would play research and applied science such as improvement in production, services, and skills in technology and management, technology and management in the country.

REFERENCES

Daniel, W.W. (1978). Applied nonparametric Statistics. Houghton Mifflin Company: Boston.

Friedman, M. (1937). "The Use of Ranks to Avoid the Assumption of Normality Implicit in the Analysis of Variance,". Journal of American Statistical Association. 32, 675-701.

Friedman, M. (1940). "A Comparison of Alternative Tests of Significance for the Problem of Rankings,", Annauls of Mathematical Statistics 11, 86-92.

Gibbons, J.D. (1971). Nonparametric Statistical Inference. Tokyo McGraw Hill:

Hollander, M. and Wolfe, D.A. (1973). Nonparametric Statistical Methods. New York: John Wiley

McDonald, B.J. and Thompson W.A. (1967). Rank Sum Multiple Comparisons in One- and Two- Way Classifications. Biometrika 54, 487-497.

Minton, P.D (1983). "The Visibility of Statistics as a Discipline,". The American Statistician. 37, 284-289.

Page, E.B. (1967). "Ordered Hypotheses for, Multiple Treatments: A Significance Test for Linear Ranks," Journal of American Statistical Association. 58, 216-230.