A SURVEY OF THE APPLICATION OF QUANTITATIVE TECHNIQUES IN BUSINESS

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# TABLE OF CONTENT

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Need for the Study</td>
<td>3</td>
</tr>
<tr>
<td>Statement of Purpose</td>
<td>4</td>
</tr>
<tr>
<td>General Statement of the Problem</td>
<td>5</td>
</tr>
<tr>
<td>Statement of the Research Questions</td>
<td>6</td>
</tr>
<tr>
<td>II. REVIEW OF LITERATURE</td>
<td>7</td>
</tr>
<tr>
<td>Introduction</td>
<td>7</td>
</tr>
<tr>
<td>The Modernization of Decision Analysis to Respond to Actual and Future Needs of Decision Maker</td>
<td>7</td>
</tr>
<tr>
<td>Keeney's Approach</td>
<td>7</td>
</tr>
<tr>
<td>Ronald Howard's Descriptive Analysis</td>
<td>13</td>
</tr>
<tr>
<td>Application of Decision Theory Techniques</td>
<td>18</td>
</tr>
<tr>
<td>Synthesis Drawn from those Studies</td>
<td>34</td>
</tr>
<tr>
<td>III. PROCEDURES AND METHODOLOGY</td>
<td>36</td>
</tr>
<tr>
<td>Population and Sample Selection</td>
<td>36</td>
</tr>
<tr>
<td>Description of the Selected Variables and their Measurement</td>
<td>39</td>
</tr>
<tr>
<td>Description of all Measures Used to Collect Data</td>
<td>41</td>
</tr>
<tr>
<td>Description of the Conceptual Framework for Analysing the Data</td>
<td>42</td>
</tr>
<tr>
<td>IV. FINDINGS OF THE STUDY</td>
<td>43</td>
</tr>
<tr>
<td>Introduction</td>
<td>43</td>
</tr>
<tr>
<td>Major Characteristics of the Selected Sample</td>
<td>44</td>
</tr>
<tr>
<td>Extent of Familiarity, Use and Particular Application of Quantitative Techniques</td>
<td>47</td>
</tr>
<tr>
<td>Analysis of the Relationship Between Familiarity and Other Independent Variables</td>
<td>54</td>
</tr>
<tr>
<td>Educational Level</td>
<td>54</td>
</tr>
<tr>
<td>Experience</td>
<td>62</td>
</tr>
<tr>
<td>Line of Business</td>
<td>65</td>
</tr>
<tr>
<td>Level in Organization Hierarchy</td>
<td>69</td>
</tr>
<tr>
<td>Analysis of the Relationship Between Use of Quantitative Techniques and Other Independent Variables</td>
<td>71</td>
</tr>
<tr>
<td>Age</td>
<td>72</td>
</tr>
<tr>
<td>Level in Organization Hierarchy</td>
<td>75</td>
</tr>
<tr>
<td>Extent of Use Based on Line of Business and Experience</td>
<td>78</td>
</tr>
<tr>
<td>Barriers Preventing Use of Quantitative Techniques</td>
<td>80</td>
</tr>
<tr>
<td>Experience</td>
<td>83</td>
</tr>
<tr>
<td>Age</td>
<td>86</td>
</tr>
<tr>
<td>Education Level</td>
<td>88</td>
</tr>
<tr>
<td>V. SUMMARY AND CONCLUSIONS</td>
<td>90</td>
</tr>
<tr>
<td>Implications</td>
<td>92</td>
</tr>
<tr>
<td>Recommendations</td>
<td>93</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>95</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

The fast technological development of the 20th century induced the creation of quantitative techniques. In fact without those techniques, computer, which is the core of those inventions, would not have reached its actual level of control over our lives and even over some of the natural phenomenon. It is true that computer provided us with the so awaited mean of processing a large volume of data, but it is the quantitative techniques which gave meaning to those data.

Although, computer did foster the widespread of quantitative techniques but basically it is the economic difficulties of this century, namely unlimited need vs. limited resources, that called for the creation of those techniques. Consequently, maximizing utility and the desire to take the most effective action under all circumstances pushed man of this century to use all his powers, physical and intellectual, and all kinds of available means including war. His deep reflection led to the creation of a new body of science—namely Decision Analysis.
Decision analysis was able to respond to the complexities of the 20th century by providing us with a "systematic procedure for transforming opaque decision problems into transparent decision problems by a sequence of transparent steps." The origin of this alteration is information, and quantitative data are in the essence of information.

However, the fact that quantitative techniques require the collection and processing of large volume of data, they did not conquer the business world on a widespread basis until the late 1960's when the prices of computers became affordable to organizations. Previous to that date, usage was restricted to telephone companies which used mathematical model to determine optimum supply of circuits to meet the demand of telephone lines, and they were also successfully used by the Allied during the second world war.

Anyway, the introduction of quantitative techniques to business world had a major drawback as it has been found later. They were solely developed by scientists and universities without involving or taking into consideration real world decision-makers' points of view. This resulted in total disregard of those techniques by decision maker. In fact, Grayson in 1973 in his well known article "Management Science and Business Practice" pointed out to a gap that exists between decision analysts and decision makers or between decision theory and decision practice."


Since that time concern has been concentrated on bridging the gap between theory and practice. Some reported success of the bridge yet others, like Amitai Etzioni (1989), reported failure of quantitative techniques and their collapse.3

Decision analysis and its techniques were designed to take care and solve any problem. They were thought of as a Magic Box where problems enter from one side and leave through the other after being solved. If this is true, then those techniques are inevitable while finding solutions to the Lebanese financial problems.

Therefore, this research was meant to find out the opinion of the Lebanese financial manager, in regard to this statement.

Need For The Study

Since its creation, Lebanon has been distinguished by its trade and business deals. Unfortunately, the Lebanese environment in which decisions must be made nowadays is becoming more complex than before. Governmental decrees and regulations, such as increasing public service fees, high cost of living, customs fees and restrictions imposed on trade are increasing risks and uncertainties to future management decision. Dealing with hyperinflation and at the same time satisfying low income consumers' needs add to the dilemma of the Lebanese decision maker, especially in the last years of this century.

Such economic events, in addition to the confusion that the commercial sector is witnessing, had not had any chance to happen before, since the Lebanese were always pioneers in applying the latest innovations. However, it has never been clear how the application of the quantitative techniques was hindered by the latest civil war.

No previous research we know of, has ever been conducted in Lebanon to test the extent of familiarity, usage and barriers to the application of quantitative techniques in the Lebanese financial sector. It is obvious that those techniques, if used properly, are powerful tools for decision making. Still, little evidence is found, either to ascertain the usefulness of those models to Lebanese decision makers or to the value of those techniques to Lebanese decision makers.

Statement of Purpose

The purpose of this research is to try to ascertain the extent to which quantitative models are used by the Lebanese financial sector. Parallels, the extent of familiarity of those techniques to decision maker, major area of application and the importance of some barriers which are preventing the use of quantitative techniques will be tested. Another purpose of this study is to show the value of quantitative techniques in decision making and the benefits it provides managers with.
Banking sector and Insurance companies, constituting the major part of the financial sector were the sole source of data collection. Being almost the sole decision makers, different levels of managers, first line, middle and top level have been involved in this study.

General Statement of the Problem

The importance of quantitative models does not lie in their development, but in their application to real world situation by decision makers or managers.

Managers are in powerful positions since decision is in their hands. Being the end users of those techniques, they should be involved in their development so that they would not ignore them. Moreover, they might consider decision analysts a threat to their position and could use their legal power to prevent them from carrying out their work.
Statement of the Research Questions

Since this study is based on the work of Petty and Bowlin (1976), Green, Newsom and Jones (1977), and Coccaari (1989), the following five common questions among those studies will be tested to Financial Lebanese firms:

1- To what extent are quantitative techniques being used in decision making?

2- How are quantitative techniques being applied?

3- What are the reasons which make some managers hesitant to use quantitative techniques?

4- What are the major barriers to utilization?

5- What is the future of quantitative techniques in decision making?
CHAPTER II

REVIEW OF LITERATURE

Decision analysis and the use of quantitative techniques have been a long standing issue in management science since the late 1960's. Although useful, they present for managers a scientific tool to lay on, they are usually avoided.

In this chapter, the researcher will try to present a literature review by first making a clear definition of decision analysis and the use of quantitative techniques. Then, by presenting issues related to the application of those techniques in most organizations, and the various domains in which those techniques could be applied.

The Modernization of Decision analysis to respond to actual and future needs of decision maker.

Under this section decision analysis will be fully described as viewed by two analysts in the management world Ronald Howard and Ralph Keeney.

Keeney's approach.

Keeney (1981), divided the methodology of decision analysis into four steps:

1. Structure the decision problem
2. Assess possible impacts of each alternative
3. Determine preferences (Values) of decision makers
4. Evaluate and compare alternatives.

Two steps must be taken in structuring the problems, generation of alternatives and specification of objectives.

Two problems must be avoided in generating alternatives. The first one is to avoid having too much alternatives and the second is to avoid having few alternatives.

How to select and search for alternatives has been the subject of many studies which are far beyond the scope of this project. But, a prominent study worth mentioning in this field is the one conducted in January 1983 by Takahashi and Takayanagi. They introduced a new typology of decision procedures the fixed size procedure and the sequential procedure in selecting alternatives.

Fixed size procedure call the decision maker to "comprehensively surveys the fixed-size possible alternatives before going through the third and fourth process".  

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In the sequential procedure the decision maker searches and accepts one alternative at a time if it reaches satisfactory level, otherwise rejects it and returns to the second phase of decision analysis. It has an advantage over the fixed size procedure by economizing on time and resources.

They conducted a survey in a large Japanese firm about the fact that the decision maker who takes the sequential procedure, searches the smaller number of alternatives than the decision maker who takes the fixed size procedure. They found that 58.4% of the firms are using the fixed size while 41.6% are using the sequential one. In addition, they found a relationship between conflict resolution mode and fixed or sequential procedure. In the fixed size procedure firm resolution passes through the decision procedure jointly made by many persons, and the sequential procedure firm resorts to conflict resolution through the decision processes made by a single person.

They also investigated Galbraith "design actions" and found that the fixed size procedure firm uses design actions to increase information processing, while the sequential procedure firms resort to designs which reduce the need for information processing.

Now that the work of Takahashi and Takayanagi has clarified the importance of alternatives in decision analysis Ralph Keeney proposes a proper way for conducting decision analysis.
It is better to begin first by a careful definition of the decision problem. Defining a problem implies having specific objectives and possible alternatives. In the development of alternatives, knowing what information to collect reduces the burden of quantifying the decision maker's values. Thus, concentrating on the preference of the decision maker can save "time, effort, and money on a decision analysis and result in more useful insights for the problem."\textsuperscript{3}

Keeney stipulates that the information needed by the decision maker could be influenced by the following:

1- The information may be sensitive.
2- The natural procedures to process the information in one's mind often result in biased judgments.
3- The respondent may have vested interest in misrepresenting information.

The decision analyst should be able to interact and build trust between him and other parties working on a decision problem in order to diminish such bias. He proposes four devices in order to reduce the effect of the sensitive nature of decision information, conflicts and unconscious biases. Those are:

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\footnotesize{3. Ralph L. Keeney, "decision Analysis: An Overview," p. 818.}
- Iteration with consistency checks, whereby information are gathered and inconsistencies are investigated until consistency is achieved.

- Assessment with a different individual, where it is preferred to collect a different point of view.

- Dividing the problem under study to its component and obtaining judgment on the components.

- Sensitivity analysis can clarify problem elements and help in evaluating alternatives.

Finally, he investigated the extent to which decision analysis is being used and found four misconceptions which are limiting the application of decision analysis.

1- Objective, value free analysis is needed, whereas decision analysis is too subjective and value laden.

2- Decision analysis does not apply to many decision makers who, by their choices of alternatives, violate the axiom of decision analysis.

3- The purpose of decision analysis is to solve decision problems, but this is rarely achieved since important factors are always left out of the analysis.

4- Decision analysis requires a single, identifiable decision maker, yet most decisions involve a group of decision makers, some of whom may not be clearly identified.
Keeney analyzed those misconceptions and found that objective value-free analysis is not desirable since problems are becoming more complex than ever before and there is an impossibility to collect objective data from those problems. What is needed is a systematic reasoning which makes use of available data.

The prescriptive power of decision analysis helps the decision maker to choose the alternatives that are consistent with the available information about the problem, thus preventing any violation of its axiom. Decision analysis is a tool for helping the decision maker make better decision and was never a tool for solving decision problems. In addition, decision analysis does not require a single decision maker but individuals able and willing to make decisions.

His study revealed five pitfalls to decision analysis:

1. Weak or no logical or theoretical foundation.
2. Lack of consideration of subjective and value components of the decision problem.
3. A claim that analysis provides a solution to the decision problem.
4. Poor analysis.
5. Weak personal interaction skills.

Finally, decision theory is not restricted to its narrow definition of problem identification but tries to find out a solution to this problem, and it was widened to make use of a body of knowledge namely Management Science and its different techniques.
How management science techniques were applied to real world situation and used by managers in their decision making, is what we will try to find out in the next section.

Ronald Howard's Descriptive Analysis.

Decision analysis, according to Ronald Howard (1988), is a systematic procedure for transforming opaque decision problems into transparent decision problems by a sequence of transparent steps.∗

Highly influenced by John keynes(1964), he investigated the reasons behind which decision analysis is not getting its true value as it should and is not yet routinely applied to important decision. He found that five factors have a direct implication on the use or not use of decision analysis; consideration of human nature, concept, scope, skill and efficiency. A detailed description of those factors might prove useful.

1. Consideration of Human Nature

Some people prefer to be guided by feeling and not thoughts. If this is the case then decision analysis cannot work in this context. This is not in conformity with decision analysis which requires logical and systematic steps.

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2. Conceptual Considerations.

Based on his experience as professor and business-man Howard found that most people make no distinction either between decision and outcome or between descriptive and normative models.

"A good outcome is a future state of the world that we prize relative to other possibilities. A good decision is an action we take that is logically consistent with the alternatives we perceive, the information we have, and the preferences we feel."[15]

The importance of normative models lies in the fact that it substantiates the limited capabilities of human beings. In order to disseminate those misconceptions he suggests that those subjects should be taught beginning from elementary school.

3. Consideration of Scope

To Howard, framing, creating alternatives, decision consulting and measuring decision quality, could give insight to the decision maker that he is on the right track.

Framing is the most difficult part of the decision analysis process. If not deeply understood, the decision maker could end by working on the wrong problem.

"Framing poses the greatest challenge to the automation of decision analysis."[16]

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6. Ibid. p. 684.
In the same token, he advances that alternatives should describe the real possibilities of the problem and that a consultant should make sure that quality is emphasized in each part of the process.

4. Consideration of Skills

Under this section he attempts to explain the fact that decision analysis sometimes fails even if it had the right people, concept and problem, due to the lack of proper tools for presenting the problem. This is true since decision analysis is based on a normative axiomatic framework where a problem is transformed into a different representation such a decision tree away from the perception of a decision maker. That is why the influence diagram emerged out of a need to bridge the gap between analysis and formulation.

"It is intuitive enough to communicate with decision makers and experts and at the same time, precise enough for normative analysis". 7

There is a cultural change in the acceptance of the models. This can be seen by the term used today to describe those models. Some people call influence diagram Bubble Charts and others call outcome of decision trees Tornado Diagrams. Influence diagrams are easy tools for problem formulation.

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It does not require a decision maker to have a doctorate in mathematics. It allows the decision analyst to frame the problem from the perspective of the decision maker, and to maintain and revise the problem from that perspective.

"The diagram is thus, an extremely helpful representation for extracting information in technically useful form, the core of elicitation process."

To Howard, the influence diagram promises to surpass decision tree. Although decision analysis is the theory and practice of trees, yet his experience revealed that few decision makers knew how to draw a decision tree. He even raises the question of whether it is time to begin teaching influence diagrams in universities instead of decision trees.

5. Consideration of efficiency

Even if decision analysis is the most effective tool for decision making, the manager will not use it if it is too costly. He found that some improvement was introduced in the late year by the introduction of spreadsheet and all kinds of statistical computer based program. Those programs allowed decisions which required months to be done previously, achieved in a few days.

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"This means that people without extensive training in decision analysis can represent sophisticated problems involving uncertainty resolution and also rather complex modeling of outcome."

Finally, the future of decision analysis lies in its use of computer, namely artificial intelligence. Howard builds on Haltzman Intelligent Decision System and presents it as shown in figure 1.

According to him, this system should be able to create decision models, evaluate them and explain their implications.

It should have normative power in the sense of being able to provide a decision model that is custom fitted to the decision maker, thus creating interaction between the system and the decision maker. The intelligent decision system is the promise of the future of decision making since it will widespread its use by providing it at a lower cost and less time.

Application of Decision Theory Techniques.

Up until 1970, there has been little factual evidence of the use of quantitative techniques in decision making. To respond to this knowledge gap, Rex Brown (1970), conducted a survey to test the application of those techniques. He found that, quantitative techniques, he calls Decision Theory Analysis, has not been really used by companies until the late 1960's and the beginning 1970's, due to the prominent work and teaching of Sclaifer and Raiffa.

Brown conducted a survey of the companies using quantitative techniques in their decision making namely Du Pont, Pillsbury, GE, and Inmont. At Du pont, he found that although a consulting section was developed to quantify decision making, it did not reach the point where it really had a major impact at the general manager level. Pillsbury, GE and Inmont revealed that quantitative techniques are being used in decision making at various degrees.
To Brown, there are many obstacles that are preventing the use of quantitative techniques. The major ones are:

First, personal competence in the sense that most executives lack education and proper training on this method.

Second, due to its limited application, no reported benefit or value to the manager could be seen.

Third, due to the fact that decision analyst is not working closely with the decision maker, the latter is seeing the work of the former as a threat to his position.

Fourth, due to the fact that outside consultants are hired by companies in order to reduce uncertainty rather than to improve their ability to deal with uncertain situation prevent consultants from using qualitative models.

He then concluded that decision theory analysis still requires some favorable conditions to be used by the decision maker such as a decrease in the cost of computers used to process the data of the model, proper training and education of the decision makers, outcome of the model should be simplified to allow the user to understand it, and most important is the manager willingness to improve his decision making.

Those unresolved questions were the subject of a thorough study conducted in 1973 by Grayson who found that there is no interaction between management and management science, each is operating in its own culture. Therefore, a bridge must be constructed between them, otherwise the fact that management
scientists thoughts, contributions and ideas being not generated from the real world of managers, resulted in having "The total impact of management science has been extremely small".¹⁰

Based on his experience in the field, Grayson presents five reasons for his rejection of using management science.

1- Shortage of time

Management scientists, while developing their decision aiding tools do not take into account time constraint and its implication on the decision maker. Those time consuming models make managers neglect them when facing a decision. Therefore, scientists must experience and take into account time constraint while developing their methods.

2- Inaccessibility of Data Models

Models developed by scientists require data that may not be available to the decision maker or require time and money to collect them. This is another reason why managers neglect those models.

3- Resistance to change

Decision makers who are not familiar with the decision tools developed by scientists may resist to use them. Scientists should incorporate human variables into their models.

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4-Long response time

Management science is dragging behind the need of decision makers. They take their time in building their systematic models when a quick solution is needed.

5-Invalidating Simplification

Disregarding time constraints, availability of data, resistance to change and slow response time, scientists are presenting oversimplified models to decision makers.

Finally, Grayson concluded that a bridge must be built between scientists and managers. He strongly believes that it is the management scientist who must move in the direction of the decision maker. Scientists model should incorporate such variables as manager needs, expectations and pressures.

To Grayson this could be done on two levels:

- Inside the operating organization, management scientists should have line responsibility in order to be able to face real world decisions and have a chance to develop an in house model, instead of implementing a ready made package that disregards complicating factors.

- In universities, scientists and students should get involved in real projects as part of their learning. The situation should dictate the tools to be used and not the other way round. One way of doing this, is that faculty members should get employed to get real world experience and managers should return to universities to learn up-to-date scientific tools.
Since questions remain as to the extent to which these models are used and the experience of corporations with theory when they are used, Petty and Bowlin tried to answer those questions.

Based on 500 companies, members of the Financial Management Association, Petty and Bowlin in 1976, conducted a study to test the extent to which quantitative models are used by businesses. They resorted to questionnaires in order to collect data and the results of their research could be divided into the following four sections:

1 - Quantitative Methods.

In general, Petty and Bowlin investigated different techniques of quantitative analysis, namely discounted cash flow, valuation models, risk-return indifference curves, utility theory, portfolio selection theory, minimizing of cost function by calculus, statistical techniques, analysis of uncertainty and mathematical programming. Their study revealed that 76.5% of the companies use discounted cash flow technique which is significantly greater than the earlier study conducted by Scott, Petty and Bird (1975) who reported a range from 50% to 58%. In addition, they found that 83.7% of the sample are using this technique in capital budgeting. 43.8% of the sampled companies used regression analysis for the prominent statistical technique. 40% of the firms when facing risk use quantitative technique which analyses uncertainty coupled with future events.
Analyses of uncertainty techniques were found to be applied to capital investment, financial leverage and working capital management. 35% of the companies were found to use valuation models mainly in the calculation of cost of capital. 20% of the companies use mathematical programming mainly in profit planning, capital investment decisions and financial budgeting.

Their study revealed that firms have a knowledge of two third of quantitative tools but do not apply it. From this, they concluded that the quantitative models are receiving limited attention among the firm sampled.

To test if user involvement has any implication on user acceptance of the model, Petty and Bowlin found that in three fourths of the companies, top management is involved in the initiation stage for the need of quantitative tools. This involvement later diminishes in the implementation process. However they concluded that there is "a relatively clear relationship between active use of quantitative models and management - staff cooperation appears to prevail". 11

2 - Specific Application of Quantitative Methods.

A second questionnaire was forwarded to the firm, which showed sign of quantitative technique usage in the first

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questionnaire, to test the use of at least two techniques by those firms. Their intent was to see how quantitative techniques were used and their impact on top level decision. They found that the use of a different type of quantitative techniques is prevalent in the categories of usage they call Analysis, Planning and Control.

In addition, their inquiry about the source of data to quantitative models revealed that the accounting, finance, marketing and production departments offer the primary source of internal data.

As to the use of the results generated by the models, they found that top management and financial people make extensive use of those results.

3 - Problem areas in implementing quantitative techniques.

Their study revealed three major problems to quantitative technique implementation. First, lack of adequate education due to the gap that exists between theory and practice, thoroughly studied by Grayson. Second, oversimplification of the quantitative model by decision scientist, makes the decision maker find them irrelevant. Finally, data was either very difficult to raise or insignificant to the model.

4 - User Satisfaction.

They found that people are either moderately or extremely pleased with quantification of problem faced.
50% consider that quantitative technique is the primary factor in the final decision.

To respond to the fact that Petty and Bowlin survey was considered one of the few studies which provide an in-depth analysis of the use of quantitative techniques, T. Green, W. Newsom, and S. Jones in 1977, conducted a survey of the application of quantitative techniques to production/operations management in large corporations listed in Fortune 500 companies.

Nineteen different quantitative techniques were tested to determine their usage, value, future utilization and barriers to utilization. They found that 9 techniques were not at all used by 60% of the responding organizations and only 7 techniques were frequently used by 25% of the organizations. However, they reported that the extent of use of quantitative techniques will increase in the future namely for simulation, queuing theory, nonlinear programming, time series analysis, network analysis and bayesian statistics.

In addition, their study revealed a correlation between the use and value of quantitative techniques. To identify the major barriers to the application of quantitative techniques, their questionnaire included a section in this regard composed of 15 barriers which ought to be rated by the respondents on a 10 point Likert scale ranging from not important to very important.
Then they used factor analysis to see if a relationship exists between those barriers to combine them into a broader classification. This resulted into 4 factors:

Factor one could be viewed as lack of knowledge of quantitative techniques by managers; factor two lack of widespread training to management, factor three cost of using quantitative techniques, and factor four as the difficulty of quantifying data.

Factor one or lack of knowledge was seen by the respondents as the major reason for not using quantitative techniques.

Factor two supports factor one and at the same time aim at the future of quantitative techniques usage.

The fact that only a small number of management is trained will intensify factor one creating a knowledge gap which will not be easily overcome.

Factor three, high cost barrier and factor four, quantifying data will have a little impact on the use of quantitative techniques unless lack of knowledge factor is overcome.

Their study revealed that big organizations use quantitative techniques to a small extent. If this is the degree of usage in big organizations, then it is expected that the application of those techniques in smaller organizations will be considerably less.

Finally, they suggested three approaches to overcome the lack of knowledge barrier which is preventing the use of quantitative techniques:
First, quantitative analysts should educate managers. Second, executive development program should include quantitative training. Third, universities should widen their teaching of quantitative techniques to non-quantitative majors.

The question of mutual increase of knowledge for both manager and decision analyst has been the subject of the study made in 1979 by Jack Fuller and Roger Atherton. The fact that those techniques are not easily understood by most managers, has created a problem to them in their dependence on specialists for "the selection of the most appropriate tool and the evaluation and interpretation of results".¹²

First, finding that his superior does not have either the time to apply the quantitative techniques or lack of knowledge of those techniques, is increasing in the specialist the sense of independence and superiority. This makes the manager lose control over specialists. Second, lacking the broader point of view of managers, specialists are disregarding from their decision making models, users factors and real world problems having influence on decision making. The same was reported by Grayson (1973) and Petty and Bowlin (1976), Ulvila and Brown (1982).

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Third, the complexities of quantitative techniques are making even the specialists to be experts in only a small set of those techniques. Thus, using a familiar technique and generalizing it to apply to all situations. Mutual increase of knowledge for managers and specialists, Patty and Bowlin (1976), Coccari (1989) is the answer for the problem. Managers must get training on quantitative techniques and specialists should have a greater awareness of managerial goals.

Finally, they concluded by presenting four recommendations for increasing manager specialist interaction:

1. Education for both parties.
2. Improving communication.
4. Joining forces to achieve organizational goals.

But, the use of quantitative techniques is not restricted to business application. In fact, in 1981, Samuel Bodily reported that some managers having realized the effectiveness of decision techniques are applying them to their legal problems. This allows them to reduce their risk and to save on time and litigation costs. Legal action entails big financial risks that can lead to bankruptcy and yet managers leave the matter to lawyers who may not have their skills in facing high-stake decisions.
He analyzed a hypothetical case, Parker vs. Denner based on other bona fide cases. After showing that both parties lose on a legal case, namely money and time under normal circumstances, he proposes his new approach of applying decision analysis to legal litigation. He demonstrates the possibility of quantifying a legal problem and the benefits derived from such presentation namely a better understanding of how to manage the risks litigation. By presenting the problem in a scientific way and by giving a clear picture of the estimated financial risks, decision analysis is making both parties seek settlement outside the court.

Although decision analysis, when applied to litigation has tremendous payoff, Bodily found three pitfalls to its application; human limitation in processing information, organizational weakness, and the complex nature of the competitive situation.

Finally, he concluded that uncertainties in any field could be quantified and he proposes four leading measures for a case to be a candidate for decision analysis:

- If a good deal of uncertainty exists.
- If the case is complex and a number of factors render a seat-of-the pants judgment very difficult.
- If the case has a potentially large financial and large range impact on a company.

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- If neither the company nor its decision maker has fully formed goals or preferences.

This cultural change or the improvement in using quantitative techniques to which Bodily referred to, was the subject of the study conducted in 1982, by Rex Brown and Jacob Ulvila.

Twelve years after Grayson article "Management Science and Business Practice", Jacob Ulvila and Rex Brown, reinvestigated some ideas raised in that article, and found that there is improvement in bridging the gap between decision theory and decision practice. Enhancement has been introduced to decision analysis to incorporate personal judgment and to improve interaction with the user; they call it personalized decision analysis. Yet decision analysis did not become the dominant analytical discipline as some expected.

To illustrate the improvement of personalized decision analysis they present three cases study of how managers use the three major tool of decision analysis, decision tree, probabilistic forecasting and multi attribute utility analysis. Decision tree will be a success if it is developed from the interaction of top management and analysts and if it incorporates three components: simple displays, sensitivity analysis to guide refinements, and subsidiary models to ensure completeness.
Probabilistic forecasting, the result of which could be used in
decision making is another form of personalized decision making.
What is new about this approach is that it combines personal
judgment with objective data.
Multiattribute utility analysis is a new technique of decision
analysis, useful when multiple factors should be accounted for,
some of the factors cannot be quantified, and no best choice
exists.

Then, they re-examined Grayson suggestion of making decision
analysis an integrated part of decision making and recommended
the establishment of an institute of research
and teaching which will conduct professional training to
managers and specialized decision analysts, to
"... integrates the logical, the psychological, and
the organizational aspects of applied subjective
decision analysis." 14

This same conclusion was the subject of the study conducted
in 1989, by Ronald Coccaro. He stipulated that the
"Schools of business have recently been attempting to
bridge the gap between academic course offering and the
real demands of the decision making manager." 15

14. Jacob W. Ulvila and Rex Brown, "Decision Analysis Comes Of Age,"

15. Ronald L. Coccaro, "How Quantitative Business Techniques Are Being
Almost three decades after Grayson had raised the subject for the first time (1973), the gap was still unabridged. Fascinated by this fact, Coccari conducted a survey in small and medium sized organizations to investigate the extent to which quantitative techniques are being applied.

The sample consisted of 900 small and medium size manufacturing firms. The main goal of the survey was to examine the type and usage of quantitative techniques under two broad categories, operations research and forecasting. The result of operation research showed that the usage of operation research is concentrated into two functional areas accounting for 70% of the application of this technique, namely production management with 45.9% and general management accounting for 24.5%. As to the individuals applying operations research methods they were mainly working in industrial engineering, operation research departments and management.

Then he investigated the frequency of use of each technique and found that quality control, inventory analysis and production scheduling models were the most used due to direct benefit and easiness in application as some respondents indicated.
Based on the responses of his research Coccari found three main reasons for not using the other operation techniques:

1. No perceived need for using them.
2. A lack of quantitative skills necessary for using them.
3. A lack of resources.

Those barriers, previously cited by Grayson (1973) and by Green, Newsom and Jones (1977), are still dominant and could be removed by increasing the manager knowledge of quantitative techniques. The result of forecasting techniques revealed that those methods are used in all areas of business. Yet, two functional areas make extensive use of those methods namely marketing, accounting for 25.7% of usage and production management, accounting for 23% of usage.

To the contrary of operation research users, the survey revealed that marketing and management personnel are the heavy users of those methods since they are not time consuming and performed just as well as sophisticated methods. Trend analysis, seasonal-cyclical indexes, and moving averages are the most used methods. The same reasons for not using operation research techniques were also found to apply to forecasting methods.

But in addition to the knowledge gap, Green, Newsom and Jones (1977), forecasting method survey revealed also a communication gap between users and forecasters. In most instances there seem to be a difference between the
perceptions of the users and forecasters whereby the latter fail to understand management needs and to identify the important issues relevant to the decision maker.

The remedy to this situation is increasing training to both parties. Based on his survey, he advised universities to emphasize simple quantitative techniques and to provide more training in applying those techniques to ill-defined problems. However, teaching the way of implementing quantitative methods to real world situations is still the main problem that universities must face.

**Synthesis drawn from those studies**

All the above mentioned studies point out the limited use of quantitative techniques in decision making. They point out to the fact that a gap exists between scientific world and decision making. Starting from Jackson Grayson in 1973, and ending with Ronald Coccari in 1989, all those studies required that there should be a dual education for both managers and decision analysts. The former should return to university to get up to date techniques in decision making. The latter should be exposed to real world situation cases as part of their training.

Yet, if this gap is finally bridged will quantitative techniques be used in decision making or it is time to disregard them since they proved their failure as Amitai Etzioni indicates, only the future will tell.
This chapter presented a detailed review of some studies who tackled the problem of quantitative techniques usage in decision making. Those studies were mainly made in industrial advanced countries. Now in the following chapters we will try to find out to what extent decision in the financial institutions in this country are based on the use of quantitative techniques.
CHAPTER III

Procedures and Methodology

Population and Sample Selection

Based on review of literature it is found that quantitative techniques could be used and applied to any field. However, the application of those techniques is not without a cost. A firm or a legal entity must have at least the following three factors in order to use quantitative techniques:

First, presence of a computer to process a large volume of data into a useful model.

Second, skilled human resources being able to use quantitative techniques and computers.

Third, having the financial ability.

In order to define the population which would serve as a target for this study, a pretest survey consisting of a random interview with different types of firms asking them about their usage of quantitative techniques had been conducted.

The pretest survey revealed that in order to use quantitative techniques a firm must have the following common points:

- It must have a working force consisting of at least 100 employees.
- Its capital must be at least equivalent to five million dollars.
- It must have some sort of external relation or tie with an outside firm, such as being a branch for an outside mother company.

It stands to reason that the only sector in Lebanon that may satisfy the above requirements is the financial sector, namely banking and insurance sectors. In order to have an accurate idea about the volume of those two sectors, a brochure issued from Banque Du Liban showing names of banks with their relative branches working in Lebanon, and a second brochure issued from the (Association des companies d'assurance au Liban) "ACAL", which also shows the name of insurance companies with their related branches working in Lebanon have been obtained.

The questionnaire was pretested in Bank Beirut Pour Le commerce with some of its related branches, and in American Life Insurance Company with its related branches.

It was revealed that decision making is centralized in Lebanon. The main branch or home office is the sole decision maker, and branches have a little margin for decision making. Thus, the questionnaire was modified to be addressed to managers. A section inquiring about the manager level in the organization hierarchy was added.
Based on this, the population of the study consists of 89 banks and of 74 insurance companies having their main office in Beirut, with the exception of two insurance companies, having their main offices in Tripoli.

All insurance companies had at least ten managers. However, this number varied with the number of line of business in which those companies were involved. But all of them had the following common managers:

1- General manager.
2- Administrative manager.
3- Chief accountant.
4- Agencies superintendent.
5- Policy owner service manager.
6- Underwriting manager.
7- Claims manager.

Banks on the other hand had the following common managers:

1- Chairman
2- Deputy Chairman
3- Personnel Manager
4- Cash Manager
5- Savings Manager
6- Current Account Manager
7- Foreign Exchange Manager
8- Credits Manager
9- Facilities Manager
We aimed at covering the population in those two sectors. Thus we were able to reach sixty insurance companies and seventy-five banks. We distributed at least five questionnaire in each firm.

**Description of the selected variables and their measurement**

In order to collect data a questionnaire which was handed in or mailed was constructed. Our questionnaire was based on J. William Petty and Oswald D. Bowlin (1976) questionnaire and Thad B. Green, Walter B. Newsom and S. Roland Jones (1977) questionnaire. It consisted of five sections in addition to the demographic characteristic section. The first section was designed to highlight the familiarity of the manager with quantitative techniques. It comprised nine major quantitative techniques with extent of familiarity ranging from not at all familiar to very familiar. The second section was a follow up to the first section; whereby, a manager familiar with the quantitative techniques had to indicate his extent of usage of those techniques. It comprised the same nine major quantitative techniques with extent of usage ranging from not at all to very frequent.
The third section consisted of 19 common areas requiring use of quantitative techniques, namely:

1- Capital Expenditure decisions.
2- Lease Vs. Buy
3- Debt Refunding Decisions
4- New Product Decisions
5- Cost of Capital
6- Acquisition analysis
7- Stock Selection Tool
8- Inventory Management
9- Cash Management
10- Capital Budgeting
11- Security & Portfolio Analysis
12- Capital Investment Decisions
13- Working Capital Management
14- Financial Leverage Decisions
15- Profit Planning
16- Financial Budgeting
17- Financing Decisions
18- Dividend Decisions
19- Other Statistical Technique.

Managers had to indicate techniques used in those areas. More than one quantitative technique could be used in the same area. The fourth section consisted of fifteen common barriers the same used by Green, Newsom, and Jones (1977).
Managers had to indicate the degree of the importance of those barriers, from not important to very important.

The fifth section was designed to test the present and future value of quantitative techniques to managers. It consisted of a subjective question; whereby, manager were asked to indicate the benefits they had received from the use of quantitative techniques.

Description of all measures used to collect data

Age is broken into five categories and could be measured by one through five.

Sex is dichotomous binomial variable and could be measured by one or zero otherwise.

Education level will be treated as nominal variable with seven categories for the frequency analysis and it will be broken into two categories for the regression and discriminant analysis.

Years of education and experience will be treated as continuous variable.

The rest will be treated as categorical variable.

The dependent variables Extent of familiarity is made up of 19 items. Each one is measured by five points Likert type scale ranging from "Not at all" to "Very Frequently". Hence each respondent is expected to receive a score ranging between zero and 95 on the extent of familiarity. By the same token the same respondent will receive the same score for the extent of usage.
Frequency analysis is used to indicate in what area the major qualitative techniques are used. For the barriers facing the financial manager in implementing quantitative techniques in decision making the dependent variable is measured by zero to five point scale. Each respondent is expected to receive a score ranging from zero to seventy five. This variable will be analyzed by frequency analysis, elaboration of variable and factor analysis.

**Description of the conceptual framework for analyzing the data**

Since this piece of research is an explanatory one, and since most of the variables are of nominal and interval types, different descriptive and analytical techniques will be used as follows:

First, the percentage and frequency analysis will be used to describe the major characteristics of the Lebanese financial managers.

Second, elaboration of variables (Cross Tabulation using Chi-Square) will be used to test the relation between extent of familiarity or extent of usage for a given quantitative technique and the explanatory variables, i.e the respondents' characteristics.

Third, discriminant function will be used to determine the relative importance of the discriminating variables that differentiate between familiarity or usage and the managers.
CHAPTER IV

Findings of the Study

The findings of the study are presented and discussed herein, under five major sections:

The first section describes the major characteristics of the selected sample.

The second section will try to draw some light on the extent of familiarity and use of quantitative techniques in addition to the particular applications of selected techniques.

The third section analyzes the relationships between "familiarity with quantitative techniques" and an independent variable using chi-square.

The fourth section analyzes the relationships between "extent of use of quantitative technique" and an independent variable using chi-square.

Finally, the fifth section describes the major barriers which are preventing the widespread use of quantitative techniques.
Major characteristics of the selected sample

Based on the selected sample mentioned in chapter III, it was found that only forty six insurance companies and forty five banks out of sixty insurance companies and seventy five banks, responded to our questionnaire. This represents a high ratio; especially, if we know that there is seventy five insurance companies operating in Lebanon according to the (Association des companies d'assurance au Liban) "ACAL", and 109 banks according to the central bank "Banque du Liban". This could be attributed to the nature of the subject which is of high interest to any manager. The selected sample of managers is described according to the following independent variables:

1. Age
2. Sex
3. Educational Level
4. Years of Education.
5. Language Spoken
6. Experience with the present firm
7. Experience with previous firms
8. Line of business.
9. Level in the organization hierarchy.
Table 1 summarizes the above mentioned characteristics of the study.

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AGE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 30</td>
<td>21</td>
<td>23.10</td>
</tr>
<tr>
<td>30 - 40</td>
<td>68</td>
<td>82.70</td>
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<tr>
<td>41 - 50</td>
<td>21</td>
<td>23.10</td>
</tr>
<tr>
<td>51 - 60</td>
<td>1</td>
<td>1.10</td>
</tr>
<tr>
<td><strong>SEX</strong></td>
<td></td>
<td></td>
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<tr>
<td>MALE</td>
<td>78</td>
<td>85.70</td>
</tr>
<tr>
<td>FEMALE</td>
<td>13</td>
<td>14.30</td>
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<td><strong>EDUCATION LEVEL</strong></td>
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<tr>
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<td>4</td>
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<tr>
<td>B.S.</td>
<td>62</td>
<td>82.10</td>
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<td>M.S.</td>
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<td>26.20</td>
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<tr>
<td>Ph.D.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15 YEARS</td>
<td>5</td>
<td>5.50</td>
</tr>
<tr>
<td>18 YEARS</td>
<td>1</td>
<td>1.10</td>
</tr>
<tr>
<td>19 YEARS</td>
<td>12</td>
<td>13.20</td>
</tr>
<tr>
<td>20 YEARS</td>
<td>37</td>
<td>40.70</td>
</tr>
<tr>
<td>21 YEARS</td>
<td>7</td>
<td>7.70</td>
</tr>
<tr>
<td>22 YEARS</td>
<td>8</td>
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</tr>
<tr>
<td>23 YEARS</td>
<td>16</td>
<td>17.60</td>
</tr>
<tr>
<td>24 YEARS</td>
<td>3</td>
<td>3.30</td>
</tr>
<tr>
<td>26 YEARS</td>
<td>1</td>
<td>1.10</td>
</tr>
<tr>
<td>30 YEARS</td>
<td>1</td>
<td>1.10</td>
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<tr>
<td><strong>LANGUAGE SPOKEN</strong></td>
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<td>54.90</td>
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<tr>
<td>FRENCH</td>
<td>2</td>
<td>2.20</td>
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<tr>
<td>BOTH</td>
<td>39</td>
<td>42.90</td>
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<td><strong>ACTUAL EXPERIENCE</strong></td>
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<td>LESS THAN FIVE YEARS</td>
<td>61</td>
<td>67.00</td>
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<tr>
<td>MORE THAN FIVE YEARS</td>
<td>30</td>
<td>33.00</td>
</tr>
<tr>
<td><strong>PREVIOUS EXPERIENCE</strong></td>
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<td></td>
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<tr>
<td>NO EXPERIENCE</td>
<td>81</td>
<td>89.00</td>
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<tr>
<td>LESS THAN FIVE YEARS</td>
<td>8</td>
<td>8.80</td>
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<td>MORE THAN FIVE YEARS</td>
<td>2</td>
<td>2.20</td>
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<td><strong>HIERARCHY</strong></td>
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<td></td>
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<td>FIRST LINE</td>
<td>55</td>
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<td>MIDDLE MANAGEMENT</td>
<td>35</td>
<td>38.50</td>
</tr>
<tr>
<td>TOP MANAGEMENT</td>
<td>1</td>
<td>1.10</td>
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<tr>
<td><strong>BANKING SECTOR</strong></td>
<td>45</td>
<td>51.00</td>
</tr>
<tr>
<td><strong>INSURANCE SECTOR</strong></td>
<td>45</td>
<td>49.00</td>
</tr>
</tbody>
</table>

As could be seen, fifty three percent of managers are between age 30 and 40 with three quarters 75% being below 40 years.
Eighty six percent of the sample are male while only fourteen percent are female. According to the majority of the selected sample 89% hold a university degree, with 68% having a B.S. degree. The years of education of the selected sample has a median of 20 years.

Sixty percent of the managers are first line managers while thirty nine percent are middle managers. First line managers consist mainly of supervisors, and middle managers in most cases are heads of departments.

Ninety eight percent of the managers know English and French, while fifty five percent know English only.

Sixty seven percent of the managers hold a managerial position for at most five years or less and are considered as having low experience. On the other hand, thirty three percent of the managers had a managerial position for at least six years and are considered well experienced, while eighty nine percent of the managers are not having a managerial position in previous firms.

Forty nine percent of the sampled manager belongs to the banking sector while fifty one percent of the managers belong to the insurance sector.

From the above mentioned characteristics the following conclusion could be drawn:
The majority of the managers of this sample are male between 30 years and 40 years old, holding at least a B.S. degree, knowing
at least the English language, and being a first or a middle line manager for at least one year and at most five years of actual and/or previous experience.

The youthfulness and inexperience characteristics found in the majority of the respondents, in the banking and insurance sectors, could be explained by the brain drain our market is suffering from, especially in the last decade, coupled with high turnover that firms are witnessing due to economic problems.

The high ratio of male to female managers, holding a managerial position, reveals some sort of discrimination with regard to females in those two sectors. It could be explained by the fact that managerial positions in Lebanon demand travelling.

Another interesting point, is the fact that the English language is dominating in those two sectors, and this is in conformity with the general trend of the Lebanese business sector. In fact one of the reasons that some questionnaires were returned unfilled is due to the respondents lack of the English language.

Extent of Familiarity, Use and Particular Application of Quantitative Techniques.

Table 2 reveals the survey data related to respondents familiarity with twenty five quantitative techniques.
<table>
<thead>
<tr>
<th>TECHNIQUE</th>
<th>LEVEL 1</th>
<th>LEVEL 2</th>
<th>LEVEL 3</th>
<th>LEVEL 4</th>
<th>LEVEL 5</th>
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<td>30.8</td>
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<td>12.1</td>
<td>39.5</td>
<td>36.3</td>
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<td>c. Capital Asset-Pricing Model</td>
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<td>33.0</td>
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<td></td>
<td>16.5</td>
<td>34.1</td>
<td>29.6</td>
<td>14.3</td>
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<td>UTILITY THEORY</td>
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<td></td>
<td>29.7</td>
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<td>26.4</td>
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<td></td>
<td>28.6</td>
<td>23.1</td>
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<td>MINIMIZATION OF COST FUNCTION</td>
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<td>BY CALCULUS</td>
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<td>19.7</td>
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<td>a. Regression and Correlation</td>
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<td>19.7</td>
<td>38.5</td>
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<tr>
<td>b. Analysis of Variance and Covariance</td>
<td>13.2</td>
<td>16.5</td>
<td>27.5</td>
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<td>c. Discriminant Analysis</td>
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<td>28.0</td>
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<td>d. Recursive Systems</td>
<td>30.2</td>
<td>31.9</td>
<td>6.9</td>
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<td>e. Causal Models</td>
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<td>18.8</td>
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<td>a. Simulation</td>
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<td>d. Markov Analysis</td>
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<td>1.1</td>
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<td>a. Linear Programming</td>
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<td>41.7</td>
<td>25.0</td>
<td>6.8</td>
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<td>b. Non-Linear Programming</td>
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<td>25.3</td>
<td>17.6</td>
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<td>1.1</td>
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<td>c. Goal Programming</td>
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<td>1.1</td>
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<td>d. Integer Programming</td>
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<td>24.2</td>
<td>9.9</td>
<td>4.4</td>
<td>1.1</td>
</tr>
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</table>

1. Unfamiliar  
2. Hardly Familiar  
3. Familiar  
4. More than Familiar  
5. Highly Familiar

With the responses unfamiliar and hardly familiar combined together to reflect unfamiliarity with the techniques, the results show that fifty percent or more of the managers are not at all familiar with seventeen of the twenty-five techniques.
At the other extreme only nine techniques were more and highly familiar to twenty percent or more of the responding institutions. Those ratios represent a somewhat high percentage of unfamiliarity with techniques supposed to be one of the basic tool in those risky sectors, i.e. banking and insurance.

In addition, they draw some question marks on the responsibilities of the Lebanese universities in this regard, since as we mentioned earlier 89% of the sample hold university degrees. They also aim at the educational inadequacy of the human resource in those sectors.

Coming to the extent of use of those techniques, table 3 summarizes the survey findings.
<table>
<thead>
<tr>
<th>TECHNIQUE</th>
<th>EXTENT OF USE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>DISCOUNTED CASH FLOW</td>
<td>23.1</td>
</tr>
<tr>
<td>VALUATION MODELS</td>
<td></td>
</tr>
<tr>
<td>a. Earnings Model</td>
<td>44.0</td>
</tr>
<tr>
<td>b. Dividend Model</td>
<td>38.5</td>
</tr>
<tr>
<td>c. Capital Asset-Pricing Model</td>
<td>70.3</td>
</tr>
<tr>
<td>RISK-RETURN INDIFFERENCE CURVES</td>
<td>71.4</td>
</tr>
<tr>
<td>UTILITY THEORY</td>
<td>87.0</td>
</tr>
<tr>
<td>PORTFOLIO SELECTION THEORY</td>
<td>64.8</td>
</tr>
<tr>
<td>MINIMIZATION OF COST FUNCTION</td>
<td>64.8</td>
</tr>
<tr>
<td>BY CALCULUS</td>
<td></td>
</tr>
<tr>
<td>STATISTICAL TECHNIQUES.</td>
<td></td>
</tr>
<tr>
<td>a. Regression and Correlation</td>
<td>37.4</td>
</tr>
<tr>
<td>b. Analysis of Variance and</td>
<td></td>
</tr>
<tr>
<td>Covariance</td>
<td></td>
</tr>
<tr>
<td>c. Discriminant Analysis</td>
<td>54.9</td>
</tr>
<tr>
<td>d. Recursive Systems</td>
<td>74.7</td>
</tr>
<tr>
<td>e. Causal Models</td>
<td>62.4</td>
</tr>
<tr>
<td>f. Chi Square</td>
<td>81.3</td>
</tr>
<tr>
<td>g. Bayesian Statistics</td>
<td>88.1</td>
</tr>
<tr>
<td>ANALYSIS OF UNCERTAINTY</td>
<td>69.0</td>
</tr>
<tr>
<td>a. Simulation</td>
<td>72.5</td>
</tr>
<tr>
<td>b. Decision Trees</td>
<td>38.5</td>
</tr>
<tr>
<td>c. Equations</td>
<td>44.0</td>
</tr>
<tr>
<td>d. Markov Analysis</td>
<td>92.3</td>
</tr>
<tr>
<td>MATHEMATICAL PROGRAMMING</td>
<td></td>
</tr>
<tr>
<td>a. Linear Programming</td>
<td>49.4</td>
</tr>
<tr>
<td>b. Non-Linear Programming</td>
<td>90.1</td>
</tr>
<tr>
<td>c. Goal Programming</td>
<td>85.7</td>
</tr>
<tr>
<td>d. Integer Programming</td>
<td>80.8</td>
</tr>
<tr>
<td>e. Quadratic Programming</td>
<td>76.7</td>
</tr>
<tr>
<td>f. Dynamic Programming</td>
<td>92.3</td>
</tr>
</tbody>
</table>

1. Not at All  
2. Hardly Ever  
3. Sometimes  
4. Frequently  
5. Very Frequently

Combining not at all usage responses with hardly ever usage responses we find out that twenty of the twenty five listed quantitative techniques are not being used by eighty percent or more of the responding institutions.
At the other extreme, combining sometimes usage responses with very frequent usage responses revealed that only five techniques are being used by twenty four percent or more of the responding institutions. Those are: Discounted cash flow, earning models, dividend models, decision trees, and equations.

Discounted cash flow has the highest percentage of usage, 66% among the sampled firms. This is an interesting percentage since it represents almost double the percentage of the second technique in use. This high ratio could be traced back to the difficult economic situation prevailing in the Lebanese market during the last two decades. Lebanese managers were obliged to be constantly on the alert and to precautiously manage their liquidity in order to face any unexpected high volume of cash retrieval. This situation was of particular interest to the banking sector where shortage of liquidity meant immediate bankruptcy. "Valuation Models" and "Analysis of Uncertainty" come in the second and third place of usage respectively.

As could be noticed the three categories, discounted cash flow, valuation models and analysis of uncertainty, have a common goal among them, which is better management of risk. Still, those ratios indicate that the use of quantitative techniques in the Lebanese banking and insurance sectors are very low and almost not present.

Table 4 compares our results to those of Coocari (1989), Green et. al. (1977), and Petty and Bowlin (1976).
<table>
<thead>
<tr>
<th>Technique</th>
<th>Not at All</th>
<th>Hardly Ever</th>
<th>Sometimes</th>
<th>Frequently</th>
<th>Very Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discounted Cash Flow</strong></td>
<td>22.1%</td>
<td>11.0%</td>
<td>35.2%</td>
<td>29.4%</td>
<td>1.4%</td>
</tr>
<tr>
<td><strong>Valuation Models</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Earnings</td>
<td>44.0%</td>
<td>28.6%</td>
<td>25.2%</td>
<td>1.1%</td>
<td>1.1%</td>
</tr>
<tr>
<td>b. Dividend</td>
<td>36.3%</td>
<td>23.3%</td>
<td>26.6%</td>
<td>4.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>c. Capital Asset-Pricing</td>
<td>70.3%</td>
<td>24.6%</td>
<td>5.3%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Risk-Return Indifference Curves</strong></td>
<td>71.4%</td>
<td>26.4%</td>
<td>2.2%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Utility Theory</strong></td>
<td>78.0%</td>
<td>17.5%</td>
<td>3.3%</td>
<td>1.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Portfolio Selection Theory</strong></td>
<td>64.6%</td>
<td>31.9%</td>
<td>2.2%</td>
<td>1.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Minimiz. of Cost Function by Calculus</strong></td>
<td>64.8%</td>
<td>32.0%</td>
<td>3.3%</td>
<td>2.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Statistical Techniques.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Regression and Correlation</td>
<td>37.4%</td>
<td>14.6%</td>
<td>65.1%</td>
<td>43.0%</td>
<td>18.0%</td>
</tr>
<tr>
<td>b. ANOVA and Covariance</td>
<td>54.6%</td>
<td>26.4%</td>
<td>15.4%</td>
<td>2.2%</td>
<td>4.4%</td>
</tr>
<tr>
<td>c. Discriminant Analysis</td>
<td>74.7%</td>
<td>22.1%</td>
<td>2.2%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>d. Recursive Systems</td>
<td>93.4%</td>
<td>3.3%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>e. Causal Models</td>
<td>81.3%</td>
<td>16.3%</td>
<td>2.2%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>f. Chi Square</td>
<td>68.2%</td>
<td>32.0%</td>
<td>18.0%</td>
<td>6.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>g. Bayesian Statistics</td>
<td>89.0%</td>
<td>74.6%</td>
<td>17.0%</td>
<td>6.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Analysis of Uncertainty</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Simulation</td>
<td>72.5%</td>
<td>32.0%</td>
<td>29.7%</td>
<td>1.1%</td>
<td>2.2%</td>
</tr>
<tr>
<td>b. Decision Trees</td>
<td>38.5%</td>
<td>30.8%</td>
<td>20.8%</td>
<td>8.6%</td>
<td>1.1%</td>
</tr>
<tr>
<td>c. Equations</td>
<td>44.0%</td>
<td>19.4%</td>
<td>19.8%</td>
<td>3.3%</td>
<td>1.1%</td>
</tr>
<tr>
<td>d. Markov Analysis</td>
<td>92.3%</td>
<td>78.0%</td>
<td>1.1%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Mathematical Programming</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Linear Programming</td>
<td>49.4%</td>
<td>27.8%</td>
<td>55.2%</td>
<td>5.8%</td>
<td>6.9%</td>
</tr>
<tr>
<td>b. Non-Linear Programming</td>
<td>90.1%</td>
<td>37.8%</td>
<td>21.0%</td>
<td>5.8%</td>
<td>4.1%</td>
</tr>
<tr>
<td>c. Goal Programming</td>
<td>85.7%</td>
<td>35.7%</td>
<td>7.0%</td>
<td>1.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>d. Integer Programming</td>
<td>80.2%</td>
<td>36.9%</td>
<td>7.0%</td>
<td>4.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>e. Quadratic Programming</td>
<td>94.7%</td>
<td>35.2%</td>
<td>2.2%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>f. Dynamic Programming</td>
<td>92.3%</td>
<td>36.9%</td>
<td>5.3%</td>
<td>1.1%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

: Researcher Findings

: Green, Newman & Jones 1977

: Petty & Bowen 1976

: Coccaro 1989

52
Although all studies tend to have a high percentage of non usage of quantitative techniques, our results are more severe if we take into consideration the difference in time.

Finally, table 5 reveals the result of the third section of our questionnaire whereby managers using quantitative techniques were asked to indicate the area in which those techniques were used.

<table>
<thead>
<tr>
<th>TECHNIQUE</th>
<th>AREA OF USE</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted Cash Flow</td>
<td>Capital Expend. Decis.</td>
<td>27.50%</td>
</tr>
<tr>
<td></td>
<td>Debit Refunding Decis.</td>
<td>26.40%</td>
</tr>
<tr>
<td></td>
<td>New Product Decision</td>
<td>13.20%</td>
</tr>
<tr>
<td></td>
<td>Stock Selection Tool</td>
<td>16.50%</td>
</tr>
<tr>
<td>Valuation Model</td>
<td>Acquisition Analysis</td>
<td>12.10%</td>
</tr>
<tr>
<td></td>
<td>Stock Selection Tool</td>
<td>11.00%</td>
</tr>
<tr>
<td></td>
<td>Dividend Decision</td>
<td>17.60%</td>
</tr>
<tr>
<td>Minimization of Cost Function</td>
<td>Cost of Capital</td>
<td>3.30%</td>
</tr>
<tr>
<td>Utility Theory</td>
<td>Working Capital Mngt.</td>
<td>3.30%</td>
</tr>
<tr>
<td>Analysis of Uncertainty</td>
<td>New Product Decision</td>
<td>19.80%</td>
</tr>
<tr>
<td></td>
<td>Stock Selection Tool</td>
<td>13.20%</td>
</tr>
<tr>
<td></td>
<td>Capital Invest. Decis.</td>
<td>14.30%</td>
</tr>
<tr>
<td></td>
<td>Financial Lever. Mngt.</td>
<td>11.00%</td>
</tr>
<tr>
<td></td>
<td>Profit Planning</td>
<td>23.30%</td>
</tr>
<tr>
<td>Portfolio Selection Theory</td>
<td>Security &amp; Portfolio Anal.</td>
<td>4.40%</td>
</tr>
<tr>
<td>Mathematical Programming</td>
<td>Working Capital Mngt.</td>
<td>5.50%</td>
</tr>
<tr>
<td></td>
<td>Financial Budgeting</td>
<td>5.50%</td>
</tr>
<tr>
<td>Statistical Technique</td>
<td>Capital Invest. Decis.</td>
<td>11.00%</td>
</tr>
<tr>
<td></td>
<td>Financial Lever. Mngt.</td>
<td>9.90%</td>
</tr>
<tr>
<td>Risk Return Indifference Curve</td>
<td>Financial Decision</td>
<td>3.30%</td>
</tr>
</tbody>
</table>

It can be seen out of the nine listed techniques that only four techniques were significantly used. Listed according to the degree of their usage: Discounted cash flow, Analysis of uncertainty, Valuation models, and Statistical techniques.
Analysis of the Relationship Between Familiarity and other Independent Variables.

This study reveals that there are four independent variables which are playing a major role in determining respondents' familiarity with quantitative techniques. Listed by their order of importance, those are:
1. Educational Level, (ten relations).
2. Experience, (four relations).
3. Line of business, (three relations).
4. Level in the organization hierarchy, (two relations).

Educational Level

Inspecting table 6 reveals that level of education plays an important role in determining the familiarity of managers with discounted cash flow techniques.

Table 6
Crosstabulation: Discounted Cash Flow
By X3 Educational Level

<table>
<thead>
<tr>
<th></th>
<th>B.S. &amp; Below</th>
<th>M.S. &amp; Ph.D</th>
<th>Row Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>X9</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>UNFAMILIAR</td>
<td>8</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>10</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>25</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>25</td>
<td>11</td>
<td>36</td>
</tr>
<tr>
<td>HIGHLY FAMILIAR</td>
<td>0</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>68</td>
<td>23</td>
<td>91</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
31.66510 4 0.0000 2.022 3 of 10 (30.0%)
Most of the undergraduates are unfamiliar as compared to the majority of the graduates who are familiar. Almost 83% of the respondents holding an MS or a Ph.D degree are highly familiar with discounted cash flow while only 36.8% of the respondents holding a B.S. degree or less are highly familiar with the technique.

Table 7 re-emphasizes the role that education is playing in determining respondents familiarity with "Capital Asset Pricing Model".

Table 7
Crosstabulation: X12 Capital Asset Pr. Mod.
By X3 Education Level

<table>
<thead>
<tr>
<th>X12</th>
<th>B.S. &amp; BELOW</th>
<th>M.S. &amp; Ph.D</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>X3</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>UNFAMILIAR</td>
<td>1</td>
<td>28 41.20</td>
<td>3 13.00</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>2</td>
<td>27 39.70</td>
<td>3 13.00</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>3</td>
<td>10 14.70</td>
<td>1 8.90</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>4</td>
<td>3 4.40</td>
<td>3 3.00</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>68 74.70</td>
<td>23 25.30</td>
<td>91 100.00</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
23.52885 3 0.0000 1.516 2 OF 8 (25.0%)

61% of the sample holding a graduate degree are familiar with the technique while only 15% of the sample holding a B.S. degree are familiar with the same technique.
Table 8 reveals that 57% of the sample holding an MS or Ph.D degree are highly familiar with "Risk Return Indifference Curve" while only 7.4% of the sample holding undergraduate degree are familiar with the same technique.

Table 8
Crosstabulation: X13 Risk Return Ind. Curve
By X3 Education Level

<table>
<thead>
<tr>
<th>X13</th>
<th>B.S. &amp; BELOW</th>
<th>M.S. &amp; Ph.D</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>UNFAMILIAR</td>
<td>15</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>26</td>
<td>5</td>
<td>31</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>22</td>
<td>5</td>
<td>27</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>5</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>HIGHLY FAMILIAR</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

COLUMN TOTAL
68 23 91

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
30.93339 4 0.0000 1.264 4 OF 10 (40.0%)

Table 9 shows that 39% of the sample respondents holding a graduate degree are highly familiar with "Utility Theory Technique" while only 7.3% of the undergraduate are familiar with the technique.
### Table 9
Crosstabulation: X14 By X3

<table>
<thead>
<tr>
<th>X3</th>
<th>B.S. &amp; BELOW</th>
<th>M.S. &amp; Ph.D</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>TOTAL</td>
</tr>
<tr>
<td>UNFAMILIAR</td>
<td>27</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>39.70</td>
<td>0</td>
<td>29.70</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>22</td>
<td>26</td>
<td>1.40</td>
</tr>
<tr>
<td></td>
<td>32.40</td>
<td>17.40</td>
<td>28.60</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>14</td>
<td>10</td>
<td>43.50</td>
</tr>
<tr>
<td></td>
<td>20.60</td>
<td>26</td>
<td>25.40</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>3</td>
<td>8</td>
<td>34.80</td>
</tr>
<tr>
<td></td>
<td>4.40</td>
<td>12.10</td>
<td></td>
</tr>
<tr>
<td>HIGHLY FAMILIAR</td>
<td>2</td>
<td>3</td>
<td>3.30</td>
</tr>
<tr>
<td></td>
<td>2.90</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>68</td>
<td>23</td>
<td>91</td>
</tr>
<tr>
<td></td>
<td>74.70</td>
<td>25.30</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Chi-Square: 27.1116
D.F.: 4
Significance: 0.0000
Min. E.F.: 0.756
Cells with E.F. < 5: 3 OF 10 (30.0%)

Table 10 reveals that 65% of the graduates are familiar with "Regression Analysis" techniques while only 29.4% of the undergraduates are familiar with the same technique.

### Table 10
Crosstabulation: X17 By X3

<table>
<thead>
<tr>
<th>X3</th>
<th>B.S. &amp; BELOW</th>
<th>M.S. &amp; Ph.D</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>TOTAL</td>
</tr>
<tr>
<td>UNFAMILIAR</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4.40</td>
<td>0</td>
<td>3.30</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>17</td>
<td>18</td>
<td>4.30</td>
</tr>
<tr>
<td></td>
<td>25.00</td>
<td>19.80</td>
<td></td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>20</td>
<td>35</td>
<td>30.40</td>
</tr>
<tr>
<td></td>
<td>41.20</td>
<td>38.50</td>
<td></td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>16</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>23.50</td>
<td>27.50</td>
<td></td>
</tr>
<tr>
<td>HIGHLY FAMILIAR</td>
<td>4</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>5.90</td>
<td>11.00</td>
<td></td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>68</td>
<td>23</td>
<td>91</td>
</tr>
<tr>
<td></td>
<td>74.70</td>
<td>25.30</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Chi-Square: 13.14354
D.F.: 4
Significance: 0.0106
Min. E.F.: 0.756
Cells with E.F. < 5: 4 OF 10 (40.0%)
Table 11 shows that 61% of the graduates are highly familiar with the "Analysis of Variance" technique, while only 36% of the undergraduates are highly familiar with the same technique.

<table>
<thead>
<tr>
<th></th>
<th>B.S. &amp; BELOW</th>
<th>M.S. &amp; Ph.D</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X18</td>
<td>X3</td>
<td>Education Level</td>
</tr>
<tr>
<td>UNFAMILIAR</td>
<td>12 17.60</td>
<td>0</td>
<td>12 13.20</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>14 20.60</td>
<td>1 4.30</td>
<td>15 16.50</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>17 25.00</td>
<td>8 34.80</td>
<td>25 27.50</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>18 26.50</td>
<td>12 52.20</td>
<td>30 33.00</td>
</tr>
<tr>
<td>HIGHLY FAMILIAR</td>
<td>7 10.30</td>
<td>2 8.70</td>
<td>9 9.90</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>68 74.70</td>
<td>23 25.30</td>
<td>91 100.00</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
10.89621 4 0.0278 2.275 3 of 10 (30.0%)

78% of the graduates are familiar with "Chi-square" while only 44% of the undergraduates are familiar with the same technique as depicted in table 12.
### Table 12
Crosstabulation: X22 By X3

<table>
<thead>
<tr>
<th>X22</th>
<th>B.S. &amp; BELOW</th>
<th>M.S. &amp; Ph.D</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>X3</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>UNFAMILIAR</td>
<td>21</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>17</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>23</td>
<td>11</td>
<td>34</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>7</td>
<td>30</td>
<td>37</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>68</td>
<td>23</td>
<td>91</td>
</tr>
</tbody>
</table>

Chi-Square: 11.68646, D.F.: 3, Significance: 0.0085, Min. E.F.: 3.538, Cells with E.F. < 5: 2 of 8 (25.0%)

Table 12 reveals that almost 70% of the graduates are highly familiar with decision trees, while 26% of the undergraduates are highly familiar with the same technique.

### Table 13
Crosstabulation: X25 By X3

<table>
<thead>
<tr>
<th>X25</th>
<th>B.S. DEELOW</th>
<th>M.S. &amp; Ph.D</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>X3</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>UNFAMILIAR</td>
<td>9</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>14</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>27</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>16</td>
<td>6</td>
<td>22</td>
</tr>
<tr>
<td>HIGHLY FAMILIAR</td>
<td>2</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>68</td>
<td>23</td>
<td>91</td>
</tr>
</tbody>
</table>

Chi-Square: 28.06961, D.F.: 4, Significance: 0.0000, Min. E.F.: 2.780, Cells with E.F. < 5: 3 of 10 (30.0%)
Table 14 shows that there is a familiarity gap concerning "Markov Analysis" in both group graduates and undergraduates. However, 17.3% of those holding a graduate degree are familiar with the technique while only 1.5% of the undergraduates are familiar with the same technique.

<table>
<thead>
<tr>
<th></th>
<th>B.S. &amp; BELOW</th>
<th>M.S. &amp; Ph.D</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNFAMILIAR</td>
<td>49</td>
<td>12</td>
<td>61</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>18</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>68</td>
<td>23</td>
<td>91</td>
</tr>
</tbody>
</table>

Chi-Square: 9.30537  D.F.: 3  Significance: 0.0255  Min. E.F.: 0.253  Cells with E.F. < 5: 4 OF 8 (50.0%)

Table 15 reveals that 52.1% of the graduates are highly familiar with "Linear Programming" while only 23.5% of the undergraduates are highly familiar with the same technique.
Finally, those results show the successful role that MS or Ph.D programs are playing in insurance and banking sectors. There is a high percentage of knowledge of the majority of quantitative techniques among graduate managers. However, the survey also reveals the poor standard of the undergraduate respondents who constitute 68% of the sample and who hold managerial positions. It is also indicated that universities as well as big institutions should include those techniques in their programs. Those institutions should make all the necessary effort to fill their managers' gap through training or seminars; otherwise, they would have to confront bad consequences.
Experience

Experience also plays a major role in determining respondents familiarity with quantitative techniques. It has the second position of importance after the educational level if we consider the number of relations in determining respondents familiarity with quantitative techniques.

Table 16 shows that 49.2% of low experienced managers are familiar with "Analysis of Variance" technique, while only 30% of highly experienced managers are familiar with the same techniques.

<table>
<thead>
<tr>
<th>Table 16</th>
<th>Crosstabulation: X18 By X6 Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Experience 1</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>UNFAMILIAR</td>
<td>8</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>5</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>18</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>25</td>
</tr>
<tr>
<td>HIGHLY FAMILIAR</td>
<td>5</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>61</td>
</tr>
</tbody>
</table>

Chi-Square  D.F.  Significance  Min. E.F.  Cells with E.F. < 5
12.13190   4    0.0164     2.967    3 OF 10 (30.0%)
Table 17 reveals that both highly experienced and low experienced managers lack knowledge of "Discriminant Analysis". But 6.6% of the low experienced managers are more than familiar with the technique, while no one of the highly experienced managers are more than familiar with the same technique.

Table 17
Crosstabulation: X19 Discriminant Anal. By X6 Experience

<table>
<thead>
<tr>
<th></th>
<th>X6 LOW EXPERIENCE</th>
<th>X6 HIGH EXPERIENCE</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNFAMILIAR</td>
<td>32 52.50</td>
<td>11 36.70</td>
<td>43 47.30</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>16 26.20</td>
<td>8 26.70</td>
<td>24 25.40</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>9 14.80</td>
<td>11 36.70</td>
<td>20 25.00</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>4 6.60</td>
<td>0 0</td>
<td>4 4.40</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>61 67.00</td>
<td>30 33.30</td>
<td>91 100.00</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
7.42353 3 0.0596 1.319 2 OF 8 (25.0%)

Table 18 also consolidates low experienced managers' position by showing that 44.2% of them are familiar with "Causal Model" while only 13.3% of the highly experienced managers are familiar with the same technique.
### Table 18
Crosstabulation: **X21** by **X6**

<table>
<thead>
<tr>
<th>X21</th>
<th>Low Experience</th>
<th>High Experience</th>
<th>Row Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>16</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>10</td>
<td>28</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61</strong></td>
<td><strong>30</strong></td>
<td><strong>91</strong></td>
</tr>
</tbody>
</table>

Chi-Square: 10.24786
D.F.: 3
Significance: 0.0166
Min. E.F.: 1.319
Cells with E.F. < 5: 2 of 8 (25.0%)

Finally, table 19 reveals that 46% of the low experienced managers are familiar with "Decision Trees", whereas only 20% of the high experienced managers are familiar with the same technique.

### Table 19
Crosstabulation: **X25** by **X6**

<table>
<thead>
<tr>
<th>X25</th>
<th>Low Experience</th>
<th>High Experience</th>
<th>Row Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>22</td>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61</strong></td>
<td><strong>30</strong></td>
<td><strong>91</strong></td>
</tr>
</tbody>
</table>

Chi-Square: 11.73910
D.F.: 4
Significance: 0.0194
Min. E.F.: 3.626
Cells with E.F. < 5: 3 of 10 (30.0%)
Based on previous results, it could be concluded that: Low experienced managers are more familiar with quantitative techniques as compared to highly experienced managers. This is due to the fact that most of the low experienced managers are fresh graduates holding a university degree, and those techniques are relatively newly introduced to the Lebanese universities and business market. In addition, this section shows that there is a negative relationship between familiarity with quantitative techniques and experience. The greater the experience, the lower the familiarity with those techniques. It is obvious that banks and insurance companies are not exerting any effort to help their managers acquire knowledge related to quantitative techniques.

Line of Business

Although both lines belong to the same sector, i.e. they constitute the major part of the Lebanese financial sector, this study reveals that each line has its own point of view with regard to quantitative techniques.

Table 20 reveals that banking institutions in general are slightly more familiar with "Causal Model" than insurance companies.
Table 20  
Crosstabulation: X21 By X7  
Causal Model  
Line of Business  

<table>
<thead>
<tr>
<th>X21</th>
<th>BANK 1</th>
<th>INSURANCE 2</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNFAMILIAR</td>
<td>10</td>
<td>22</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>22.20</td>
<td>47.80</td>
<td>35.20</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>19</td>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>13</td>
<td>14</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>28.90</td>
<td>30.40</td>
<td>29.70</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>6.70</td>
<td>2.20</td>
<td>4.40</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>45</td>
<td>46</td>
<td>91</td>
</tr>
</tbody>
</table>

Chi-Square  D.F.  Significance  Min. E.F.  Cells with E.F. < 5  
9.09857  3  0.0280  1.978  2 OF 8 (25.0%)  

This could be seen by the fact that 35.6% of the respondent in the banking sector are familiar with causal model, whereas only 32.6% of the insurance companies are familiar with the same technique. The relation is not significant at the 1% level.

Table 21 also confirms the difference in knowledge of the banking sector as compared to insurance companies.
Table 21
Crosstabulation: X23 By X7
Bayesian Sts. Line of Business

<table>
<thead>
<tr>
<th>X23</th>
<th>X7</th>
<th>BANK 1</th>
<th>INSURANCE 2</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNFAMILIAR</td>
<td>1</td>
<td>21</td>
<td>30</td>
<td>51</td>
</tr>
<tr>
<td>HARDLY FAMILIAR</td>
<td>2</td>
<td>14</td>
<td>16</td>
<td>30</td>
</tr>
<tr>
<td>FAMILIAR</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>MORE FAMILIAR</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>HIGHLY FAMILIAR</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td></td>
<td>45</td>
<td>46</td>
<td>91</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
11.71199 4 0.0196 0.495 6 of 10 (60.0%) 

22.2% of the banking managers reveal familiarity with "Bayesian Statistics" whereas no one in the insurance companies is familiar with the same technique which is significant at the 5% level.

By the same token, table 22 reaffirms the results of the previous two tables and reveals that 11.1% of the managers in the banking sector are familiar with "Quadratic Programming" whereas no one in the insurance companies ever heard of the technique.
Crosstabulation: Quadratic Programming
By: Line of Business

<table>
<thead>
<tr>
<th>X32</th>
<th>BANK 1</th>
<th>INSURANCE 2</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNFAMILIAR 1</td>
<td>31</td>
<td>29</td>
<td>60</td>
</tr>
<tr>
<td>HARDLY FAMILIAR 2</td>
<td>68.90</td>
<td>63.00</td>
<td>65.90</td>
</tr>
<tr>
<td>FAMILIAR 3</td>
<td>9</td>
<td>17</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>11.10</td>
<td>37.00</td>
<td>28.60</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>45</td>
<td>46</td>
<td>91</td>
</tr>
</tbody>
</table>

Chi-Square: 7.51812  D.F.: 2  Significance: 0.0233  Min. E.F.: 2.473  Cells with E.F. < 5: 2 of 6 (33.3%)

The above results are very interesting and could be explained by the following facts:

In general, banks have a higher turnover than insurance companies. Although this factor will adversely affect this sector in the long run, however it is acting positively with regard to familiarity with the latest techniques in the business world, especially quantitative techniques. The second factor which could explain the difference in familiarity between banks and insurance companies could be attributed to the nature of the product and to the fact that most insurance companies are affiliated to foreign companies. As such, they have to raise any encountered problem to the mother company which is the sole advisor of the action that should be implemented. Since most decisions are taken abroad and since quantitative techniques are
only helping decision aiding tools, this explains why insurance companies are less familiar with techniques, they do not need or have the chance to apply in their work. To their contrary, banks familiarity with those techniques comes out from a need to quantitative techniques, since most decisions in this sector are taken locally.

Level in Organization Hierarchy

Although it was too hard to reach high level managers and to convince them to fill in the questionnaire, the results of the survey are quite interesting and summarized in the following section.

Table 23 reveals that the level in organization plays a major role in determining the managers familiarity with "Dividend Models".
### Table 23
Crosstabulation: X11 By X8 Level in Organiz.

<table>
<thead>
<tr>
<th>X11</th>
<th>FIRST LINE</th>
<th>TOP MANAGEMENT</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>9.10</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>18.20</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>22</td>
<td>40.00</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1½</td>
<td>25.50</td>
<td>1½</td>
</tr>
<tr>
<td>5</td>
<td>2½</td>
<td>7.30</td>
<td>2½</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>60.40</td>
<td>36</td>
</tr>
</tbody>
</table>

Chi-Square: 10.51812  D.F. 4  Significance 0.0280  Min. E.F. 1.978  Cells with E.F. < 5 5 of 10 (50.0%)

55.6% of top managers are more than familiar with dividend models whereas only 32.8% of first line managers are familiar with the same technique.

Another relation was also found between level in organization and "Equation". Table 24 shows that 51% of the first line managers are more than familiar with the technique while only 22.2% of top managers are familiar with equation.
Table 24
Crosstabulation: X26 By X8
Equations Level in Organiz.

<table>
<thead>
<tr>
<th>X26</th>
<th>FIRST LINE 1</th>
<th>TOP MANAGEMENT 2</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNFAMILIAR 1</td>
<td>5 9.10</td>
<td>8 8.30</td>
<td>8 8.80</td>
</tr>
<tr>
<td>HARDLY FAMILIAR 2</td>
<td>5 9.10</td>
<td>8 22.20</td>
<td>13 14.30</td>
</tr>
<tr>
<td>FAMILIAR 3</td>
<td>17 30.90</td>
<td>17 47.20</td>
<td>34 37.40</td>
</tr>
<tr>
<td>MORE FAMILIAR 4</td>
<td>17 30.90</td>
<td>7 19.40</td>
<td>24 26.40</td>
</tr>
<tr>
<td>HIGHLY FAMILIAR 5</td>
<td>11 20.00</td>
<td>1 2.80</td>
<td>12 13.20</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>55 50.40</td>
<td>36 39.60</td>
<td>91 100.00</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
10.16856 4 0.0377 3.165 3 OF 10 (30.0%)

The conclusion that could be drawn from the above two tables is that as managers move up the organization hierarchy, their interest shifts to more sophisticated models. This could also be attributed to the segregation of duties between managers' level.

Analysis of the Relationship Between Use of Quantitative Techniques and other Independent Variables.

The results of the second part of our questionnaire are listed below.

Managers showing familiarity with the above mentioned twenty five quantitative techniques have been asked to mention if they
apply those techniques.

Using crosstabulation technique of the SPSS software, our survey revealed that four independent variables are playing a role in determining managers use of quantitative techniques. Those here-below listed by their order of importance are:

1. Age, five relations.
2. Level in the organization hierarchy, three relations.
3. Line of business and experience, each one relation.

**Age**

As in familiarity with quantitative techniques, age is also playing a major role in determining the use of quantitative techniques by managers.

Table 25 reveals that the younger the manager, the more likely he will use "Minimization of Cost Function" technique.

<table>
<thead>
<tr>
<th>Crosstabulation:</th>
<th>Table 25</th>
<th>Minimi. of Cost Func.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X41 X1</td>
<td>&lt; 30</td>
</tr>
<tr>
<td></td>
<td>By X1 Age</td>
<td></td>
</tr>
<tr>
<td>NOT AT ALL</td>
<td>1</td>
<td>15.40</td>
</tr>
<tr>
<td>HARDLY EVER</td>
<td>2</td>
<td>14.30</td>
</tr>
<tr>
<td>SOMETIMES</td>
<td>3</td>
<td>4.80</td>
</tr>
<tr>
<td>FERQUENTLY</td>
<td>4</td>
<td>9.50</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>21</td>
<td>23.10</td>
</tr>
</tbody>
</table>

Chi-Square: 14.58305  D.F.: 6  Significance: 0.0238  Min. E.F.: 0.462  Cells with E.F. < 5: 6 of 12 (50.0%)
Combining column two and three of the same table with row three and four, we find out that 4.2% of the managers who are at least 30 years old use minimization of cost function, whereas 14.3% of the managers being at most 30 years old use the same technique. The relation is not significant at 5%.

The same results are revealed by table 26 where the use of "Regression Analysis" decreases as age increases.

<table>
<thead>
<tr>
<th></th>
<th>X42</th>
<th>X1</th>
<th>&lt; 30</th>
<th>30-40</th>
<th>&gt; 40</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT AT ALL</td>
<td>1</td>
<td>7</td>
<td>33.30</td>
<td>13</td>
<td>63.60</td>
<td>34</td>
</tr>
<tr>
<td>HARDLY EVER</td>
<td>2</td>
<td>8</td>
<td>38.10</td>
<td>25</td>
<td>6</td>
<td>39</td>
</tr>
<tr>
<td>SOME TIMES</td>
<td>3</td>
<td>6</td>
<td>28.60</td>
<td>10</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>21</td>
<td>23.10</td>
<td>48</td>
<td>20.80</td>
<td>22</td>
<td>91</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
9.94293 4 0.0414 4.154 2 OF 9 (22.2%)

That is 28.6% of the managers being at most 30 years use regression analysis, whereas 20.6% of the managers between age thirty and forty use the technique and only 9.1% of the managers being at least forty years use the same technique.

14.3% of the managers being at most thirty years use "Recursive System" in their decision making, whereas no manager being more than thirty years uses this technique. Those results are depicted in table 27.
Table 27
Crosstabulation: \( X_{45} \) Recursive Sys. By \( x_1 \) Age

<table>
<thead>
<tr>
<th>( x_1 )</th>
<th>(&lt; 30)</th>
<th>(30-40)</th>
<th>( &gt; 40)</th>
<th>Row Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>( X_{45} )</td>
<td>|</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOT AT ALL</td>
<td>1</td>
<td>16</td>
<td>76.20</td>
<td>67</td>
</tr>
<tr>
<td>HARDLY EVER</td>
<td>2</td>
<td>2</td>
<td>9.50</td>
<td>2</td>
</tr>
<tr>
<td>SOMETIMES</td>
<td>3</td>
<td>3</td>
<td>14.30</td>
<td>0</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>21</td>
<td>23.10</td>
<td>52.70</td>
<td>22</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
14.28301 4 0.00064 0.692 6 OF 9 (65.7%)

Table 28 strengthens the above results by showing that 9.5% of the managers being thirty years or less, are using "Causal Model", whereas no manager above thirty year is using the same technique.

Table 28
Crosstabulation: \( X_{46} \) Causal Model By \( x_1 \) Age

<table>
<thead>
<tr>
<th>( x_1 )</th>
<th>(&lt; 30)</th>
<th>(30-40)</th>
<th>( &gt; 40)</th>
<th>Row Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>( X_{46} )</td>
<td>|</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOT AT ALL</td>
<td>1</td>
<td>13</td>
<td>61.90</td>
<td>39</td>
</tr>
<tr>
<td>HARDLY EVER</td>
<td>2</td>
<td>6</td>
<td>28.60</td>
<td>9</td>
</tr>
<tr>
<td>SOMETIMES</td>
<td>3</td>
<td>3</td>
<td>9.50</td>
<td>0</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>21</td>
<td>23.10</td>
<td>48.70</td>
<td>22</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
14.22168 4 0.0066 0.462 5 OF 9 (55.6%)

Age also is a major determinant of managers using "Linear Programming". Table 29 reveals that the use of linear

74
programming by managers decreases at an increasing rate when the age of managers increases.

### Table 29

<table>
<thead>
<tr>
<th>X53</th>
<th>&lt; 30</th>
<th>30-40</th>
<th>&gt; 40</th>
<th>Row Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOT AT ALL</td>
<td>10</td>
<td>18</td>
<td>17</td>
<td>45</td>
</tr>
<tr>
<td>HARDLY EVER</td>
<td>6</td>
<td>22</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>SOMETIMES</td>
<td>4</td>
<td>8</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>VERY FREQUENTLY</td>
<td>19.00</td>
<td>16.70</td>
<td>1</td>
<td>1.10</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>21</td>
<td>48</td>
<td>22</td>
<td>91</td>
</tr>
</tbody>
</table>

Chi-Square: 13.78012   D.F.: 6   Significance: 0.0322   Min. E.F.: 0.231   Cells with E.F. < 5: 5 out of 12 (41.7%) 

From the above five relations, the following conclusion could be drawn: The larger percentage use of quantitative techniques among young managers as compared to senior managers could be traced to the fact that the former are new graduates, and as such have a better opportunity to study a subject, relatively newly introduced at universities. In addition, the above results show that young managers try to base their decision on rational techniques, whereas senior managers base their decision on intuition.

Level in Organization Hierarchy. The results of our survey reveal that the level in organization hierarchy plays a small role in determining
extensive use of quantitative techniques.

The results show that both, first line and top managers, have an inclination for not using quantitative techniques. However, there is some sort of difference between first line and top manager like the one shown in table 30, where we can clearly see that first line managers have more inclination toward using "Causal Model" technique.

<table>
<thead>
<tr>
<th>Table 30</th>
<th>Crosstabulation: X46 By X8</th>
<th>Causal Model Level in Organiz.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FIRST LINE 1</td>
<td>TOP MANAGEMENT 2</td>
</tr>
<tr>
<td>X46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOT AT ALL</td>
<td>1</td>
<td>39</td>
</tr>
<tr>
<td>HARDLY EVER</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>SOMETIMES</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>55</td>
<td>36</td>
</tr>
</tbody>
</table>

Chi-Square 11.7619 2 D.F. 0.0028 Significance 0.791 Min. E.F. 2 of 6 (33.3%) Cells with E.F. < 5 70.9% of them never use the technique, whereas 97.2% of top management never use the same technique.

Table 31 goes along the previous results and shows that 41.8% of first line managers hardly ever use "Chi square", while 58.2% of them never use the technique.
Table 31  
Crosstabulation: X47 By X8  
Chi Square Level in Organiz.

<table>
<thead>
<tr>
<th>X47</th>
<th>FIRST LINE 1</th>
<th>TOP MANAGEMENT 2</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT AT ALL 1</td>
<td>32</td>
<td>56.20</td>
<td>30</td>
</tr>
<tr>
<td>HARDLY EVER 2</td>
<td>23</td>
<td>41.80</td>
<td>5</td>
</tr>
<tr>
<td>SOMETIMES 3</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>55</td>
<td>60.40</td>
<td>36</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
9.06405 2 0.0108 0.396 2 OF 6 (33.3%)

However, only 13.9% of top managers hardly ever use the technique with the majority 83.3% not using chi square at all.

Finally, table 32 reveals that 18.2% of first line managers sometimes use linear programming whereas only 8.3% of top managers sometimes use the same technique.

Table 32  
Crosstabulation: X53 By X8  
Linear Programming Level in Organiz.

<table>
<thead>
<tr>
<th>X53</th>
<th>FIRST LINE 1</th>
<th>TOP MANAGEMENT 2</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT AT ALL 1</td>
<td>19</td>
<td>34.50</td>
<td>26</td>
</tr>
<tr>
<td>HARDLY EVER 2</td>
<td>25</td>
<td>45.50</td>
<td>7</td>
</tr>
<tr>
<td>SOMETIMES 3</td>
<td>10</td>
<td>18.20</td>
<td>3</td>
</tr>
<tr>
<td>VERY FREQUENTLY 5</td>
<td>1</td>
<td>1.80</td>
<td>0</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>55</td>
<td>60.40</td>
<td>36</td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
12.56379 3 0.0057 0.396 2 OF 8 (25.0%)
This table also shows that only 34.5% of first line managers don't use the technique as compared to 72.2% of top management who never use linear programming.

The above results depict the following:

Most of the managers don't use quantitative techniques, but as they move up the organization hierarchy, their tendency for not using those techniques increases. This could be attributed to the fact that although decisions in most instances are taken at top management level, top managers in most cases do not themselves prepare the reports on which decision should be based. But they delegate this task to lower level managers on whom lie the responsibilities of preparing such reports. In addition, the majority of first line managers are new graduates who had a better opportunity to study quantitative techniques.

Extent of Use Based on Line of Business and Experience.

Although line of business and experience plays a little role in determining managers' use of quantitative techniques, both cases confirm the conclusion we arrived at in the previous section.
Table 33 reveals that banks differ a little bit from insurance companies in using "Discriminant Analysis".

<table>
<thead>
<tr>
<th>X44</th>
<th>X7</th>
<th>BANK 1</th>
<th>INSURANCE 2</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT AT ALL</td>
<td>1</td>
<td>29</td>
<td>84.80</td>
<td>68</td>
</tr>
<tr>
<td>HARDLY EVER</td>
<td>2</td>
<td>14</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>SOMETIMES</td>
<td>3</td>
<td>2</td>
<td>2.20</td>
<td>2</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>45</td>
<td>46</td>
<td>91</td>
<td></td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
5.79363 2 0.0552 0.989 2 OF 6 (33.3%)
Only 4.4% of the bank managers sometimes use discriminant analysis.

Table 34 on the other hand, shows that 3.3% of the low experienced managers sometimes use "Causal Model".

<table>
<thead>
<tr>
<th>X46</th>
<th>X6</th>
<th>LOW EXPERIENCE 1</th>
<th>HIGH EXPERIENCE 2</th>
<th>ROW TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT AT ALL</td>
<td>1</td>
<td>45</td>
<td>29</td>
<td>74</td>
</tr>
<tr>
<td>HARDLY EVER</td>
<td>2</td>
<td>14</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>SOMETIMES</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>COLUMN TOTAL</td>
<td>61</td>
<td>30</td>
<td>91</td>
<td></td>
</tr>
</tbody>
</table>

Chi-Square D.F. Significance Min. E.F. Cells with E.F. < 5
6.97514 2 0.0306 0.659 3 OF 6 (50.0%)
As we have said previously, the results of those two tables confirm our previous conclusion. Banks may have more need to quantitative techniques, since they are operating in a very risky environment and most of their decisions are taken locally. To their contrary, the nature of insurance companies products which risk is pre-assessed and standardized according to client risk, in addition to the fact that most of them are affiliated to an outside mother company, make them in no need for using quantitative techniques. Increased use of quantitative techniques by low experienced managers could be explained by the fact that those low experienced managers had a better chance to be exposed to those techniques, since the subject has been relatively newly introduced to Lebanese universities.

Barriers preventing use of quantitative techniques

This section intends to explain the barriers which are preventing managers from using quantitative techniques. The same fifteen barriers analyzed by Green, Newsom and Jones (1977), were included in our questionnaire to be tested on Lebanese managers.
The result of our survey are depicted in table 35.

<table>
<thead>
<tr>
<th>BARRIER</th>
<th>MEAN</th>
<th>RANK</th>
<th>FACT.1</th>
<th>FACT.2</th>
<th>FACT.3</th>
<th>FACT.4</th>
<th>FACT.5</th>
<th>FACT.6</th>
<th>FACT.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MANAGER LACK KNOWLEDGE OF QUANTITATIVE TECHNIQUES</td>
<td>4.11</td>
<td>2</td>
<td>-.09</td>
<td>-.10</td>
<td>-.11</td>
<td>.86</td>
<td>-.01</td>
<td>.04</td>
<td>.68</td>
</tr>
<tr>
<td>2. MANAGERS ARE NOT QUANTITATIVELY ORIENTED</td>
<td>3.54</td>
<td>8</td>
<td>-.10</td>
<td>-.14</td>
<td>-.10</td>
<td>-.09</td>
<td>.20</td>
<td>-.03</td>
<td>.71</td>
</tr>
<tr>
<td>3. BENEFITS OF USING TECHNIQUES ARE NOT CLEARLY UNDERSTOOD BY MANAGERS</td>
<td>4.10</td>
<td>3</td>
<td>-.23</td>
<td>-.25</td>
<td>.18</td>
<td>.27</td>
<td>.32</td>
<td>-.21</td>
<td></td>
</tr>
<tr>
<td>4. MANAGERS ARE UNWILLING OR UNABLE TO USE THE COMPUTER FOR DECISION MAKING AND/OR COMPUTERS ARE NOT AVAILABLE</td>
<td>2.51</td>
<td>12</td>
<td>.15</td>
<td>.17</td>
<td>.13</td>
<td>.24</td>
<td>-.33</td>
<td>-.05</td>
<td>.68</td>
</tr>
<tr>
<td>5. MANAGERS ARE NOT EXPOSED TO QUANTITATIVE TECHNIQUES EARLY IN THEIR TRAINING</td>
<td>3.73</td>
<td>6</td>
<td>-.09</td>
<td>.06</td>
<td>.02</td>
<td>-.02</td>
<td>.91</td>
<td>-.01</td>
<td>.01</td>
</tr>
<tr>
<td>6. MANAGEMENT IS SUCCESSFUL WITHOUT USING TECHNIQUES</td>
<td>2.68</td>
<td>12</td>
<td>.66</td>
<td>.19</td>
<td>-.23</td>
<td>.26</td>
<td>.11</td>
<td>-.03</td>
<td>.22</td>
</tr>
<tr>
<td>7. MANAGERS IN KEY POSITIONS LACK KNOWLEDGE OF QUANTITATIVE TECH.</td>
<td>3.37</td>
<td>9</td>
<td>.21</td>
<td>-.01</td>
<td>.24</td>
<td>.22</td>
<td>.34</td>
<td>.02</td>
<td>.42</td>
</tr>
<tr>
<td>8. ONLY SMALL PORTION OF MANAGEMENT IS TRAINED IN THE USE OF QUANTITATIVE TECHNIQUES</td>
<td>3.26</td>
<td>10</td>
<td>.24</td>
<td>.02</td>
<td>.06</td>
<td>-.30</td>
<td>-.16</td>
<td>-.02</td>
<td>-.04</td>
</tr>
<tr>
<td>9. SENIOR MANAGEMENT PERSONNEL DO NOT ENCOURAGE USE OF TECHNIQUES BY YOUNGER MANAGEMENT PERSONNEL</td>
<td>3.71</td>
<td>7</td>
<td>-.20</td>
<td>.19</td>
<td>.83</td>
<td>-.11</td>
<td>.02</td>
<td>-.01</td>
<td>-.01</td>
</tr>
<tr>
<td>10. REQUIRED DATA ARE DIFFICULT TO QUANTIFY</td>
<td>3.31</td>
<td>4</td>
<td>.19</td>
<td>-.36</td>
<td>-.14</td>
<td>-.40</td>
<td>.02</td>
<td>.48</td>
<td>.23</td>
</tr>
<tr>
<td>11. THE COST OF DEVELOPING MODELS AND USING TECHNIQUES IS TOO HIGH</td>
<td>3.39</td>
<td>14</td>
<td>.27</td>
<td>.64</td>
<td>-.14</td>
<td>-.14</td>
<td>.23</td>
<td>-.27</td>
<td>.03</td>
</tr>
<tr>
<td>12. MANAGEMENT DISTRACTS OR FEARS THE USE OF TECHNIQUES ARE NOT AVAILABLE</td>
<td>2.00</td>
<td>15</td>
<td>.03</td>
<td>.72</td>
<td>.08</td>
<td>.14</td>
<td>-.08</td>
<td>.08</td>
<td>-.19</td>
</tr>
<tr>
<td>13. THE DATA REQUIRED IN USING THE TECHNIQUES ARE NOT AVAILABLE</td>
<td>4.14</td>
<td>1</td>
<td>.03</td>
<td>-.13</td>
<td>.05</td>
<td>-.07</td>
<td>.01</td>
<td>-.87</td>
<td>.07</td>
</tr>
<tr>
<td>14. THE EXPENSE OF EMPLOYING QUANTITATIVE SPECIALISTS IS TOO GREAT</td>
<td>2.76</td>
<td>11</td>
<td>-.12</td>
<td>.65</td>
<td>.05</td>
<td>-.23</td>
<td>-.04</td>
<td>.19</td>
<td>.26</td>
</tr>
<tr>
<td>15. RECENT COLLEGE GRADUATES WITH QUANTITATIVE TRAINING HAVE NOT YET ATTAINED POSITIONS OF INFLUENCE</td>
<td>3.81</td>
<td>4</td>
<td>.32</td>
<td>.26</td>
<td>.82</td>
<td>-.01</td>
<td>-.01</td>
<td>-.11</td>
<td>.03</td>
</tr>
</tbody>
</table>
This table presents the fifteen barriers as they appeared in our questionnaire with their respective mean and rank listed in column two and three. Respondent had to rate each barrier on a five point likert scale. The mean of the barriers of our survey ranked from 4.143 to two. The most important barriers is unavailability of data and the least important is "Management distrusts or fears the use of techniques are not available".

Three independent variables are playing an important role although at different degree in determining managers perceived importance of the fifteen barriers. Experience and age have the highest degree of importance with three relationships, followed by education with one relation. SPSS software was used to conduct a factor analysis in order to see if relation exists between the barriers. This resulted in seven distinct factors, as compared to the four factors of Green et al.1977, as follows: Factor one, consisting of barriers number six and eight, and could be labeled as managers are satisfied without being trained in quantitative techniques. Factor two, consisting of barriers number eleven, twelve and fourteen, could be labeled high cost in using the techniques. Factor three, consisting of barriers number nine and fifteen, could be labeled as lack of influence of junior managers. Factor four, consisting of barrier number one, could be labeled as lack of knowledge of quantitative techniques.
Factor five, consisting of barrier number five, could be labeled as lack of training.

Factor six, consisting of barrier number thirteen, could be labeled as difficulty to quantify data.

Factor seven, consisting of barriers number two and four, could be labeled as resistance to change.

This study has the following common point with Green, Newsom, and Jones (1977) study:

Factor one in this study is very close to factor two in Green et al. study. Barrier eight is common between them, however this study stresses more the fact that manager can succeed without those techniques. On the other hand, factor two could be compared to factor three in Green et al. study. It includes nearly the same barriers, number eleven and fourteen, with the exception of number twelve which could be explained by the difference in cultures and educational level.

Finally, factor four and factor five could be compared to a certain extent to factor one of Green et al. study.

They all aim to the fact that managers lack knowledge of quantitative techniques coming either from lack of education or due to lack of training.

Experience

As the results of the survey shows, managers experience plays also a role in determining managers point of views about some barriers.
Table 36 reveals that "The expense of employing quantitative specialists is too great", is equally seen as important barrier by low and high experienced managers.

<table>
<thead>
<tr>
<th>Crosstabulation: X72 by X6</th>
<th>Speci. Expense High Experience</th>
<th>LOW EXPERIENCE 1</th>
<th>HIGH EXPERIENCE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT IMPORTANT 1</td>
<td></td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>LITTLE IMPORTANT 2</td>
<td></td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>MODERATE IMPORTANT 3</td>
<td></td>
<td>32</td>
<td>12</td>
</tr>
<tr>
<td>IMPORTANT 4</td>
<td></td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>VERY IMPORTANT 5</td>
<td></td>
<td>1</td>
<td>1.30</td>
</tr>
</tbody>
</table>

Chi-Square 13.52796  D.F. 4  Significance 0.0090  Min. E.F. 0.659  Cells with E.F. < 5 5 of 10 (50.0%)

20% of the later see this barrier as not important, whereas no low experienced managers consider the same barrier as not important.

As to barrier "Managers are not exposed to quantitative techniques early in their training", table 37 shows that if we combine row four and five, 80% of the high experienced managers consider this barrier as important whereas only 54% of low experienced managers consider this variable as important.
### Table 37
Crosstabulation: \( X_{63} \) Unexposed To Q.T. Experience

<table>
<thead>
<tr>
<th>( X_{63} )</th>
<th>LOW EXPERIENCE 1</th>
<th>HIGH EXPERIENCE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT IMPORTANT 1</td>
<td>11 18.00</td>
<td>0 0</td>
</tr>
<tr>
<td>MODERATE IMPORT. 2</td>
<td>17 27.90</td>
<td>6 20.00</td>
</tr>
<tr>
<td>IMPORTANT 3</td>
<td>33 54.10</td>
<td>2 80.00</td>
</tr>
</tbody>
</table>

**Chi-Square** 8.05642  
**D.F.** 2  
**Significance** 0.0178  
**Min. E.F.** 3.626  
**Cells with E.F. < 5** 1 OF 6 (16.7%)  

Finally, table 38 shows that 26.6% of high experienced managers consider barrier "Management is successful without using techniques", whereas 14.8% of low experienced managers consider the same barrier as important.

### Table 38
Crosstabulation: \( X_{64} \) Mgr. Success Without Q.T. Experience

<table>
<thead>
<tr>
<th>( X_{64} )</th>
<th>LOW EXPERIENCE 1</th>
<th>HIGH EXPERIENCE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT IMPORTANT 1</td>
<td>12 19.70</td>
<td>0 0</td>
</tr>
<tr>
<td>LITTLE IMPORT. 2</td>
<td>16 26.20</td>
<td>7 23.30</td>
</tr>
<tr>
<td>MODERATE IMPORT. 3</td>
<td>24 39.30</td>
<td>15 50.00</td>
</tr>
<tr>
<td>IMPORTANT 4</td>
<td>9 14.80</td>
<td>7 23.30</td>
</tr>
<tr>
<td>VERY IMPORTANT 5</td>
<td>0 0</td>
<td>1 3.30</td>
</tr>
</tbody>
</table>

**Chi-Square** 9.37634  
**D.F.** 4  
**Significance** 0.0524  
**Min. E.F.** 0.330  
**Cells with E.F. < 5** 3 OF 10 (30.0%)  

85
In addition 19.7% of them consider this barrier as not important, while no high experienced managers see the same barrier as not important.

From the above results we can conclude that as managers acquire experience, their point of view becomes more clear vis-a-vis the barriers which could prevent their use of quantitative techniques.

Age

Table 39 reveals the results of our survey with respect to the relationship between age and barrier "Managers are not quantitatively oriented".

<table>
<thead>
<tr>
<th>Crosstabulation:</th>
<th>X60</th>
<th>Mgr. Not Quant. Oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X1</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>X60</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NOT IMPORTANT</td>
<td>23.80</td>
<td>0</td>
</tr>
<tr>
<td>MODERATE IMPORT.</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>IMPORTANT</td>
<td>3</td>
<td>28</td>
</tr>
</tbody>
</table>

Chi-Square
D.F.  Significance Min. E.F.  Cells with E.F. < 5
14.61421  4  0.0056  1.395  3 OF 9 (33.3%)  
We can clearly see from the third row that the importance of this barrier increases at an increasing rate when age increases.
This finding is further confirmed in table 40, whereby combining row three and four, we can see that the importance of barrier "Senior management personnel does not encourage use of techniques by younger management personnel", increases at an increasing rate when age increases.

<table>
<thead>
<tr>
<th>X67</th>
<th>X1</th>
<th>&lt; 30</th>
<th>30-40</th>
<th>&gt; 40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>NOT AT ALL</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1.10</td>
</tr>
<tr>
<td>LITTLE IMPORTANT</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2.20</td>
</tr>
<tr>
<td>MODERATE IMPORT.</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>4.00</td>
</tr>
<tr>
<td>IMPORTANT</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>6.30</td>
</tr>
<tr>
<td>VERY IMPORTANT</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>4.20</td>
</tr>
</tbody>
</table>

Chi-Square 17.47995  D.F. 8  Significance 0.0255  Min. E.F. 0.462  Cells with E.F. < 5 8 OF 15 (53.3%)

Finally table 41 also reveals that as manager age increases the importance of barrier "The expense of employing quantitative specialists is too great" also increases.
The following could be concluded from the last three tables: Managers at all age agree on the importance of the above mentioned barriers, however their importance increases with seniority. This could be attributed to the fact that senior managers have more experience than younger managers.

It is experience which is making senior managers answer more decisively than their counterparts.

**Education Level**

Our survey reveals that education has a role in determining barriers that prevent managers from using quantitative techniques.
Table 42 shows that 69.6% of the managers holding an M.S or a Ph.D degree see that "Managers are not quantitatively oriented", is a very important barrier, while only 50% of the managers holding a B.S. degree or less, consider the same barrier as important.

<table>
<thead>
<tr>
<th>Crosstabulation:</th>
<th>X60</th>
<th>Not Quant. Oriented</th>
<th>By X3</th>
<th>Education Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X60</td>
<td>B.S. &amp; BELOW</td>
<td>M.S. &amp; Ph.D</td>
<td></td>
</tr>
<tr>
<td>NOT IMPORTANT</td>
<td>1</td>
<td>2.90</td>
<td>2.70</td>
<td></td>
</tr>
<tr>
<td>LITTLE IMPORT.</td>
<td>2</td>
<td>2.90</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>MODERATE IMP.</td>
<td>3</td>
<td>44.10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>IMPORTANT</td>
<td>4</td>
<td>45.60</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>VERY IMPORTANT</td>
<td>5</td>
<td>4.60</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chi-Square</th>
<th>D.F.</th>
<th>Significance</th>
<th>Min. E.F.</th>
<th>Cells with E.F. &lt; .5</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.39038</td>
<td>4</td>
<td>0.0147</td>
<td>0.505</td>
<td>5 of 10 (50.0%)</td>
</tr>
</tbody>
</table>

The results of this section could be summarized in the following:

Senior managers having high experience and holding an M.S or a Ph.D degree are more pessimistic than their counterpart in stating the importance of the barriers.
CHAPTER V

Summary and Conclusions

This survey clearly points out to the fact that the majority of the Lebanese managers working in the banking and insurance sectors, do not use most of the available quantitative techniques. Hasn't it been for "discounted cash flow" and "decision tree", there wouldn't be any trace of quantitative techniques, in the decision making of the above mentioned managers. Those results are very troubling. They reflect the answers of two major financial sectors, having a high percentage of university graduates, and in which quantitative techniques are supposed to be one of their basic tools.

It has been noticed also, that seniority is playing a negative role vis a vis the use of quantitative techniques by those managers. Most of the middle managers attained their positions through seniority and not due to their educational level or due to merit. Most of them ignore how to apply those techniques. They are using their influence in order to prevent their use by lower level managers. This does not mean that middle management does not include educated people. However, the domination of seniority in the middle and upper level management, makes it very difficult to their educated counterpart even to initiate some change by introducing quantitative techniques.
This research found also that the most important barrier preventing the use of quantitative techniques, is due to the unavailability of data. To the contrary of most advanced countries, Lebanon lacks institutions concerned with collecting data, and making it available for a certain fee. In addition, the Lebanese market lacks a centralized computer network, whereby external data could be made available on an on-line basis. On the other hand, most of the Lebanese institutions are unable to handle properly their internal data, since they lack specialists who can adequately do this job.

From the above factors, it can be concluded that the low usage of quantitative techniques by the surveyed institutions, could be traced back to the fact that the Lebanese market does not provide quantitative techniques with their basic foundations.

Another important barrier is the fact that most managers lack knowledge of quantitative techniques, coming either from lack of education or from lack of training. This is a very negative sign since it clearly reflects the unhealthy environment in which those sectors are operating.

Finally, the future of quantitative techniques in Lebanon is quite unclear. Although most of the sampled managers are not using those techniques, however most of them recognize their superiority in giving more systematic and clear picture about any decision. Time will improve the situation to a certain extent.
In the future the class of uneducated senior management will be retired and a new blood will take over represented by younger educated managers who are better prepared to accept and apply quantitative techniques. However, this new class will still lack training in the application of quantitative techniques or at the time it will replace the old class it will have forgotten most of the learned techniques.

Implications

This study has been able to draw some lights on one of the major deficiencies of the Lebanese market which could be summarized by the fact that there is a rare trace of scientific techniques in the basis of the Lebanese managers' decisions. Most of them base their decision on intuition. It has been noticed that most managers are unable to cope with the prevailing risks of the market.

Although the market is witnessing a stagflation and a severe fluctuation of foreign currencies from almost a decade now, it is found that managers are unable to access this risk or even to cope with this problem. The solution could be found in quantitative techniques, like regression analysis or decision trees.

The majority of the sampled institutions are not benefiting from the revenues that quantitative techniques could provide.
That is decreasing cost and increasing revenues by providing a mean to better allocation of resources, better investments, and more adequate feasibility studies.

In addition, it has been found out that little effort is made from managers and universities to bridge the communication gap that exists between them and to which Grayson in 1973 aimed at for the first time. Managers are still reluctant in using those techniques and universities are not making any effort to respond to the market need.

**Recommendations**

This study found little use of quantitative techniques in the banking and insurance sectors, however more studies are still needed in order to depict their application in other sectors of the economy and to follow up their improvement especially with the widespread of computerization.

Universities and managers should coordinate their efforts toward a common goal. Universities should emphasize real world applications. Their academic programs should aim at satisfying the needs of the Lebanese managers and to respond to the local market need. In other words, they should not continue blindly teaching imported techniques without making any effort to see the results of those techniques in the real world.
Firms, on the other hand, should conduct seminars to their managers in quantitative techniques in order to improve their level. Personnel departments have a very important role to play. They should have a better communication with universities in order to make them aware of their needs.

Government should either encourage private sector to build a computer communication network, or to undertake this project on its own. This fact will facilitate the availability of external data to private organizations.

Lebanese firms should seriously think in improving their business level by using quantitative techniques in order to be able to compete with foreign firms who are re-opening in Lebanon. Otherwise, foreign firms based on technologies and scientific tools will be able to surpass our firms and to undertake all the high yielding projects.
APPENDIX A

A

SAMPLE

QUESTIONNAIRE
Demographic Characteristics

1 - Age :

________________ 1) Below 30
________________ 2) 31 To 40
________________ 3) 41 To 50
________________ 4) 51 To 60
________________ 5) Above 60

2 - Sex :

________________ Male
________________ Female

3 - Education Level:

________________ 1) Less than high School
________________ 2) High School
________________ 3) Former College Student
________________ 4) Bachelor degree
________________ 5) M.S. Degree
________________ 6) Ph.D.
________________ 7) Others (please specify):

4 - Years of Education: ____________

5 - Language spoken : English —

French —

Both —

________________ For the present firm :

6 - For how long have you been manager?<

________________ For previous firms :

7 - What is your line of business? __________________________

________________ First Line Manager: —

________________ Middle Manager : —

________________ Top Manager : —

________________ Other: ____________________


I. This section is designed to highlight your familiarity with the quantitative approach in decision making. Please answer by crossing the appropriate box.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Extent of Familiarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted cash flow</td>
<td></td>
</tr>
<tr>
<td>Valuation Models</td>
<td></td>
</tr>
<tr>
<td>a. Earnings Model</td>
<td></td>
</tr>
<tr>
<td>b. Dividend Model</td>
<td></td>
</tr>
<tr>
<td>c. Capital Asset-Pricing Model</td>
<td></td>
</tr>
<tr>
<td>Risk-Return Indifference Curves</td>
<td></td>
</tr>
<tr>
<td>Utility Theory</td>
<td></td>
</tr>
<tr>
<td>Portfolio Selection Theory</td>
<td></td>
</tr>
<tr>
<td>Minimization of Cost Function by Calculus</td>
<td></td>
</tr>
<tr>
<td>Statistical Techniques.</td>
<td></td>
</tr>
<tr>
<td>a. Regression and correlation.</td>
<td></td>
</tr>
<tr>
<td>b. Analysis of variance and covariance.</td>
<td></td>
</tr>
<tr>
<td>c. Discriminant Analysis.</td>
<td></td>
</tr>
<tr>
<td>d. Recursive Systems.</td>
<td></td>
</tr>
<tr>
<td>e. Causal Models</td>
<td></td>
</tr>
<tr>
<td>f. Chi Square</td>
<td></td>
</tr>
<tr>
<td>g. Bayesian Statistics.</td>
<td></td>
</tr>
<tr>
<td>Analysis of Uncertainty.</td>
<td></td>
</tr>
<tr>
<td>a. Simulation</td>
<td></td>
</tr>
<tr>
<td>b. Decision Trees</td>
<td></td>
</tr>
<tr>
<td>c. Equations</td>
<td></td>
</tr>
<tr>
<td>d. Markov Analysis</td>
<td></td>
</tr>
<tr>
<td>Mathematical Programming</td>
<td></td>
</tr>
<tr>
<td>a. Linear Programming</td>
<td></td>
</tr>
<tr>
<td>b. Non-linear programming.</td>
<td></td>
</tr>
<tr>
<td>c. Goal Programming</td>
<td></td>
</tr>
<tr>
<td>d. Integer Programming</td>
<td></td>
</tr>
<tr>
<td>e. Quadratic Programming</td>
<td></td>
</tr>
<tr>
<td>f. Dynamic Programming</td>
<td></td>
</tr>
</tbody>
</table>

1. Unfamiliar
2. Hardly Familiar
3. Familiar
4. More Familiar
5. Highly Familiar
II. If you are familiar with the below mentioned techniques please indicate the extent to which you are using them.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Extent of Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discounted cash flow</td>
<td>1</td>
</tr>
<tr>
<td>Valuation Models</td>
<td></td>
</tr>
<tr>
<td>a. Earnings Model</td>
<td></td>
</tr>
<tr>
<td>b. Dividend Model</td>
<td></td>
</tr>
<tr>
<td>c. Capital Asset-Pricing Model</td>
<td></td>
</tr>
<tr>
<td>Risk-Return Indifference Curves</td>
<td></td>
</tr>
<tr>
<td>Utility Theory</td>
<td></td>
</tr>
<tr>
<td>Portfolio Selection Theory</td>
<td></td>
</tr>
<tr>
<td>Minimization of Cost Function by Calculus</td>
<td></td>
</tr>
<tr>
<td>a. Regression and correlation.</td>
<td></td>
</tr>
<tr>
<td>b. Analysis of variance and covariance.</td>
<td></td>
</tr>
<tr>
<td>c. Discriminant Analysis.</td>
<td></td>
</tr>
<tr>
<td>d. Recursive Systems.</td>
<td></td>
</tr>
<tr>
<td>e. Causal Models.</td>
<td></td>
</tr>
<tr>
<td>f. Chi Square.</td>
<td></td>
</tr>
<tr>
<td>g. Bayesian Statistics.</td>
<td></td>
</tr>
<tr>
<td>Statistical Techniques.</td>
<td></td>
</tr>
<tr>
<td>Analysis of Uncertainty.</td>
<td></td>
</tr>
<tr>
<td>a. Simulation</td>
<td></td>
</tr>
<tr>
<td>b. Decision Trees</td>
<td></td>
</tr>
<tr>
<td>c. Equations</td>
<td></td>
</tr>
<tr>
<td>d. Markov Analysis</td>
<td></td>
</tr>
<tr>
<td>Mathematical Programming</td>
<td></td>
</tr>
<tr>
<td>a. Linear Programming</td>
<td></td>
</tr>
<tr>
<td>b. Non-linear programming.</td>
<td></td>
</tr>
<tr>
<td>c. Goal Programming</td>
<td></td>
</tr>
<tr>
<td>d. Integer Programming</td>
<td></td>
</tr>
<tr>
<td>e. Quadratic Programming</td>
<td></td>
</tr>
<tr>
<td>f. Dynamic Programming</td>
<td></td>
</tr>
</tbody>
</table>

1. Not At All  4. Frequently
2. Hardly Ever  5. Very Frequently
3. Sometimes
III. Indicate in what area you are using those techniques.

<table>
<thead>
<tr>
<th>Area of Use</th>
<th>Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Expenditure decisions.</td>
<td></td>
</tr>
<tr>
<td>Lease Vs. Buy</td>
<td></td>
</tr>
<tr>
<td>Debt refunding Decisions</td>
<td></td>
</tr>
<tr>
<td>New Product Decisions</td>
<td></td>
</tr>
<tr>
<td>Cost of Capital</td>
<td></td>
</tr>
<tr>
<td>Acquisition analysis</td>
<td></td>
</tr>
<tr>
<td>Stock Selection Tool</td>
<td></td>
</tr>
<tr>
<td>Inventory Management</td>
<td></td>
</tr>
<tr>
<td>Cash Management</td>
<td></td>
</tr>
<tr>
<td>Capital Budgeting</td>
<td></td>
</tr>
<tr>
<td>Security &amp; Portfolio Analysis.</td>
<td></td>
</tr>
<tr>
<td>Capital Investment Decisions</td>
<td></td>
</tr>
<tr>
<td>Working Capital Management</td>
<td></td>
</tr>
<tr>
<td>Financial Leverage Decisions</td>
<td></td>
</tr>
<tr>
<td>Profit Planning</td>
<td></td>
</tr>
<tr>
<td>Financial Budgeting</td>
<td></td>
</tr>
<tr>
<td>Financing Decisions</td>
<td></td>
</tr>
<tr>
<td>Dividend Decisions</td>
<td></td>
</tr>
<tr>
<td>Other Statistical Technique</td>
<td></td>
</tr>
</tbody>
</table>

1. Discounted Cash Flow
2. Valuation Model
3. Minimization of Cost Function
4. Utility Theory
5. Analysis of Uncertainty
6. Portfolio Selection Theory
7. Mathematical Programming
8. Statistical Techniques
9. Risk Return Indifference Curve
IV. Based on your experience, please indicate the degree of importance of the following barriers to quantitative techniques implementation.

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Degree of Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manager lack knowledge of quantitative techniques</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. Managers are not quantitatively oriented</td>
<td></td>
</tr>
<tr>
<td>3. Benefits of using techniques are not clearly understood by managers.</td>
<td></td>
</tr>
<tr>
<td>4. Managers are unwilling or unable to use the computer for decision making and/or computers are not available</td>
<td></td>
</tr>
<tr>
<td>5. Managers are not exposed to quantitative techniques early in their training</td>
<td></td>
</tr>
<tr>
<td>6. Management is successful without using techniques</td>
<td></td>
</tr>
<tr>
<td>7. Managers in key positions lack knowledge of quantitative techniques</td>
<td></td>
</tr>
<tr>
<td>8. Only a small portion of management is trained in the use of quantitative techniques</td>
<td></td>
</tr>
<tr>
<td>9. Senior management personnel does not encourage use of techniques by younger management personnel</td>
<td></td>
</tr>
<tr>
<td>10. Required data are difficult to quantify.</td>
<td></td>
</tr>
<tr>
<td>11. The cost of developing models and using techniques is too high</td>
<td></td>
</tr>
<tr>
<td>12. Management distrusts or fears the use of techniques are not available</td>
<td></td>
</tr>
</tbody>
</table>

1. Not Important
2. Little Important
3. Moderately Important
4. Important
5. Very Important
<table>
<thead>
<tr>
<th>Barrier</th>
<th>Degree of importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. The data required in using the techniques are not available.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>14. The expense of employing quantitative specialists is too great.</td>
<td></td>
</tr>
<tr>
<td>15. Recent college graduates with quantitative training have not yet attained positions of influence.</td>
<td></td>
</tr>
</tbody>
</table>

1. Not Important          4. Important  
2. Little Important       5. Very Important  
3. Moderately Important   

V. What benefits, if any, you think you have received from the application of quantitative techniques.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
BIBLIOGRAPHY


