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PREDICTING THE ACADEMIC PERFORMANCE
OF THE GRADUATE STUDENTS AT BEIRUT
UNIVERSITY COLLEGE USING A MULTIPLE
LINEAR REGRESSION MODEL

A Research Topic
Presented to Business Division
Beirut University College

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Business
Management

BY
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TO THOSE WHO GAVE ME
THE ESSENCE OF LOVE AND LEARNING,
MY PARENTS AND MY TEACHERS...

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~~As always the unknown soldier receives no direct~~
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CHAPTER I

INTRODUCTION

A fact that could be clearly witnessed today is that higher education has become a very important issue that is highly prized, pressured and probed. Providing the best education to selected students that show a high capability in performing up to the required standards set by the university can play a great role in upgrading the level of education in our country, especially after its decline due to the effect of the civil war.

Due to the social and the economic circumstances existing around us our youths are encouraged to seek further education, especially at the graduate level. The result is that an increasing number of students are applying for the graduate studies in universities. Though generally willing to take most of the students, colleges can't & should not do so. They should be highly selective in the process of student admission, and here comes the importance of evaluation and performance prediction.

"It has long been recognized that evaluation, both in a general sense and in more specialized applicants, is necessary if the complex process of higher education are to be administered most efficiently, effectively, and economically."¹ Because of this, there should be a

¹ Paul L. Dressel , Evaluation in Higher Education, (Boston: Houghton Mifflin Company, 1961) P.ix

this, there should be a systematic consideration of the many types of judgements and evaluation techniques used by a college in its process of selecting applicants and predicting their performance.

Education is a complex process involving the selection of concepts, values, skills and the planning of experiences designed to master these ideas by the students. Therefore, evaluation is inevitable. It involves the judgement of the worth of an experience, process or idea on some absolute basis. Nevertheless, it is concerned with the nature of data, the range of considerations involved in making judgements, and the responsible persons entrusted. First, measurement is a major essential tool of evaluation or research, it provides the basic data for analysis. Statistical procedures emphasizing objectivity and counting operations are usual and useful methods of this approach. Second, assessment is also vital, it undertakes the study of the characteristics of the tested situation, and the interaction of the two.

General Background

In recent years, there has been a pressing need in Lebanon & the Arab world for qualified personnel with Technical knowledge and new ideas for development. Since graduate schools offer more advanced studies than the undergraduate programs, the number of graduate students in the graduate programs has grown rapidly.

Table I presents the number of graduate students in Lebanon for the years 1974 - 1989.

Now what about the admission policies in Beirut University College, & how does it predict the performance of applying students to the Master Program in Business ?

Before answering this question, a general background of this program might prove useful. In 1981, Beirut University College began its Master of Science Program in Business Management. This was done in response to two demands. First, it responded to the demands of students who sought further education in the field of business management through a curriculum drawn upon the experience of other leading business schools. Second to the demands of those who are seeking employees who are well trained in the field of business and having the required educational background.

Need for the study

The demand for the graduate program at B.U.C. is increasing semester by semester due to many reasons. First, the huge increase in the number of the undergraduate students. Second, the inability of most fresh graduating students to find a very handsome job. Third, the inflationary economic situation affects the students by reducing the number of those who can afford to complete their high graduate educational studies abroad.

Table I

Graduate students in Lebanon for the period 1974-1988

Year	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88

University :														

B.U.C :														
: FALL	--	--	--	--	--	--	--	47	97	144	107	83	78	80
: SPRING	--	--	--	--	--	--	--	67	119	99	102	71	80	80
: SUMMER	--	--	--	--	--	--	--	--	107	52	53	49	62	56

A.U.B														
Bus.Sch. :	142	95	162	163	182	191	197	255	279	262	269	245	199	253

A.B.U :	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bus.Adm.Col:														

LEB.UNIV :	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bus.Adm.Col:														

Source: Registrar's Office-Records.

Meanwhile, B.U.C. can not accept the whole number of applicants due to many reasons such as : capacity, preserving and improving the educational standard and restricted number of highly professional staff of faculty. Moreover, another reason is to reduce the number of students who are placed on academic probation which affects in one way or another the existing program.

Students who attend graduate programs are often faced with academic problems. The intensity of the problems encountered varies with situational and background variables such as academic background, occupation during the M.S. program and career interest etc...

Many studies have been carried out on university students in general, or on graduate students in a particular university, however, there was no attempt to study & evaluate the performance of the graduate students at B.U.C. This researcher believes it is important to have studies on graduate students at B.U.C. A study such as the one conducted here is recommended by experts in the field of management.

Purpose of the study

B.U.C. can not accept the huge number of applicants for the graduate program. Therefore, the purpose of this study is to explain and evaluate the variations in academic performance of the graduate students in the

graduate program at B.U.C.. Thus enabling us to predict the academic performance for the new applicants in order to select the best from the applications to maintain and improve the good academic performance of the program.

Research questions

1 - What are the major characteristics of the selected students ?

2 - What is the relative importance of the independent variables to the proportion of explained variations in the academic performance of the graduate students ?

CHAPTER II

REVIEW OF LITERATURE

It is clearly known that the survival and the future of a nation depends to a great extent, on providing a better education to a larger percentage of its youth. Moreover, it is widely noticed, at these times, that higher education is highly rewarded and pursued. The result is that an increasing number of students are motivated to seek higher education. This increasing number of applicants surely leads the university or the college to become highly selective. But the selection process is never an easy issue, for as R. H. Tawney stated :

"Which of a number of varying individuals is to be judged superior to the rest depends upon the criterion which is applied, and the criterion is a matter of ethical judgement. That judgement will, if it is prudent, be tentative and provisional, since men's estimates of the relative desirability of initiative, decision, common sense, imagination, humility and sympathy appear, unfortunately, to differ, and the failures and fools - the Socrates and St. Francis - of one age are the sages and saints of another."²

² Robert Klitgaard, Choosing Elites, (New York: Basic Book, 1985) P.V

Because of the difficulty involved in the selection process, it becomes evident that choosing students for higher education in a university is really a sign of how the university thinks about efficiency, mobility, and incentive. Predicting the academic performance of these students is a basic and a very fundamental tool in the selection process. So, how should selection be done? What are the factors affecting such a process? To answer these questions, one needs to think hard about the objectives of selection, and how these objectives fit with the mission of the institution. One needs to know what kind of information helps to make better predictions about which candidates are most likely to fulfill the institution's objectives, and needs to use that information effectively.

This chapter will basically deal with 2 main issues :

1- The objectives that should be pursued in choosing candidates for higher education, more specifically the M.S. program in colleges.

2- The measures and criteria that should be used by the admissions committees and how they could be effectively applied.

Since the applicants for an M.S. program have the preconception that they should have certain qualifications before applying to the program, then it should be concluded that the college will be dealing with a certain

kind of the applicant population, that placed on the "right tail" of the normal distribution of characteristics, talents, or attributes. So, let's begin our analysis with an overview of the selection at the right tail and its major aspects.

A. Selection at the right tail.

The question of selection involves much more than simply screening out prospective failures. True, even that is not a trivial undertaking, because people are unpredictable. But both theoretically and practically, it is more difficult to select at the "right tail" of the distribution. By the term "right tail" we mean the right-hand portion of the bell-shaped curve that is often used to symbolize a distribution of desired attributes or abilities.³(Fig.I)

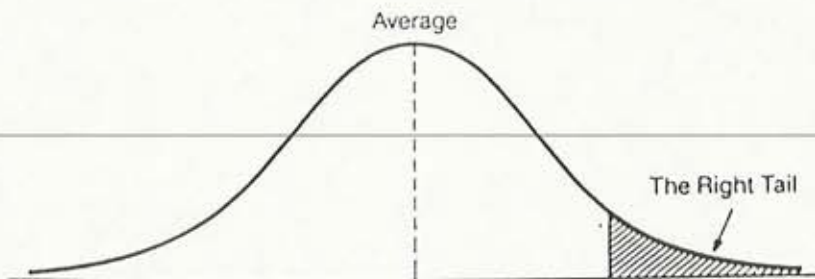


FIGURE I

Normal Distribution of Desired Attributes

³ Robert Klitgaard, Choosing Elites, (New York: Basic Book, 1985) P.4

The difficulty of selection at the right tail occurs when most applicants are well qualified and we have a limited number to choose. First, the objectives of the admission or the selection process are very hard to define; their defining being dependent upon the mission of the institution. The mission of a university might be to "train future leaders of the educational profession".⁴ In this case, the specification of desired characteristics of candidates should be set. Such characteristics might include criteria such as leadership, evidence of outstanding performance in various fields, past academic performance, professional plans and motivation. More specifically, candidates applying for higher education in the field of business are expected to represent future managers. So, they should be characterized not only by academic talent but by enthusiasm, interpersonal skills, leadership ability, and the capability to deal with irregular situations. Of course, as a university moves beyond academic criteria, the selection problem grows more difficult and complex. Thus, how should the college evaluate the applicants, and if including non academic criteria leads to a more costly evaluation process, how far should this be used? In fact, the answer depends to a great extent on the college conception of the due process, on what it teaches, and on what its competitors do. To state what a college should be trying to do in its admissions process is full of complexity.

⁴ Ibid., P.5

A second reason that makes selection at the right tail difficult is that the indicators of past achievement and future success are most frequently tools designed to measure large differences across the distribution of qualifications. For example, grades and aptitude test scores could prove helpful in distinguishing "Average" performance from "Good" and "Good" from "Excellent". But when most applicants for higher education show excellent performance, then such criteria will not contribute much help to the admission committee trying to choose among them.

Selection at the right tail is also difficult for a third reason. The environment is dynamic and ever changing. These changes in the external environment could have a great impact on "the applicant pool, the objectives of admission policies, and the usefulness of various predictors and measures of achievement."⁵ Thus, the changes in labor markets will influence the number of potential students and what they will wish to study. In Lebanon, for example, the number of applicants and enrollment in the M.S. program in Business Management Studies is increasing. Carrying such a degree will positively affect their future careers; providing them with higher promotion and better financial advantage. As to the objectives of admission policies, they would also change in response to the changing environment conditions.

⁵ Ibid., P.7

It could be clearly noticed that, because of the security situation in our country which had its adverse effects on our level of education and academic standards. In such circumstances, it might be argued that some universities should set high academic standards, and by doing so, "The erosion in academic values could be halted".⁶ This, in turn, leads us to say that if objectives must be reacademic because of changes in the external environment, then the predictors or measures used by the admission committees should be changed as well. The use of grades and recommendations has thus come into question. However, there is little said about what might replace these measures. The problem of imperfect prediction is seldom dealt with and analysed in all its aspects of messiness and uncertainty. And up till now, no one has yet encountered a balanced and a constructive treatment of how to select at the right tail.

B.U.C. Admission Requirements

Now let's describe how the admission process works at the Beirut University College. The criteria and procedures followed at this university in selecting applicants for the M.S. program are :

- Recommendations :

The recommendations could be classified as highly positive, positive or negative. The highly positive

⁶ Ibid., P.10

usually help in case of a border line acceptance. While the positive ones do not have that effect but the negative cases are so much crucial in rejecting the applicant.

- Past achievement records :

It is the base for any acceptance or rejection. Grades are so important. Experience also helps at times. Moreover, the nature of the degree whether Business related or not is also taken into consideration. Again, the case of studying for another M.S. degree will be treated differently.

- Admissions committees :

The work of it is to set the regulations to be accepted upon. It studies and measures the demand and supply. The trend followed now is to select the best students for the high standard policy. Therefore, the tendency is to move up and have good students of "G.P.A. 3.00 & up" rather than the opposite. Besides, the issue is also to encourage students from other majors to join the program with the need to take needed undergraduate courses.

- Relevant references :

The highly connected applicants are sometimes looked at more carefully than the unconnected. Since each member of the committee will try to show that he is not influenced by the well known powerful names. Thus, it sometimes works out negatively rather than positively for the applicant.

- Others :

Personality and image of the applicant have a role in the application. The educational environment of the family also plays a role. Nevertheless, special cases and obvious cases are treated here such as transfer students from abroad and so on.

A.U.B. Admission Requirements

The American University of Beirut has the same requirements for admission as Beirut University College. The applicants should have a minimum G.P.A. of 3.00. The university also uses the recommendations presented, work experience and the English level as factors to predict the performance of M.S. students. A basic requirement that students coming from other universities & applying for the M.S. Program at A.U.B. have to meet is that they should take 3 to 6 undergraduate courses even if their G.P.A score is more than 3.00 points. Probably by this, the university plans to prepare students for the academic system followed in its M.S. Program.

U.S. Universities Admission Requirements

Someone professional and expert in choosing elites for higher education in colleges might not find such a policy out and feasible. We don't wish here to invalidate the correctness of such procedures, but rather to mention that they are not adequately effective and sufficient to

be used in choosing our elites. To illustrate, we will look at the policies followed by several universities, here and abroad, outlining their objectives, criteria. and procedures for admissions.

1 - California State University (Los. Angeles, Cal.)

California State University requires an appropriate baccalaureate degree from an accredited university, G.P.A. of 3.0 in the last 60 semesters units of the upper-division course work taken, GMAT \geq 475 or the Formula Admission Score (F.A.S) where a minimum of $1075(200 * GPA + GMAT)$ & 1100 for M.S. Accounting, TOEFL \geq 550. If $2.5 \leq G.P.A < 3.0$ the student may be admitted as conditionally classified graduate student. Also the university examines the academic ability & managerial potential of each candidate, all academic work, letters of recommendations, work experience, level of responsibility, other factors that may have a bearing upon the individual's potential for success.⁷

2 - Duke University (Durham, North Carolina)

For admission, Baccalaureate degree from a recognized institution with no specific major, evaluation of academic record (emphasis on the last two years), GMAT, personal recommendations, work experience when applicable, leadership in extracurricular activities, and evaluative interviews.⁸

⁷ The Official Guide To MBA Programs, (Princeton, New Jersey: Graduate Management Admission Council, 1988), P.124

⁸ Ibid., P.169

3 - Harvard University (Cambridge, Massachusetts)

The Harvard MBA program is dedicated to preparing competent, responsible, and morally sensitive general managers and leaders. Selection is based on a combination of academic and administrative abilities coupled with experience and other personal qualities that indicate high potential for benefiting from & contributing to the education process at Harvard. The student must have a Bachelor's degree from recognized institution without specification. The interest is more on the quality of the person, and the quality of the work done, than in the specific courses taken. A strong emphasis on full-time work experience.⁹

4 - McGill University (Montreal, Quebec, Canada)

For admissions, undergraduate degree from an accredited college with GPA ≥ 3.0 , GMAT & TOEFL, personal interview could be requested, students are encouraged to gain work experience.¹⁰

5 - Ohio State University (Columbus, Ohio)

Ohio State University requires GMAT, GPA ≥ 3.3 , TOEFL ≥ 575 , evaluation of academic record (emphasis on the last two years), personal recommendations, work experience, leadership in extracurricular activities, and evaluative interviews.¹¹

⁹ Ibid., P.195

¹⁰ Ibid., P.275

¹¹ Ibid., P.323

6 - Stanford University (Stanford, California)

For admissions, biographical data, employment history, responses to a series of essay questions, three recommendations, academic transcripts, GMAT & TOEFL. From the application derivation about the candidate's demonstrated motivation, academic aptitude, communication & interpersonal skills, maturity, achievement orientation, capacity to command the respect of others, energy level, & ability to exploit.¹²

7 - State University of N.Y. At Albany (Albany, N.Y.)

The school seeks candidates whose undergraduate record, GMAT score, recommendations, and experience indicate a committment and clarity of purpose that will likely predict success in the mature environment of a graduate program.¹³

8 - Texas A & M University (College Station, Texas)

Texas A & M University requires GMAT, two official transcripts, resume, three reference evaluation forms, GPA \geq 3.0, test scores in the 80th percentile or above. Selection is based upon a distinguished undergraduate record, competitive GMAT scores and above average scores on the TOEFL.¹⁴

¹² Ibid., P.373

¹³ Ibid., P.403

¹⁴ Ibid., P.417

9 - University of Cal., Los Angeles (Los Angeles, Cal)

For admissions, Bachelor's degree from university of recognized standing without specific major, proficiency in algebra & differential calculus, academic record, GMAT, several personal essays, two recommendations & potential for management as evidenced by work experience and demonstrated leadership through community or extracurricular activities.¹⁵

10 - The University of Michigan (Ann Arbor, Michigan)

Less concern for major specification but more evidence of sound scholarship & potential for responsible leadership in Management. Applicants must have completed formal course work in macroeconomics & microeconomics, at least one college mathematics course (including calculus). For Statistics & Management Science should have a higher level of preparation in mathematics including a full year calculus.¹⁶

11 - University of Pittsburgh (Pittsburgh, PN)

Applicants must have completed a Baccalaureate degree from an accredited college or university. Previous course work in business is not required. Successful completion of a college-level course covering integral and differential calculus is a prerequisite before matriculation.

Admission to the accelerated MBA program is based on

¹⁵ Ibid., P.420

¹⁶ Ibid., P.461

the applicant's prior academic record, letters of recommendations, score on the Graduate Management Admission Test, indication of managerial promise, leadership, and prior work experience. The nature of the accelerated program demands a student who is particularly motivated and mature. Applicants whose native language is not English must score 575 or higher on the TOEFL.¹⁷

As could be noticed from the description outlined about the procedure followed in some U.S. universities for the admission of students for the MBA Program, there is a great emphasis on factors that could help in predicting the academic performance of M.S. students. Factors such as prior academic record, letters of recommendations, EEE or TOEFL scores, and work experience are used in all universities. Other factors such as GMAT, GRE, evaluative interviews, a satisfactory background in mathematics and calculus, level of responsibility, and essay writing test results are all significant factors that can draw a clear picture helping the admission committee to predict the success of applicants in the M.S. Program.

Now, given the problem of predicting success and the expense of the admission system, why not admit more students and then send away those who show unsatisfactory performance ? Or why not select randomly among applicants who are above a certain standard of admissibility ? These questions will open the way for us in order to start our discussion about the objectives of selection.

¹⁷ Ibid., P.524

B. The objectives of selection :

Selectivity might have "unpleasant" connotations of elitism, unfairness, snobbiness, and uniformity".¹⁸ After all, the college always has many more candidates than the entering class. Only some can be accepted, and someone had to decide who they will be.

If we think of higher education as a market facing forces of supply and demand, then there may be a way out. View the problem as follows : places at the college are a product, or a service. That product is experiencing excess demand. So, economically speaking, we have to find a way to ration that excess demand. But why ration it ? Why not raise the tuition fees so that demand will be reduced, or expand the enrollment until supply and demand are at equilibrium ? It should be noted here that to increase the enrollment will be done at the expense of increasing the faculty problems and of reducing the level of academic standards.

Such an approach contains the basis of a market-based approach to the selection problem. This implies that the way to solve the problem here is not to select at all but to use pricing as the means of overcoming the problem of excess demand. Yet, this is not the only way. It is true that there is a market for higher education. But it is also true that an institution, especially a university,

¹⁸ Robert Klitgaard, Choosing Elites, (New York : Basic Book, 1985) P.51

has other values. It should care about the non financial contributions that its students contribute to its health and reputation, such as through their academic excellence. A university has academic values apart from economic ones. Also, besides money and economic values, there are social and personal attributes of applicants. Therefore, the simple economic idea of an auction somehow violates the notion of a university. McGregor Bundy criticizes the views that "Graduate education is a form of investment in human capital, with the benefits primarily private, not public."¹⁹ History, itself, reveals the fragility and importance of academic values in the face of economic forces.

Thus, former Yale president Kingham Brewster's criticism of an auction model somehow sounds true : "There are relatively few institutions whose education does conspicuously offer a special career advantage, and they must be convincingly open to free, competitive admission based on merit. Assessing the merits of individuals will involve many subjective judgements about character and motivation which, of course, no test scores or grades should obscure or override. But I really believe that more fundamental to the survival of our way of life in this country than the race to the moon or the size of the

¹⁹ Burton A. Weisbrod and Peter Karpoff, "Monetary Returns to College Education, Student Ability and College Quality," Review of Economics & Statistics 50, no.4 (Nov.1968) PP.491-497

missile arsenal will be our ability to sustain the widespread conviction that in a society based on private property and contract, a society governed by a federated republic, success is at best related to effort, at worst dependent on luck, and as little as possible rigged by either private status or public favor.

If the Yale privilege, and the springboard to a headstart which it offers, were to be rationed by inheritance, if it were to be auctioned in return for financial support, if it were to be conditioned by racial or social or economic preference, we would by that measure be dealing a very serious blow to the 'opportunity sense' that is the greatest heritage and the greatest promise of the country."²⁰

Even if the tuition charged by the college does in part reflect what the market will bear; even if there are similarities between scholarships and the economist's concept of price discrimination; and even though money can be translated into academic inputs (such as books, laboratories, grants, and computer centers) -even so, almost no one would advocate an auction-based admission policy. Such a policy does "solve" the problem of excess demand; i.e., raising the price of education does reduce the number of applicants to higher education in college. But somehow it doesn't seem quite right and effective.

²⁰ Ibid., PP. 491-497

Another alternative to selective admissions is to delay the decision process forward in time. Would it not be fairer to give students a 'tryout'? Why not admit more students and, after a trial period, flunk out those that show less satisfactory performance than desired. Such an alternative, if considered in graduate admissions, has its pros and cons:

1 - Selecting on the basis of the trial period will result in fewer 'mistakes' and a higher level of performance.

2 - The cost of testing and admission will decline because less selectivity will be needed to take place.

3 - Pushing the decision process forward in time will give students of various backgrounds a greater opportunity to demonstrate their talents.

4 - By using this system, students may be enhanced to work harder. Just as economists state that competition breeds better performance, so might educators argue that the fear of flunking out will endanger higher levels of academic attainment in college (although perhaps less attainment in high school).

Another framework that could be suggested as a baseline for discussing how we should choose an elite for our MS program is to select students to 'maximize the value added' of the education an institution provides. This applies to the social value added of the education for students' later lives depending on their attributes &

what other universities offer, the value of the students to the university itself in terms of their contributions to its financial, academic, & social well being, and the intrinsic value of selecting certain kinds of students in terms of their personal, moral and the representation in the student body of certain groups. The basic assumption here is that the university knows everything about the applicants and that it has perfect measures of their past academic achievements, personal characteristics of all kinds, aptitudes and interests, and any other information deemed important. But this is an ideal assumption which doesn't exist.

So, who then are the most qualified applicants ? and what is the best admission policy ?

In fact, there is not one "right" admission policy. What could be thought of are just frameworks for thinking about the aims of a selection system as was mentioned above. In real life situations, selection policies must be made and handled with predictions, not certainties. With incomplete and unreliable information, a university will try to predict which applicants will fulfill its objectives - predictions based on various brands of imperfect information. In the following lines, a list of various factors and predictors will be discussed. Also, we will try to evaluate the usefulness of each predictor. Multiple regression analysis will be used to help us judge how much a certain - sized increase in a predictor really matters.

So, what are the various factors and criteria used by a university to predict the students' performance in a certain program ? That's what the following discussion will try to show.

C. Factors affecting the prediction of academic performance

It was previously mentioned that one of the most important objectives in admissions to high level education is to select those students who will further an institution's "academic values". Of course, nothing is more important in the world of university than the value of academic excellence. But measuring this and predicting it through using certain factors are other matters. The important questions to be answered are : How would a university know whether one student will contribute to the academic values more than another ? And how well could it predict this given the imperfect information available at admissions time? In fact there are certain elements that could be taken into consideration in order to assess the performance of students applying to the Master Program and thus helping in their admission to the Program. These elements are the following :

1 - Academic Background

This is a very important factor that contributes well in the process of performance prediction and admission. Knowing the student's major in his B.S. & his performance in his undergraduate studies, is very important.

The undergraduate major has a great effect in deciding which students are to be enrolled in the program. It can give a clear picture of the student's ability to meet the course requirements of the Master Program. A student with a B.A in Fine Arts cannot be expected to do well in the Master courses offered here and that deal only with management and other business related fields. Also, a student having a B.S in business will have the chance to be enrolled to the program more than a student having a B.S in Natural Science Studies.

Moreover, to study the performance of the student during his B.S studies, B.U.C. refers to grades as the best indicator to that. It is well known that the most commonly used measures of academic success in a university are grades. Grades reflect teachers' assessments of how much students have learned and the degree of academic excellence they have achieved. The G.P.A. reflects the academic success of a student. As a criterion, B.U.C. does not admit students with a G.P.A. lower than 3.00 points unless a raising average process takes place before the student is enrolled the program.

But the question here is that to what extent should grades be used as a criterion for admitting students to the Master Program ? A criticism about the reliability of grades is that " Grades are incomplete and unreliable measures of academic performance. They do not necessarily

measure progress toward subtler educational goals, such as creativity, aesthetic and ethical sensitivity, and so forth. They are full of measurement error, in part because students self-select into harder and easier courses and majors, and in part because course grades themselves are unreliable."²¹

2 - The English Level

The English level of the applicants is a very important factor in predicting their performance in the Master program. This is because being a master student requires an ability to communicate in writing with clarity and style, a capacity to analyze problems by collecting relevant data and mastering pertinent arguments, and an ability to master new concepts and materials. Information about such level could be known from the EEE and / or the TOEFL scores and from his performance in the undergraduate English courses.

3 - Average Load / Semester

The number of credits that a student in a semester can of course have an influence upon his performance. If a student takes courses more than he can study or absorb, then this will have an adverse effect upon his general performance. Such an effect will be more revealed if the Master student has also job responsibilities.

²¹ Robert Klitgaard, Choosing Elites, (New York : Basic Book, 1985) PP.104-105

4 - Graduate Tests

Tests such as the GMAT and the GRE are aptitude tests designed to predict the ability of the student in handling business problems and cases that have to do with general knowledge, also reflecting his graduate level performance.

5 - Occupation

This is a significant factor for the simple reason that experience adds to the knowledge of the person and enriches it. The level of competency that experience gives is an important thing that can not be easily overlooked. Here, the total years of experience in past and present occupations are a kind of information that is worth knowing. Moreover, the nature of the job and whether it is of the type that having a Master degree in business will help to develop and perform better in are also important in predicting the performance of the students. As to their type, jobs could be of a public nature or of a private nature. Also, the student could be self employed or an employee, and this can have an effect upon controlling his own work time and study time.

6 - Career Interest

If a student has certain career interests, then he could be motivated to get the Master degree in order to meet those interests. This in turn will be reflected in his academic performance. He will seek better performance so that he will be able to achieve or to reach the positions he aims for.

7 - Financial Support

The way a student finances his studies during his M.S. years of study is a matter that should be taken into consideration. A student may finance his studies either through himself or a scholarship or a financial support from certain institutions such as the Hariri support, then he will be obliged to attain a certain G.P.A level. If he has a scholarship or financial assistance from the college, then he should also have a good G.P.A average. However, if he finances his studies by himself, then his performance will most probably depend upon his own incentives.

These in fact are the basic factors that should be used to evaluate applicants for the Master Program and to predict their performance.

CHAPTER III

PROCEDURE & METHODOLOGY

This study has been done as a result of an interest to measure the effect of many pertinent factors in predicting the performance of the Master students joining the Master Program in Beirut University College. There are many variables that can play a very important role in this study. If such a study were made under certainty, the future success or general performance of students would be known before the decision had to be made. Under uncertainty, only imperfect predictions are available to guide the decision. The candidate's past academic record, English exam score, past major and other factors would be known, but the crucial knowledge of future successful performance is unknown. Statistical methods can be used to relate the measurable factors to the future performance of the applying candidates. Although none of these performance predictors is perfect, statistical methods such as the regression analysis are useful in giving insight to the university's admission committee who must analyze the students' performance and adjust their admission system according to their analysis results. The design and methodology to be followed will be applied on a sample that could be as sufficient & convenient to the population concerned as possible. This study intends to determine the best combination of measures which will best help us in analyzing factors & their effect upon predicting the performance.

Population of the Study

For this study, since our concern is to build a system that can help us in predicting the performance of M.S. students, then the whole body of M.S. students at Beirut University College during the academic year 88/89, will be the population of study. These students carry different B.S. degrees, but most of them have a B.S. degree in Business and Business Computer. A Small percentage have a B.S. major in Computer Science and very few in other majors of study (Engineering, Chemistry,...etc.).

The average number of students joining the M.S. program at B.U.C. since spring 1986 is shown in table II. On average, the number of enrollments in 1986 is 66 students; in 1987 74; and in 1988 69 students.

Moreover, most of the students are former students of B.U.C. A small percentage come from other universities such as the Beirut Arab University, A.U.B., the Lebanese University and Haigazian.

Sample Selection

For any sample to be good, it should be sufficient and representative. Our intention in this study is to screen out the best combination of factors that could help us in predicting the performance of M.S. students. Since

TABLE II

ENROLLMENT OF M.S. STUDENTS AT B.U.C. 1986 - 1988

Year :	1986	1987	1988
----- :			
Semester :			
Spring :	71	80	80
Summer :	49	62	56
Fall :	78	80	70
Total :	198	222	206
Average :	66	74	69

SOURCE: Registrar's Office - Records.

the population of the study is very small (70 student), and the proposed statistical techniques are the Multivariate analysis require a very large sample, we therefore decided to use a very large percentage of the population (70 %) as the convenient sample for the study. That's why we cannot select a random sample as a representative of population. For this research, the convenient sample constitutes 49 cases from the M.S. students joining the M.S. program at B.U.C. Those students constitute around 70 percent of the whole number of M.S. students who were around in the academic year 1988/1989.

Instrumentation & Data Collection

Based on Review of Literature and informal discussions with my major advisor & other colleagues in this college, an objective questionnaire was constructed consisting of Independent & Dependent variables. (See Appendix : A)

Sixty copies of the questionnaire were distributed where 49 out of the 60 were valid since 11 were disregarded because of overlapping classes. It is worthwhile to note that in order to guard against filling more than one copy by the same student, the name of the student was used to identify & determine if any student responded to more than one copy. Also, that was asked by us at the beginning of the instrument.

Let us now define the variables (Dependent and Independent) that we have where these factors will be used to explain the variations in the G.P.A. of the M.S. students which in turn will help us in predicting their performance.

Selected Variables & Measurements

The Dependent Variable

The dependent variable in this study is the performance of the M.S. students measured by their M.S. G.P.A.

The Independent Variables

There are many factors that will be used to predict the performance of students joining the M.S. Program. Some of the variables are measurable, while others are dummy. The dummy variables will be assigned the code of 1 & 0.

- 1 - Coded variables for B.S. Major. Students with a Business major are assigned a code of 1, and 0 if having a different major.
- 2 - Students coming from a University where the Language of Instruction is English are assigned a code of 1, & 0 if the language is different from English.
- 3 - The cumulative G.P.A. for the B.S. Degree.
- 4 - The Major Courses G.P.A. for the B.S. Degree.
- 5 - Cumulative Average (%) for the B.S. Degree.
- 6 - The Number of Semesters completed by the students in the M.S. Program.

- 7 - The Number of Credits completed by the students in the M.S. Program.
- 8 - The Average Load / Semester for the student in the M.S. Program.
- 9 - The English Entrance Exam score for the student.
- 10 - The number of standardized tests that were taken by a student. Each student is assigned the code of 1 if he / she took one of the 4 standardized tests (EEE, TOEFL, GMAT, GRE), a code of 2 if he or she took 2 of the 4 standardized tests. Each respondent can receive a maximum of 4 for the 4 standardized tests.
- 11 - Students with Past occupation related to Business are assigned a code of 1, and 0 if not related to Business or no past occupation.
- 12 - Students with Present occupation related to Business are assigned a code of 1, and 0 if not related to Business or no present occupation.
- 13 - The number of total years of work experience for the student in the past & present.
- 14 - The Type of Work of the student is assigned a code of 1 if it is a private job, and 0 if it is otherwise.
- 15 - If the student is Self Employed he is given a code of 1, and 0 if he is an employee.
- 16 - The Average Daily Working Hours for the student in his job in the M.S. Program.

17 - Sex of student is coded 1 for male and 0 for female.

18 - Single students are coded 1 while married students are coded 0.

19 - The Age of the student.

Item # 15 which was included in this study to measure the range of responsibility of the student, was excluded from the data before the regression analysis, since all of the respondents in this study were employees & non of them was self employed.

Based on logical basis and in addition to those variables, interaction between the variables will be used. The reason is that interaction between variables is better than simple additive forms, since it is difficult to find one or two variables in isolation, and hence it would be more powerful. Therefore, the regression model run on the Statistical Package for the Social Science (SPSS), will be based on the following variables.

X1 : No. Credits Completed * No. Semesters Completed.

X2 : No. of Years of Experience * Present Business Occupation * Past Business Occupation.

X3 : English Entrance Exam * English Entrance Exam.

X4 : No. Years of Exp. * Present Business Occupation.

X5 : Present Business Occupation * Past Business Occupation.

Conceptual Framework for Analyzing the Data

The major aim of this research is to find the most significant factors that help us in predicting the performance of students in the M.S. program. Therefore, this research used the multiple regression analysis where the dependent variable, T , was associated to the other variables that were considered to be independent. The data was entered on a computer software called DBASE III+ which was later; in the analysis run; linked to the computer software called (SPSS) the Statistical Package for the Social Science. SPSS provides in the printout as a minimum the multiple regression equation, the standard error of the estimate, and the coefficient of multiple correlation.

CHAPTER IV

FINDING OF THIS STUDY

Chapter Four will answer the research questions that were stated in Chapter One as follows:

1 - What are the major characteristics of the selected Students.

2 - What is the relative importance of the independent variables to the proportion of explained variations in the academic performance of the graduate students ?

The evaluation of the characteristics of the students will be based on an analysis of the graphical illustration and the frequency distributions of the variables under study. To indicate the relative importance of the independent variables in explaining variations, a regression equation would be derived which may help in predicting the performance of the M.S. students.

A study of the graphical illustration which reflects the frequency distribution of the variables used shows the following facts :

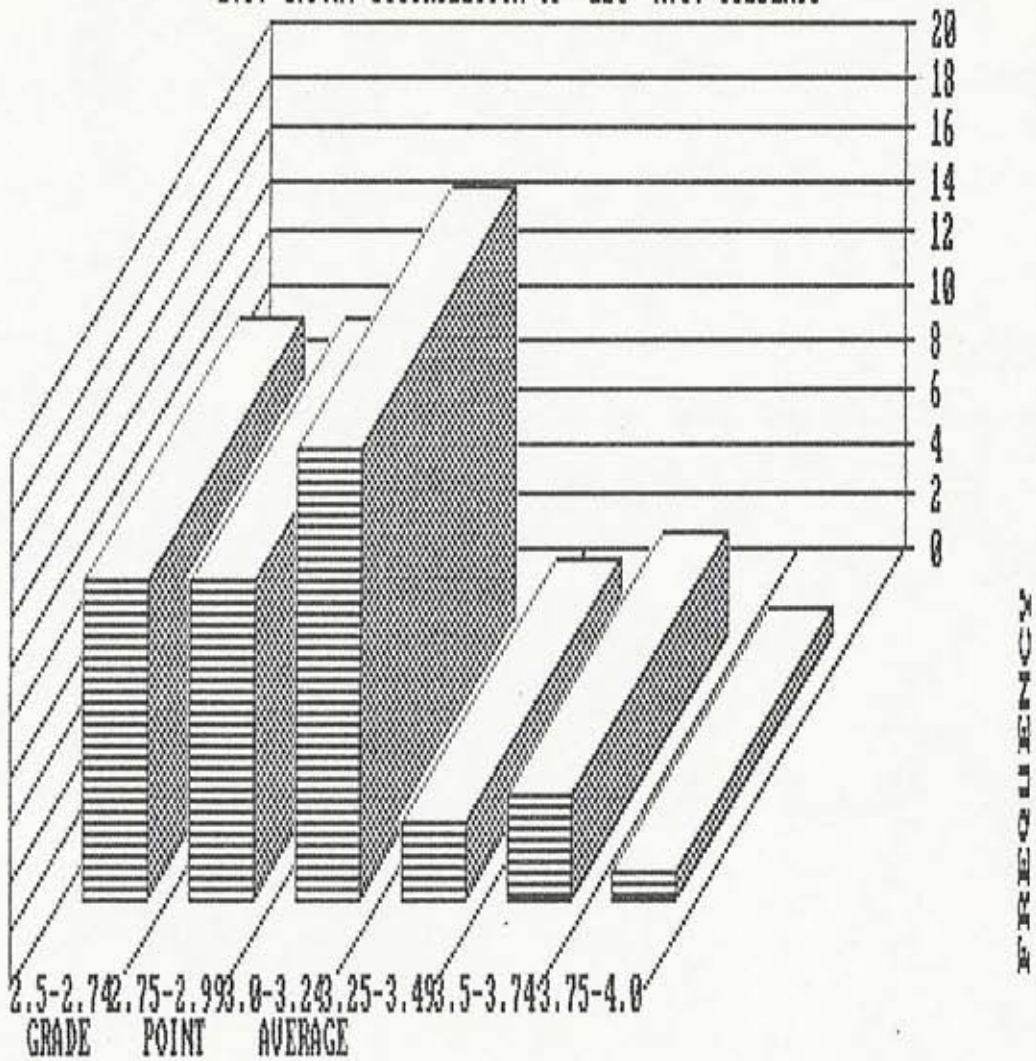
Table III & Figure II (Computer Printout) show the B.S. Cumulative G.P.A. frequency distribution. For example, seventeen students (34.7 percent) of the student's sample in study had a G.P.A ranging between 3.0 - 3.24 which reflects the highest percentage of the students. Also, as can be noticed in figure II the distribution is positively skewed which means that the majority of the students falls in the low G.P.A. brackets.

TABLE III

B.S G.P.A distribution of the B.U.C M.S. students.

Class.Int	Mid.Pt	Freq.	%	Val. %	Cum. %
2.50 - 2.74	2.62	12	24.5	24.5	24.5
2.75 - 2.99	2.87	12	24.5	24.5	49.0
3.00 - 3.24	3.12	17	34.7	34.7	83.7
3.25 - 3.49	3.37	3	6.1	6.1	89.8
3.50 - 3.74	3.62	4	8.2	8.2	98.0
3.75 - 4.00	3.87	1	2.0	2.0	100.0
TOTAL :		49	100.0	100.0	

B.S. G.P.A. DISTRIBUTION OF BUC M.S. STUDENTS



Mean	3.008	Std Err	.046	Median	3.120
Mode	3.120	Std Dev	.319	Variance	.102
Kurtosis	.099	S E Kurt	.668	Skewness	.666
S E Skew	.340	Range	1.250	Minimum	2.620
Maximum	3.870	Sum	147.380		
Valid Cases	49	Missing Cases	0		

Figure II

The B.S. G.P.A. Distribution Of The B.U.C. M.S. Students.

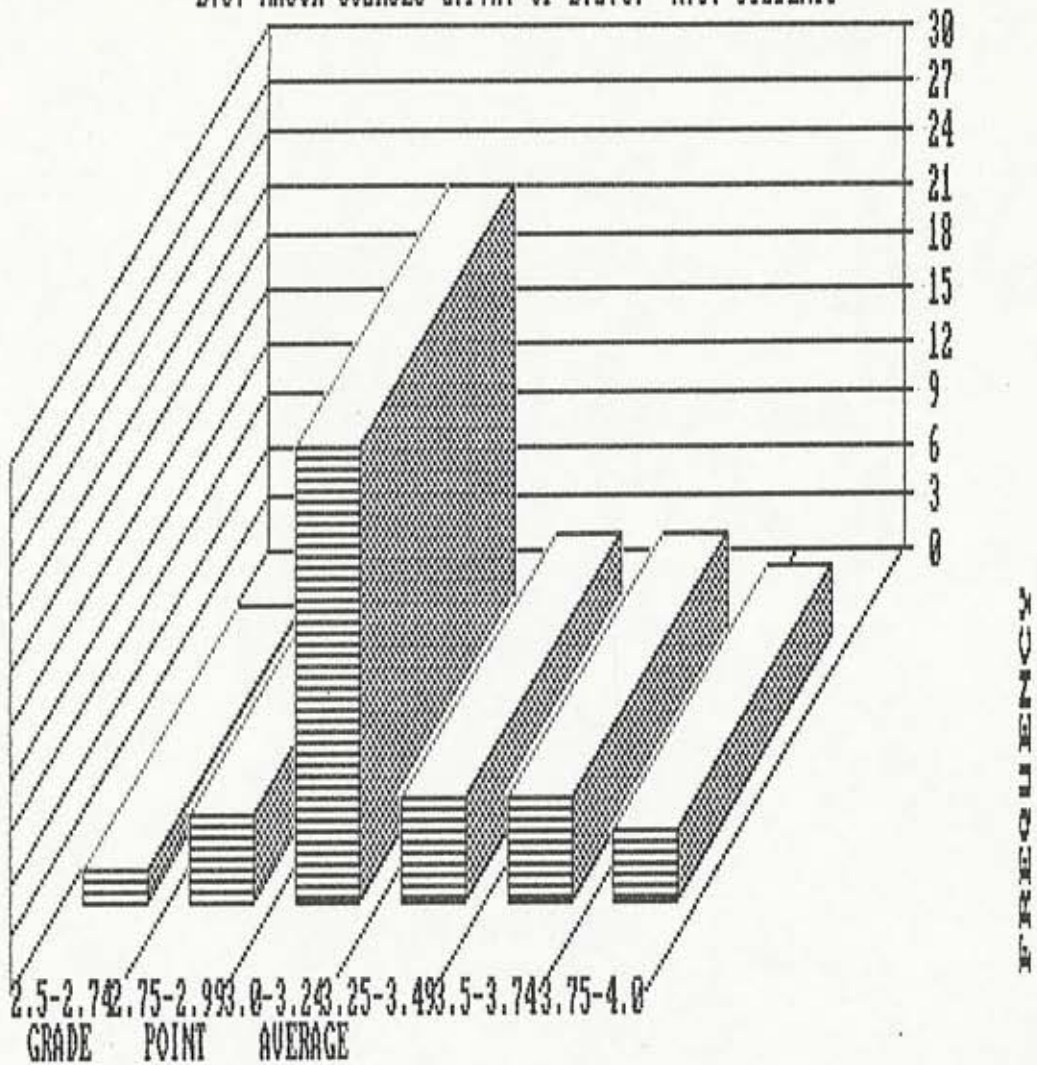
Table IV & Figure III (Computer Printout) show the B.S. Major Courses G.P.A frequency distribution. We can realize that twenty six students (53.1 percent) of the student's sample in study had a G.P.A between 3.0 - 3.24 which reflects the highest percentage of the students. Also, as can be verified in figure II the distribution is positively skewed which means that the majority of the students falls in the low G.P.A brackets. In fact, this is a very important variable especially if the student's B.S. major was in Business. It shows his ability to study and understand the Business related courses that he will get in the M.S. Program of Business.

TABLE IV

B.S Major Courses G.P.A. of the B.U.C. M.S. students

Class.Int	Mid.Pt	Freq.	%	Val. %	Cum. %
2.50 - 2.74	2.62	2	4.1	4.1	4.1
2.75 - 2.99	2.87	5	10.2	10.2	14.3
3.00 - 3.24	3.12	26	53.1	53.1	67.3
3.25 - 3.49	3.37	6	12.2	12.2	79.6
3.50 - 3.74	3.62	6	12.2	12.2	91.8
3.75 - 4.00	3.87	4	8.2	8.2	100.0
TOTAL :		49	100.0	100.0	

B.S. MAJOR COURSES G.P.A. OF B.U.C. M.S. STUDENTS



Mean	3.227	Std Err	.043	Median	3.120
Mode	3.120	Std Dev	.302	Variance	.091
Kurtosis	.171	S E Kurt	.668	Skewness	.581
S E Skew	.340	Range	1.250	Minimum	2.620
Maximum	3.870	Sum	158.130		

Valid Cases 49 Missing Cases 0

Figure III

The B.S. Major Courses G.P.A. Of The B.U.C. M.S. Students.

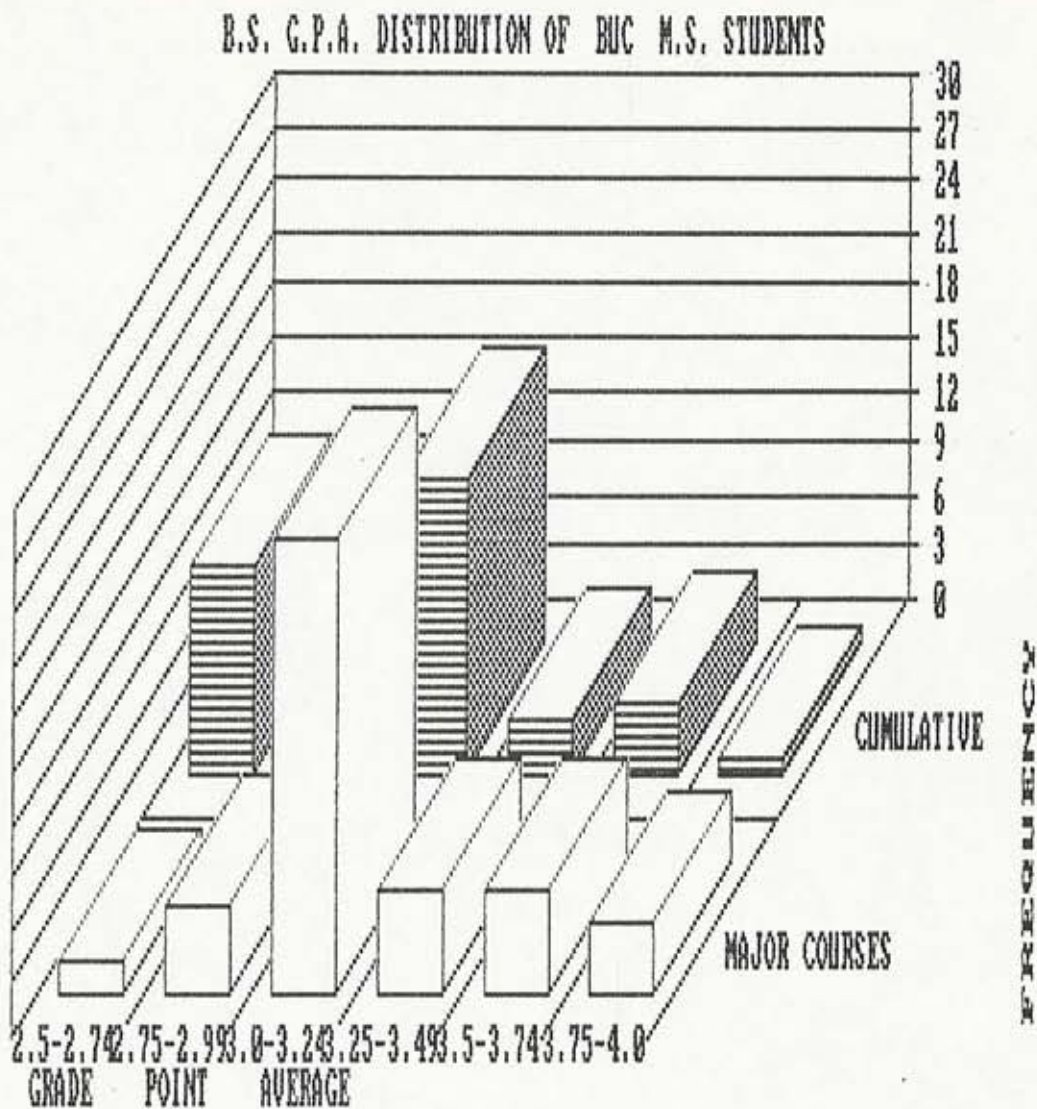


Figure IV

Comparison between the Cumulative & the Major Courses B.S. G.P.A of B.U.C. M.S. Students.

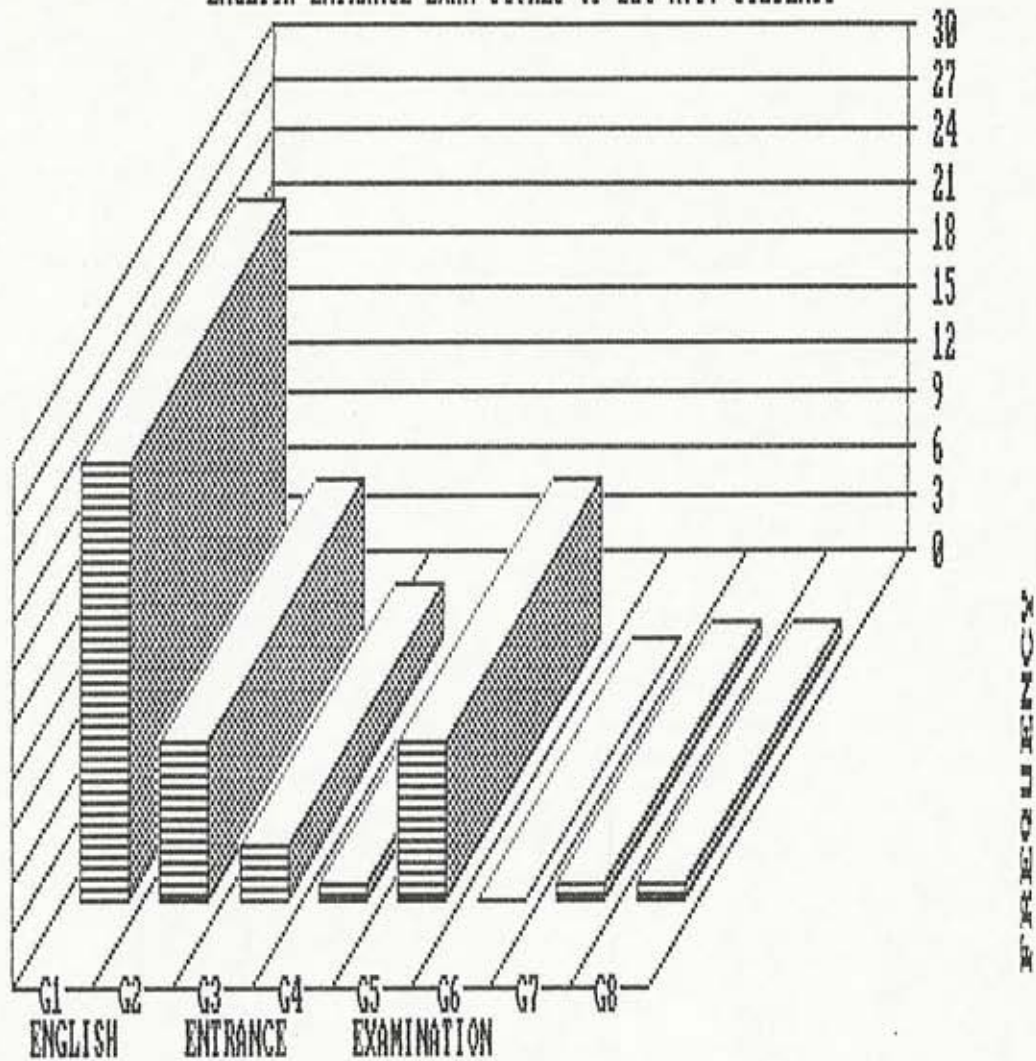
Table V & Figure V (Computer Printout) show the E.E.E scores frequency distribution. We can see that twenty five students (51 percent) of the student's sample in study had an E.E.E score ranging between 500 - 524 which reflects the highest percentage of the students. Also, as can be noticed in figure V the distribution is positively skewed which mean that the majority of the students falls in the low score brackets. In fact, this is an important variable since English is the language used in the whole M.S. Program.

TABLE V

English Entrance Exam Scores of B.U.C. M.S. students

Class.Int	Mid.Pt	Freq.	%	Val.%	Cum. %
500 - 524	512	25	51.0	51.0	51.0
525 - 549	537	9	18.4	18.4	69.4
550 - 574	562	3	6.1	6.1	75.5
575 - 599	587	1	2.0	2.0	77.6
600 - 624	612	9	18.4	18.4	95.9
650 - 674	662	1	2.0	2.0	98.0
675 - 700	687	1	2.0	2.0	100.0
TOTAL :		49	100.0	100.0	

ENGLISH ENTRANCE EXAM SCORES OF BUC M.S. STUDENTS



Mean	546.184	Std Err	6.669	Median	512.000
Mode	512.000	Std Dev	46.685	Variance	2179.528
Kurtosis	.675	S E Kurt	.668	Skewness	1.278
S E Skew	.340	Range	175.000	Minimum	512.000
Maximum	687.000	Sum	26763.000		

Valid Cases 49 Missing Cases 0

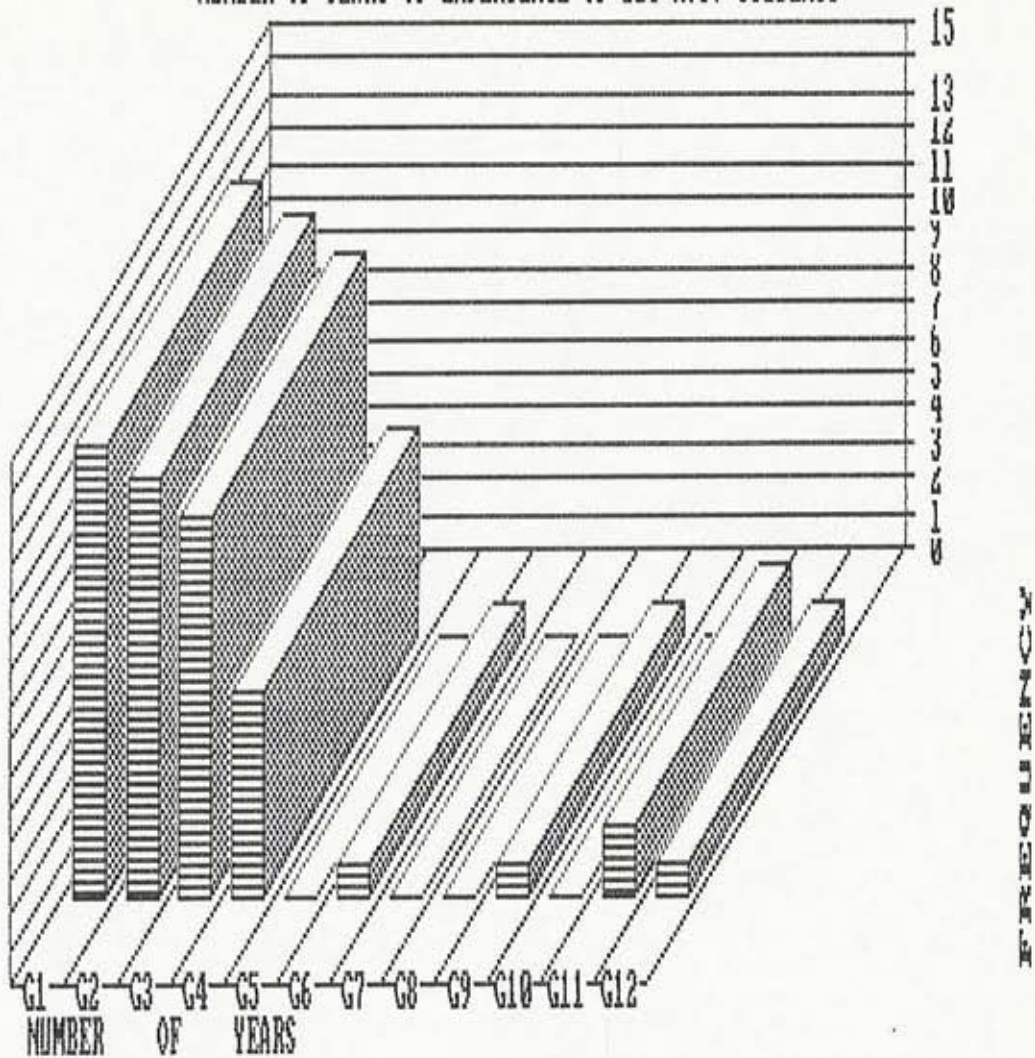
Figure V

The English Entrance Exam Scores Of B.U.C. M.S. Students.

The years of experience is an important variable that should be taken into consideration when studying the characteristics of our M.S. students. Their ability to deal with irregular situations in business and to match between what they are studying and what's really taking place in real life business cases could be well enriched and evaluated by the level of experience they have. Figure VI (Computer Printout) reveals that we have thirteen (26.5 percent) of the student's sample in study have no work experience. Also, the skewness is highly positive reflecting that the majority of the students falls in the low experience brackets. This corresponds to high percentage in our sample of study.

The last variable that we will use in evaluating the characteristics of our M.S. students is the Average Working Hours / Day. A student who works eight hours / day might not be able to study and absorb the material as another student who works only four hours/day, provided that other variables are constant, such as the number of courses taken, the mental capability, and so on. Figure VII (Computer Printout) shows that the distribution is negatively skewed reflecting that the majority of the students fall in the high working hours/day brackets.

NUMBER OF YEARS OF EXPERIENCE OF BUC M.S. STUDENTS



Mean	2.929	Std Err	.489	Median	1.500
Mode	0.000	Std Dev	4.535	Variance	20.565
Kurtosis	11.982	S E Kurt	.668	Skewness	3.204
S E Skew	.340	Range	25.000	Minimum	0.000
Maximum	25.000	Sum	143.500		

Valid Cases 49 Missing Cases 0

Figure VI

The Number Of Years Of Experience Of B.U.C. M.S. Students.

But what about our M.S. Students G.P.A. ?

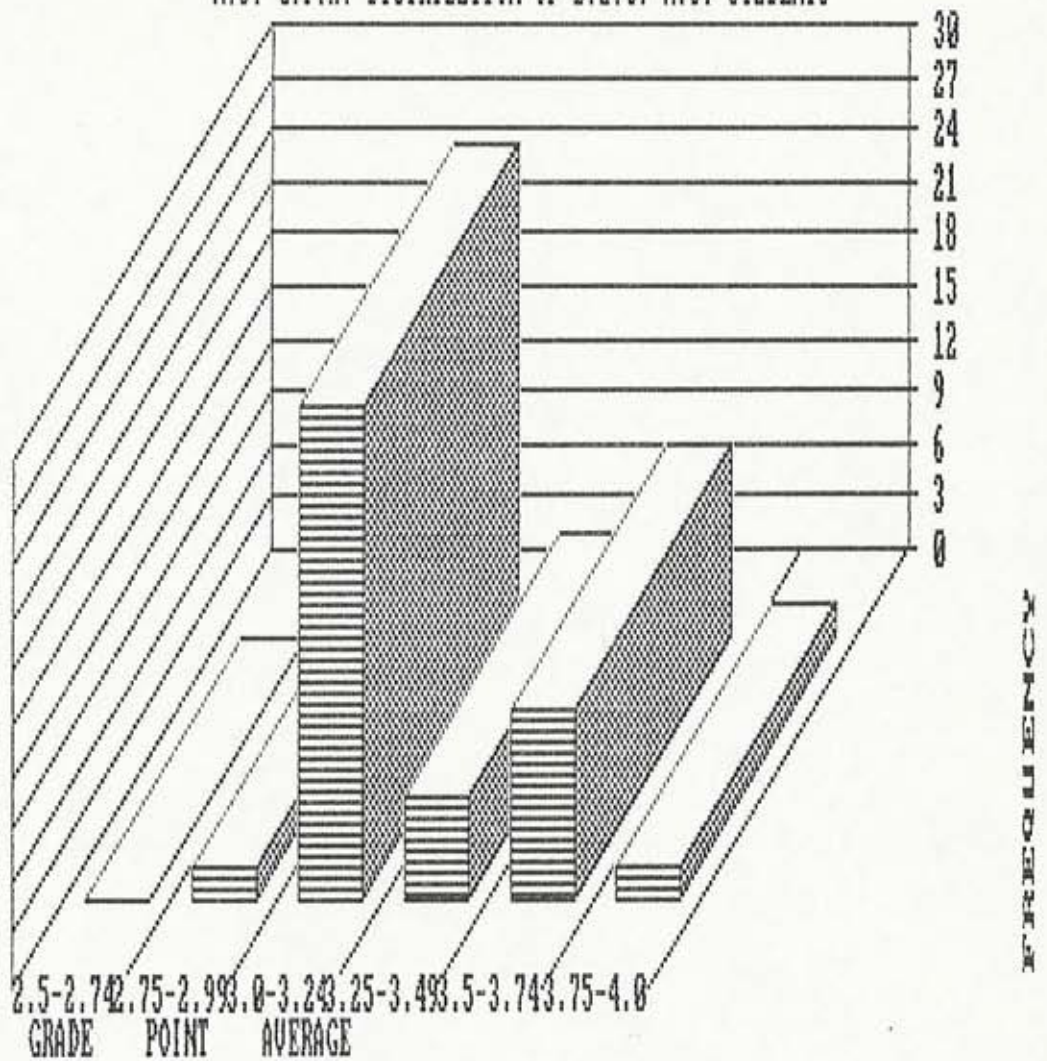
Table VI & Figure VIII (Computer Printout) show the M.S. G.P.A. frequency distribution. We can realize that twenty eight students (57.1 percent) of the student's sample in study had a G.P.A. between 3.0 - 3.24 which reflects the highest percentage of the students. Also, as can be verified in Figure II, the distribution is positively skewed which means that the majority of the students fall in the low G.P.A. brackets. In fact, this is a very important variable especially in showing the performance of the M.S. Students.

TABLE VI

M.S. G.P.A. Distribution of the B.U.C M.S. students.

Class.Int	Mid.Pt	Freq.	%	Val.%	Cum. %
2.50 - 2.74	2.62	0	0.0	0.0	0.0
2.75 - 2.99	2.87	2	4.1	4.1	4.1
3.00 - 3.24	3.12	28	57.1	57.1	61.2
3.25 - 3.49	3.37	6	12.2	12.2	73.5
3.50 - 3.74	3.62	11	22.4	22.4	95.9
3.75 - 4.00	3.87	2	4.1	4.1	100.0
TOTAL :		49	100.0	100.0	

M.S. G.P.A. DISTRIBUTION OF B.U.C. M.S. STUDENTS



Mean	3.283	Std Err	.036	Median	3.120
Mode	3.120	Std Dev	.253	Variance	0.064
Kurtosis	-.557	S E Kurt	.668	Skewness	0.759
S E Skew	.340	Range	1.000	Minimum	2.870
Maximum	3.870	Sum	160.880		

Valid Cases 49 Missing Cases 0

Figure VIII

The M.S. G.P.A. Distribution Of The B.U.C. M.S. Students.

Now if we use the M.S. G.P.A. as a measure of performance, then the major question will be : To what extent do the other variables contribute in explaining the variation of the dependent variable (The M.S G.P.A) that we have.

To answer this question, and to study the significance of each of the variables in our predicting process, the multiple linear regression analysis was used to derive an equation that associates the dependent variable with the other independent variables.

As a first step, we took the M.S. G.P.A. variable (T) to be a function of the 19 variables we had at the beginning of (A Thru S) :

$$T = F (A \text{ Thru } S)$$

$$T = 1.48961 + 0.42065 D + 0.05620 H$$

(16.094) (7.573)

$$R^2 = .34579$$

$$F = 12.1567$$

$$\text{Sig } F = .0001$$

Here, the coefficient of determination was found to be $R^2 = 0.34579$ which is an approximation of 35 percent of the variations in performance were determined or explained by the variation of the linear combination of the independent variables A Thru S.

It was reasoned that the low R^2 is due to lack of important variables in the equation. For example, the above model did not include the scores on the E.E.E. as a predicting variable. Because of this, we decided to combine between certain variables in the following manner:

- X1 : No. of Credits Completed * No. of Semesters Completed.
- X2 : No. of Years of Experience * Present Business Occupation * Past Business Occupation.
- X3 : English Entrance Exam * English Entrance Exam.
- X4 : No. of Years of Experience * Present Business Occupation.
- X5 : Present Business Occupation * Past Business Occupation.

These interactions along with the other remaining variables R, J, A, H, D, S, C, K, & M were all used to derive the performance prediction regression equation.

The regression equation derived is : (Appendix B)

$$\begin{aligned}
 T = & 2.09115 - 0.06107 X_4 + 0.06060 H + 1.311 \cdot 10^{-9} X_1 \\
 & \quad (12.957) \quad (9.116) \quad (6.672) \\
 & \quad \quad \quad S \quad \quad \quad S \quad \quad \quad S \\
 & - 0.02745 S + 0.43402 C + 0.05907 M \\
 & \quad (8.261) \quad (18.697) \quad (11.561) \\
 & \quad \quad \quad S \quad \quad \quad S \quad \quad \quad S
 \end{aligned}$$

$$R^2 = 0.52318$$

$$F = 7.68069$$

$$\text{Sig. } F = 0.0000$$

From this equation, we can notice that R^2 , the coefficient of determination, is somehow significant. It is equal to 0.52318 which means that about 52 percent of the variations in the performance of the M.S. students can

explained by, or attributed to the variables composing the equation (X4, H, X1, S, C & M). X4 is the years of experience multiplied by the present occupation in Business, H is the Average Load / Semester, X1 is the credits completed multiplied by the semesters completed, S is the Age, C is the B.S. Cumulative G.P.A. and M is the years of experience.

0.83223 is the constant or the intercept of the equation. The coefficients of the variables are the various slopes of the equation for each variable holding other variables constant. For example, if X4 changes by one unit, then the dependent variable T will change by - 0.06107 . The F ratio = 7.68069 is significant since the significant F is 0.000. The numbers in parentheses show the significance of the variables. They are the estimated parameters and we can see that they are significant as the significant F is zero.

A summary of the variables used & their coefficients is :

<u>Variable</u>	<u>Coefficient</u>
X4 : No.Y.Exp. * Pres.Occ.Bus.	0.06107
H : Average Load / Semester	0.06060
X1 : No.Cred.Comp * No.Sem.Comp.	1.311*10 ⁻⁹
S : Age	0.02745
C : B.S. Cumulative G.P.A.	0.43402
M : No. Years of Experience	0.05907

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

A high demand for higher education has been and still is a requirement of all universities. B.U.C., of course, is not an exception. Seeking higher levels of education and knowledge, and seeking better career positions are the main reasons beyond such an increase in demand. But how can B.U.C. manage such an increasing number of applications for the M.S. program ? In such a situation, a university will be faced with two alternatives : either to accept the additional volume (or number) of applicants, or to develop a system that might help it to be more selective in its admission process. Since admitting all applicants means a need for expansion, and thus incurring more costs, the college should stick to the second choice.

Developing a selective system that is both effective and efficient will make it necessary for the college to set certain criteria to predict the performance of the M.S. students, at high standards, the basis that will help it in its admission processes.

Now how can B.U.C. predict the performance of its M.S. students, and what are the variables that should be used in this prediction ?

This research has presented a review of the methods followed by the university to predict performance. It then focused on the variables that bear an effect on the students' performance, and thus a set of criteria could be established to help in the admission decision.

Nineteen variables were used in this research. An analysis to these variables helped us identify the characteristics of the students joining the M.S. program. Then these variables, along with their interaction, were fitted into a regression equation. From this analysis, it is shown that the most important or significant variables to be used in the prediction process are:

X4 : No. Years of Exp. * Present Occupation Business.

H : Average Load / Semester.

X1 : No. Credits Completed * No. Semesters Completed.

S : Age.

C : B.S. Cumulative G.P.A.

M : No. Years of Experience.

Such a model might, we hope, prove useful to the admission committee in helping them in their admission decisions, especially that the system of admission is continuously reviewed. The hope is to have a better quality system that would enable the B.U.C. to pursuit a successful graduate program.

We hope that such a model will prove useful since, after all, what concerns the university is a system or a model of selection that will keep enrollment to the M.S. Program at its optimum, but at high standards that will keep the quality of education provided at its high level.

Students questionnaires were the only source of information for this study. Further studies, engulfed in this research, and using the official students records from the registrar's office are needed to have better ideas about predicting the academic performance of the graduate students at Beirut University College using a multiple linear regression model.

APPENDIX A

- NAME : - ID # :

- AGE : - SEX :

- Marital Status :

- Academic Background.

B.S. : Major :

Institution :

Language of Instruction : Arabic English French

Cumulative G.P.A. :

Major Courses G.P.A. :

Cum. Average (%) :

M.S. : G.P.A. :

Date of Joining the Program :

Number of Semesters Completed by Summer 1988 :

Number of Credits Completed by Summer 1988 :

Average Load / Semester : 3 Cr. 6 Cr. 9 Cr.

E.E.E. (If any) : GRE (If any) :

TOEFL (If any) : GMAT (If any) :

- Occupation. (During the M.S. Study)

Past :

Present :

Total Years of Experience :

Type : Public (Government) :

Private (Banks, Trade, Industries etc.).Specify :

Self Employed Or Employee.

If Employee then No. of employees supervised :

If Entrepreneur then No. of employees :

Daily Working Hours (Formal): Starting Ending

Actual Daily Working Hours : Average :

- Career Interest :

APPENDIX B

```
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  K 33-34 L 35-36 M 37-42(2) N 43-44 P 47-51(2) Q 52-53  
  R 54-55 S 56-58 T 59-63(2).  
COMPUTE X1=G*F.  
COMPUTE X2=M*L*K.  
COMPUTE X3=SQR(I).  
COMPUTE X4=M*L.  
COMPUTE X5=L*K.  
REGRESSION VAR =D,C,S,A,J,H,M,R,K,X1,X2,X4,X5,T  
/STATISTICS=F/DEPENDENT=T/METHOD=BACKWARD.
```

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. T

Variable(s) Removed on step Number
20.. A

Multiple R	.72331
R Square	.52318
Adjusted R Square	.45507
Standard Error	.20768

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	6	1.98769	.33128
Residual	42	1.81153	.04313

F = 7.68069 Signif F = .0000

* * * * MULTIPLE REGRESSION * * * *

Equation Number 1 Dependent Variable.. T

----- Variables in the Equation -----

Variables	B	SE B	Beta	F	Sig F
X4	-.06107	.01697	-.94841	12.957	.0008
H	.06060	.02007	.35402	9.116	.0043
X1	1.311253E-03	5.07627E-04	.31994	6.672	.0134
S	-.02745	9.55213E-03	-.39484	8.261	.0063
C	.43402	.10037	.49591	18.697	.0001
M	.05907	.01737	.95212	11.561	.0015
(Constant)	2.09115	.41629		25.233	.0000

* * * * MULTIPLE REGRESSION * * * *

Equation Number 1 Dependent Variable.. T

----- Variables not in the Equation -----

Variables	Beta In	Partial	Min Toler	F	Sig F
D	.03706	.02561	.13961	.027	.8705
A	.20156	.23726	.10849	2.446	.1255
J	.12593	.16777	.13630	1.188	.2822
R	-.08690	-.11616	.13880	.561	.4582
K	-.04530	-.06203	.14449	.158	.6928
X2	-.01300	-.01824	.14319	.014	.9076

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