THE ROLE OF MATHEMATICS IN PRACTICAL MANAGEMENT DECISION-MAKING AND RESEARCH: A CASE OF SIMPLE INVENTORY DECISION MODEL

J. E. I. ABBAH ESQ.
LL.B., LL.M., MBA, FCIS, FSCA.
Lecturer, Department of Business Administration,
Nasarawa State University, Keffi.
Tel +234 805 4912 619. edacheabbah@yahoo.com
&
J. C. Ihemeje
Department of Business Administration,
Nasarawa State University Keffi, Nasarawa State.

Abstract
Mathematics is a subject that is dreaded by an average Nigerian student, either at the secondary (high school) level or at the university (college). Although the reasons may be sympathetic to the student in that he/she may not be the one to be blamed, yet mathematics plays very important role in the day to day life of the manager who has to taken decisions either in the public or private business as well as the researcher who must report findings through the use of mathematics as the language of science. A case is made for more attention to be specially paid to the teaching and declaration of mathematics as priority subject at all levels of education and particularly in the academic environment. A case is also made for a policy and national orientation on record keeping and data banks because of the role such banks may play in providing data for processing on which decision making and research are premised.

Key Words: Mathematics, Management, Decision Making

1. INTRODUCTION

In the field of social science, mathematics plays a prominent role. It serves as an aid to practical decision-making and research. It is therefore imperative that decision-makers (managers) and researchers alike should be grounded in mathematical science in order to be effective in their various callings. It is also imperative that a nation that wishes its managers and researchers to arrive at reliable results must also be information-oriented, beginning with a culture of data capture at all aspects of life, because decisions and research results rely heavily on availability of basic data. For example, demographic data which is most useful for the manager in industry or commerce as well as for a social science and management researcher requires a census base data, up-dated continuously by accurate births and deaths data-base. However, before any meaningful appreciation of the role of mathematics to practical decision- making and research, it is appropriate to understand the basic concepts of decision making, research and mathematics. Mathematics supply the best decision support tools for the decision-maker to make the choice of an alternative a more logical and more objective action.

2. DECISION MAKING

Decision-making is the process involved in choosing the best out of a number of options to achieve a pre-determined objective. According to Akingbade (1997), decision-making is the analysis of decision situations to arrive at the best choice of action that will achieve the desired objective most effectively. The increasing

difficulty of rational decision-making has been followed by numerous efforts to put this process on a more quantitative, objective and routine basis. In practical decision-making situations, where more than one environmental state exist and the probability distribution of a possible environmental states is known with doubts, it follows the logical process of identifying the desired objective, generating option, defining and screening criteria, evaluating the options and selecting the best.

The interacting elements include the decision-maker, the decision situation, the decision event and decision options modeled into a decision pay off. This is where the special branch of mathematics, Quantitative Techniques, comes in. Ihemeje (2006:19) defines this special branch "those statistical and mathematical methods of providing the decision maker with a systematic and powerful means of analyzing data in terms of numbers, symbols and other mathematical expressions for the purpose of exploring policies for achieving predetermined goals. They arte essentially helpful supplement to judgment and intuition..."

3. RESEARCH

Research is a scientific process of investigation to arrive at some feasible solution to the identified problems. According to Asika (1990), research is any organized inquiry, which aims at providing information for solving identified problems. In this context, research refers to the objective and systematic method of enunciating the problem collecting facts, analyzing the facts critically and reaching conclusions based on them. It is used to discover new facts, authenticate or disapprove existing ones, evaluating claims to knowledge and advancing it, and to discover relationships between variables (Ihemeje, 1998). The basic elements of research include objectivity and systematicism. Research is objective because only the data based facts must be reported and it is systematic because the process of arriving at a conclusion follows a laid-down procedure of data collection, analysis and interpretation.

Two of the four characteristics of characteristics of a good research design listed by Ihemeje and Tende (2006:5) are (1) the ability of the researcher to control variables by maximizing systematic variance, controlling extraneous systematic variance and minimizing cross or random variance, and (2) the ability to produce data to answer the research questions and test hypotheses. There is no doubt that, to do this, resort has to be had to mathematical tools, so that even qualitative responses are reduced to quantitative data in order for the researcher to map out clearly alternative courses from which a choice is to be made. The same authors also emphasise the use of mathematical tools to design and use samples in researches.

4. ROLE OF MATHEMATICS IN PRACTICAL DECISION-MAKING AND RESEARCH

The role of mathematics in practical decision-making and research cannot be over emphasized. Mathematics is essential in making correct decisions and taking appropriate research actions. As a basis for articulating what we want to achieve by way of quantifying our measure of effectiveness of factors that affect objectives, it enables the decision maker or the researcher to benefits from manipulating experience to analyze the decision and research situations and come up with the best choice of action to take.

By definition, mathematics is the quantification of interacting entities in specific situations, and deducing logical implications from each structure which act

as the basis for decision-making. By nature, mathematics is specific, concise and precise - specific about the entities and their relationships; concise in its representation and precise in the determination of variables of the interacting entities, showing how they are related. The essential features of mathematics include abstractness, generalizations, symbolic logic and analytical abstracts in emphasizing attributes rather than concrete entities, generalization in emphasizing efficiency in the use of symbols and notations, symbolic in describing various forms of relationships using symbols, logical in using rules and procedures of logic to establish facts; analytical in emphasizing general terms and axiomatic in emphasizing as starting point, the structural arrangements that are assumed to exist.

Mathematics can play the following basic roles in practical decision-making and research:

1. Assists in making correct decisions.
2. It is the language of scientific decision-making and research.
3. It is the most potent tool of practical decision-making and research.
4. It aids to decision analysis by providing avenues to alternative courses of action.

As an aid to decision analysis, mathematics represents the variable components as symbols, and replaces constant components, numbers and their relations with mathematical expressions. An appropriate mathematical expression enables the decision-maker or the researcher to obtain values of decision variables that yield most desirable values of the decision objective.

Mathematics is the objective language of decision-making and research. Because it uses symbols that are designated for specific types of impressions, it is employed to express impressions about phenomena in reality. In this way, mathematics makes possible the building of models which are simplified representations of complex real life situations and from the models, a decision maker or the researcher can draw various conclusions about the real life situations which they represent, by varying the major components of the model. In such context, meanings are given to specific symbols in a language system, which involves syntax and semantics.

Syntax is the symbols and the way they are structured in a language system and semantics is a specific symbols and their arrangement in a language system.

Mathematics is the most potent tool of science. It is essentially used to describe various forms of relationships which are often encountered in decision-making and research. It formalizes ways of deducing logical implications and consequences from structures which when applied to relationships in reality yield deduced information that are usable as factual basis for practical decisions and research.

In practical decision-making and research, what matter are the interacting entities and how they interrelate to account for the phenomena they represent. The simplified and abstract description of systems and their interrelationships is known as modeling. By definition, mathematical modeling is the use of symbols and mathematical concepts and notations to survey aspects, relationships and manipulation of interest in the situations. As a descriptive feature of decision-making and research, models are descriptive representations of real life situations, which are more economical, easier, and

more feasible to manipulate experimentally than real the life situations they are built to represent. By nature, a mathematical model is unambiguous and exactly represents the important aspects of the situation of interest to the researcher or the decision-maker. It is manipulatable as only symbols are used. Mathematics also elucidate, i.e. it clearly brings out distinctive qualities and relationships between or among components of the subjects or situations of interest.

5. THE LIMITATION OF MATHEMATICS IN PRACTICAL DECISION-MAKING AND RESEARCH.

Despite the prominent role of mathematics in practical decision-making and research, it has its limitation. These limitations include the following:

1. Mathematics involves the use of far-reaching assumptions. This is so because many real life relationships, particular in practical decision-making and research are too complex to understand exactly and therefore assumptions are made which may well be wrong. If the assumptions are wrong, decisions taken on the basis of those assumptions are bound to be wrong as well.
2. Mathematics requires a great deal of amount of data to be developed. This makes mathematics boring and unattractive to decision-makers and researchers who are not patient enough or numerically inclined enough to process those data.
3. Mathematics requires special skill for manipulation of variables. Unfortunately, special skill necessary for the mathematical manipulation is not always available especially for non-mathematically oriented decision-makers and researchers.
4. Mathematics, by nature, involves a great deal of abstractions, which may not be comprehensible for non-mathematical-oriented decision-makers or researcher. This aspect elicits fear and or hatred from such non-mathematically oriented decisions makers or researchers, with the consequence that decisions are taken based on qualitative considerations rather than on more solid quantitative considerations.

6. A SIMPLE INVENTORY SCHEME FOR THE USE OF MATHEMATICS IN REALITY.

The general mathematical formula for describing operational structure is:

E=F(Xi,Yj) where E= measure of effectiveness
F= functions
Xi= controllable variables
Yj= in controllable variables

The mathematical expression implies that the measure of effectiveness is a function of controllable (dependent) and uncontrollable (independent) variables. In this context, any change in controllable variable (x) lead to a change in uncontrollable variable (y).

This general format yields various types of models. An example of a scheme for the use of mathematics in reality is the simple inventory analysis.

The scheme states that in analyzing inventory, total annual inventory cost equals total cost of items purchased plus total ordering cost plus total carrying cost plus total stock-out cost.

Since the unit price is assumed to be fixed and the probability of shortage is nil, then we drop the purchasing cost and stock-out

components to arrive at the formula: total annual inventory cost equals total ordering cost plus total carrying cost i.e.

$TC = (a \times b) + (c \times d)$,

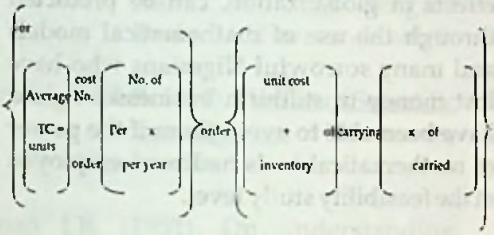
Where

a = cost per order

b = number of orders per year

c = unit cost of carrying inventory

D. = average number of units carried.



Number of order per year

$= \frac{\text{Annual demand}}{\text{Size of each order}} = \frac{d}{q}$

Average number of units carried per period

$= \frac{\text{Max. inventory} - \text{Min. Inventory}}{2}$

$= \frac{q-0}{2} = \frac{q}{2}$.

Hence, $TC = \frac{dS}{q} + \frac{qH}{2}$ Where TC = Total Annual Inventory cost
D = Demand per annual
S = order cost per order
Q = quantity ordered
H = holding cost per units

To derive the economic order quantity i.e. quantity of order that would minimize total inventory cost, we differentiate RC with respect to q and equate it to zero.

$$\frac{DTC}{dq} = \frac{dS}{q2} + \frac{H}{2} = 0$$

$$\frac{DS}{q2} = \frac{H}{2}$$

$$q2H = 2DS$$

$$q2 = \frac{2DS}{H}$$

$$q = \sqrt{\frac{2DS}{H}}$$

Where q is the optimal cost size model. This simple model demonstrates the use of mathematics in taking accurate decisions in industry. If this model is used, given that the variables (cost elements, and material usage in the production factory) have not changed, it will always lead to the lowering of costs of production from materials handling point of view (i.e. when and how much to order at any given time).

7. SUMMARY OF WORK

Mathematics is the language of science (social, applied or pure). Decision making either by a manager or a researcher is usually based on mathematical yields. Yet, Nigerians are poor in the manipulation of this unavoidable tool. Simple decisions such as the optimum level of stock to hold in a business environment or even in government, requires mathematical models.

Even though mathematics advocates the conduct of affairs on the basis of objective facts and rationalized choice, its approach is often problematic in practical social setting. This is because facts are seldom exhaustively available. Moreover time to obtain enough facts and/or cost of obtaining them may constitute constraints.

Secondly, rationalization especially at the level of quantification often leaves out some significant intangibles such as feelings and beliefs, which are of qualitative aspects and difficult to capture and express quantitatively.

Thirdly, perceptions and thoughts of situations are often far from what they are in reality. Yet such perceptions are what we often use as facts. This problem is particularly obvious in the study of management systems, which are in most cases not amenable to objective identifications and measurements.

8. CONCLUSIONS

It has been observed that the lack of interest

in the use of mathematical models by managers in commerce and industry as well as most researchers, is one singular reason why the quality of decision making and research results are not reliable in Nigeria.

It is common knowledge that as for research, the official government research organ the Bureau of Statistics often churn out very controversial and manifestly contradictory figures, particularly on inflation figures and rates of progression. The organized private sector (Manufacturers Association of Nigeria, the Nigerian Association of Chambers of Commerce Industry, Mines and Agriculture as well as the Nigerian Employers Consultative Association) are always challenging the figures produced by the Bureau. Similarly, the Central Bank of Nigeria's prestigious Research and Statistics Department also produce figures on various aspects of Nigerian Economy which are often at great variances with those of the Bureau.

The result of lack of recognition of mathematics and consequently, data collection and analysis is also manifest at the local government levels in Nigeria where basic data on agricultural production is totally lacking. So also is the data of death and births at the local government level. This is why planning is very difficult in Nigeria.

In industry, it is also evident that the absence of reliance on the use of mathematics results in poor production planning and consequently the very health of the enterprise is compromised. The rate of failure of companies in Nigeria is high. According to the Corporate Affairs Commission press briefing in October 2005, an average of a third of companies that open their doors close them within a year in Nigeria. This is due to poor availability of data that should have guided the promoters of the companies, so that unviable undertakings should not be embarked upon simply because that is what some-one has done successfully before. Many variables that account for the success of industrial production, such as fuel price increase, power situation, demographical shift, fashion trends, and effects of globalization, can be predicted through the use of mathematical models and many sorrowful Nigerians who have lost money in stillbirth businesses would have been able to avoid them if the power of mathematical tools had been employed at the feasibility study level.

9. RECOMMENDATIONS

The issue therefore is how to reconcile the benefits of mathematical analysis with the practical problems and limitations involved. A way out may be to evolve a national policy to make the teaching and learning of mathematics and its applications a national priority. This should in the long run, inculcate a culture of bias towards quantitative thinking and application. In the meantime, all levels of government should invest in the study of mathematics to make it more interesting to students at all levels of education and to also evolve a culture of keeping records and statistics, thereby reducing guesswork and thereby reducing the need to resort always to qualitative decision making either in business or research. Facts built on hard data are mathematical assets just as the population that is mathematically positively attuned to use them.

REFERENCES

Akingbade J.F. (1996), Mathematics and the Social Sciences: The Missing Links, Operational Research Consult, Panaf press Lagos.

Beck W.S. (1996), Modem Science and The Nature of Lives, Penguin Books Ltd Harmonds worth

Beveridg W. I. B (1951), The Art of Scientific Investigation, Heinemaun, London

Conan J.B. (1951), On understanding Science, the New American Library, New York, USA.

Ihemeje J. C. (2006) Quantitative Business Decision Management: Theories and Techniques, Onaivi Printing and Publishing Co. Ltd., Keffi, Nigeria.

Ihemeje J. C. and S.B.A. Tende (2006), Management Research Methodology: Principles and Practices, Onaivi Printing and Publishing Co. Ltd., Keffi, Nigeria.

Ritchie C. (1955) Science In Our Lives, The New American Library, New York, USA.