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**MATHEMATICS, STATISTICS, OPERATIONS RESEARCH AND ECONOMETRICS –
THE WORKING COMPONENTS IN QUANTITATIVE TECHNIQUES IN
MANAGEMENT: AN OVERVIEW**

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ABSTRACT

The broad content, commonness and interlink among Mathematics, Statistics, Operations Research and Econometrics (MSORE) are briefly identified and classified under working in Quantitative Techniques in Management (QTM). The importance and usage of ‘MSORE’ in QT and in Management Science is demarcated. Moreover, need of academic orientation and proper remarkable reference in academia for QTM and inclusion of econometrics in QTM is emphasized.

Key words: Quantitative Techniques, Mathematics, Statistics, Operations Research, Econometrics, Management Science.



INTRODUCTION

Management Science

Management science is an interdisciplinary branch of applied mathematics, engineering and sciences that uses various scientific research-based principles, strategies, and analytical methods including mathematical modeling, statistics and algorithms to improve an organization's ability to enact rational and meaningful management decisions. Some of the fields that are included in Management Science are: Data mining, Decision analysis, Engineering, Forecasting, Game theory, Industrial engineering, Logistics, Mathematical modeling, Optimization, Probability and statistics, Simulation, Social network, Transportation forecasting models, Supply chain management as well as many others.

Quantitative Techniques in Management

Quantitative Techniques is the major science subject in management science which helps to transform subjective matter into objective which is the quantification required for scientific use. Scholars have different opinion and idea on definition and classification of Quantitative Techniques in Management (QTM). Regarding definition mostly all of them are same, but on classification they differ more. Since, QTM is contemporarily young subject and though it is a subject, its acceptable components (Mathematics, Statistics, Operations Research, etc.) are core in nature and they have limitless boundaries, and it is simply a 'banyan tree' inside the 'banyan tree seed'. Prof. Satya Devi's classification on Quantitative Techniques in Management is more predominant. In her book 'Quantitative Techniques' she classified QTM as follows,

1. Statistical Quantitative Techniques (STQ)

1. Collection of data
2. Classification of tabulation
3. Measures of averages



4. Measures of variations
 5. Measures of relations
 6. Analysis of time series
 7. Index numbers
 8. Skewness, moments and kurtosis
 9. Diagrammatic and graph presentation
 10. Interpolation and extrapolation
 11. Statistical quality control
- 2. Mathematical Quantitative Techniques (MQT)**
1. Algebra
 2. Arithmetic
 3. geometry
 4. calculus
 5. matrices
- 3. Programming or Operation Research QT (PQT or ORQT)**
1. probability
 2. decision theory
 3. waiting line or queuing theory
 4. linear programming
 5. game theory

Quantitative methods or models, research techniques use mathematical, statistical and programming techniques involving the use of numbers, symbols, mathematical expressions and other elements which intern help to decision makers for achieving the pre determined goals. Even the classification which includes mathematics, statistics and operations research, some portions are left to identify or demarcate. Researcher is arguing that, the remaining part will be the econometrics and the justification as follows.



Mathematics and Management

In Business Mathematics, mathematics used to record and manage business operations. Commercial organizations use mathematics in accounting, inventory management, marketing, sales forecasting, and financial analysis. Mathematics typically used in commerce includes elementary arithmetic, elementary algebra, statistics and probability. Business management can be done more effective in some cases by use more advanced mathematics such as calculus, matrix, algebra and linear programming.

Statistics and probability which are branches of mathematics are used in everyday business and economics. Financial mathematics and Business Mathematics forms two important branches of mathematics in today's world and these are direct application of mathematics to business and economics. Applied mathematics such as probability theory, queuing theory, time series analysis and linear programming are vital mathematics for business.

Approximately after 1950's numerous mathematical techniques were identified to help solve various problems of management. A particular discipline called Management science sprang up. It incorporated various techniques – mathematical programming, linear algebra, network methods, queuing theory, stochastic processes, statistics, recursive relations, and computer simulation to attack various management problems. Drawing upon the above techniques, the philosophy of using science is solving of a problem.

As mathematics began to establish in business schools, applications of mathematics to various management problems became prevalent. Among them were the applications of quadratic programming to financial portfolio analysis and to the planning of production, inventories, and work force as well as the application of linear programming to advertising media selection. Queuing theory was used to analyze service facilities, such as restaurant and banks. Other applications include the transportation method of linear programming, the economic lot size formula trading off inventory and order/set-up costs, CPM-PERT networks in project



management, the use of learning curves and exponentially – weighted moving averages as means of forecasting, and gravity models for site selection are notable.

Business schools differ in employing QT. Some schools employed only OR, some are statistics and OR, some are mathematics, statistics and OR with mathematics in lesser extent. Even in the mathematical part, elementary Algebra, Matrix, Arithmetic, Geometry and Calculus alone employed. Other parts of the mathematics are not yet to be use. For complex problem, calculus is more viable which also not given due consideration. By avoiding dependency on statistics could create more consideration on mathematics and its tools.

Statistics and Management

Business statistics is a science of good decision making in the face of uncertainty and is used in many disciplines such as financial analysis, econometrics, auditing, production and operations including service improvement, and marketing research. A typical business statistics course is intended for business majors, and covers statistical study, descriptive statistics (collection, description, analysis, and summary of data), probability, and the binomial and normal distribution, test of hypotheses and confidences intervals, linear regression, and correlation.

Modern business management is more of science than art. Forecasting, planning, organizing are decision making are key activities of the business managers to draw decision for preferences of a customer base, the quality of the manufactured products, marketing of the products and availability of the financial resources to tackle ‘uncertainty’ which is the demon for all business activities. Statistical date and its methods are helping them to handle all sorts of business problems. Statistics real-world applications are mainly used in the fields of Business, Economics, Finance, OR and Management Science.



Operations Research and Management

Operations research (OR) is often considered to be a sub-field of mathematics. The terms management sciences and decision science are sometimes used as synonyms. Employing techniques from mathematical sciences, such as mathematical modeling, statistical analysis, and mathematical optimization and operation research arrive at optimal or near-optimal solutions to complex decision-making problems. Because of its emphasis on human-technology, interaction and because of its focus on practical applications, operations research has overlap with other disciplines, notably industrial engineering and operations management, and draws on psychology and organization science. Operations research is often concerned with determining the maximum (of profit, performance, or yield) or minimum (of loss, risk, or cost) of some real-world objective. Originating in military efforts before World War II, its techniques have grown to have concern on the problems in a variety of industries.

Operations research encompasses a wide range of problem-solving techniques and methods applied in the pursuit of improved decision-making and efficiency, such as Simulation, Mathematical optimization, Queuing theory and other Stochastic-process models, Markov decision processes, Econometric methods, Data envelopment analysis, Neural networks, Expert systems, Decision analysis, and the Analytical hierarchy process. Nearly all of these techniques involve the construction of mathematical models that attempt to describe the system.

Operations research could be very effective in handling issues of inventory planning and scheduling, production planning, transportation, financial and revenue management and risk management. It could be used in any situation where improvements in the productivity of the business are of paramount importance. With OR, organizations are greatly relieved from the burden of supervision of all the routine and mundane tasks. The problem areas are identified analytically and quantitatively. Tasks such as scheduling and replenishment of inventories benefit immensely from OR.



conometrics and Management

Econometrics is a young science which is developed during the twentieth century in the mid 1930's, primarily after the World War II. Econometrics is the unification of statistical analysis, economic theory and mathematics. The history of econometrics can be traced to the use of statistical and mathematics analysis in economics. Management science in its modern form is very novel in approach in the area of Business administration and related disciplines.

Econometrics has become an integrated part of teaching and research in modern economics and business and the application of mathematical and statistical theories to economics for the purpose of testing hypotheses and forecasting future trends. Econometrics takes economic models and tests them through statistical trials. The results are then compared against real-life examples. Econometrics can be sub divided into two major categories: theoretical and applied. Econometrics uses tools such as frequency distributions, probability and probability distribution, statistical inference, simple and multiple regression analysis, simultaneous equations models and time series methods.

Generally speaking, modern economics can roughly classify into four categories: macroeconomics, macroeconomics, financial economics and econometrics. Of them, macroeconomics, microeconomics and econometrics now constitute the core courses, while financial econometrics is now mainly being taught in business and management schools. Most doctoral programs in economics in the U.S. emphasize quantitative analysis. Quantitative analysis consists of mathematical modeling and empirical studies.



CONCLUSION

Over the year, many disciplines are emerged from the core subjects. These new disciplines or subjects and/or part of this and part from the core subjects combine together forms again a new discipline and it is continuous. Those subjects or disciplines emerged during or after the seventeenth century, approximately after agricultural, industrial, and technological revolutions, are mostly of interdisciplinary. Interdisciplinary subjects though it is new compared to core subjects, it has been its specialities and link or base with the core and parent subjects.

Business or Management studies, comparatively newly born subjects from the main parent subjects of commerce and economics, are also one among them. Because of its interdisciplinary nature, adopting new area is one hand, applying its tools and techniques to other areas or fields, is on the other hand, management studies have been extending its boundaries. But its adoption and applications are scientific in nature and its range is also very wide. So that, now it is rightfully called as 'management science'. Science has the tendency of conquering any field it would cross. Management science also has the same character. QT though seems like one of the subjects in management science but it takes all the responsibility to say management as a science discipline. Since, mathematics, statistics, operations research and econometrics are the main working components of quantitative techniques which are also the main pillars of the management science which is proved through the above discussion, also proved their interlink between them. Besides, unpleasantly perceived that, most of the Business schools are not availing 'professional session'. Like laboratory work or in-plant training in Engineering, Science and Medicine, professional session is a must for B-School graduate. This professional session should be of a semester or 3 – 6 months duration and he/she must participate in an industry, organization and related concerns in any type of work. This academic – industrial interaction could lead to employability, entrepreneurial, research and technology development in the field of Business management, and rightfully can claim, Business management is professional science after Engineering and Medicine.



Compare to mathematics, statistics and operations research, econometrics perceived less because of partially arts in nature though it is mainly using mathematics and statistics. But it could be the main advantage, since, econometrics has link with its parent subjects, economics and commerce and these subjects have the link with other social science subjects. So that QT and management science tools (theories, models, methods, etc.) could be sharpened, also it would get more space, chance and choice to conquer. Hence, academic curriculum must include in Quantitative Techniques and management science, so that real time application of management science will be more viable and can cover wide area.

Concisely, Researcher suggested that,

1. Appreciation must be needed to employ and explore all possibilities of mathematics in Business management.
2. Econometrics should be added in the Quantitative Techniques in Management syllabus.
3. 'Universal – minimum standard outline – reference' should be made for making academic syllabus for QTM with the options of mathematics, statistics, OR and econometrics.
4. Professional working/training session should be included in B – school's curriculum and should make it mandatory.

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