COMPLEX PROBLEM SOLVING AND ITS EFFECTS ON MATHEMATICS AND BUSINESS OPERATIONS

[1]G.Sampath Kumar, [2]A. Chandra Sekhar, [3]K. Pushpa Latha
[1,2,3]Assistant Professor, [1,2,3]Department of H & S, Brilliant Institute of Engineering and Technology, Hyderabad, India

ABSTRACT
In order to tackle complex business challenges, the interesting field of applied mathematics known as operations research brings together math, statistics, computer science, physics, engineering, economics, and social sciences. Professionals in operations research are needed by many businesses to use mathematical methods to a variety of complex problems.
Operational analysis the science of decision-making might be referred to as operations research. It has been effective in offering a methodical and scientific approach to many government, military, manufacturing, industrial, and service operations. For math grads and research scholars, operations research is an excellent field to apply their knowledge and skills in novel ways to tackle challenging problems and have an impact on important decisions.
Key words: Operations research. Industry, world war, stochastic processes, queuing theory, Network route Decision trees, Inventory control

1. INTRODUCTION

Operational Research is the name given to OR in Britain and other parts of Europe. Decision sciences, management science, and industrial engineering are additional terms that are utilised. Operations refers to the tasks completed within a company. The scientific method-based process of observation and experimentation is referred to as research. a situation, a problem description, the creation of a model, its validation through experimentation, and solutions.

Some key steps in OR that are needed for effective decision-making are:

a. Observe the problem environment (motivation, short- and long-term objectives, decision variables, control parameters, constraints)
b. Analyze and define the problem (representation of complex systems by analytical or numerical models, relationships between variables, performance metrics)
c. Select appropriate data input (model inputs, system observations, validation, tracking of performance metrics);
d. Provide a solution and test its reasonableness (optimization, stochastic processes, simulation, heuristics, and other mathematical techniques)
e. Validation and Analysis (model testing, sensitivity analysis, model robustness)
f. Interpretation and Implementation (solution ranges, trade-offs, graphical representation of results, decision support systems).

These steps all require a solid background in mathematics and familiarity with other disciplines (such as physics, economics, and engineering), as well as clear thinking and intuition. The mathematical sciences students to apply tools and techniques and use a logical process to analyze and solve problems.

"**Operation Research**" became an established discipline during World War II, when the British government recruited scientists to solve problems in critical military operations. Mathematical methods were developed to determine the most effective use of radar and other new defense technologies at the time. **OR** groups were later formed in the U.S. to meet needs of war time operations, such as the optimal movement of troops, supplies, and equipment.

Following the end of World War II, interest in OR turned to peacetime applications. There are now many OR departments in industry, government, and academia, corporate company, throughout the world. Examples of where OR has been successful in recent years are the following:

a. Airline Industry (routing and flight plans, crew scheduling, revenue management, decision making)
b. Information Technology (network routing, queue control, shortest route, Assignment problem)
c. Manufacturing Industry (system throughput and bottleneck analysis, inventory control, production replenishment, infrastructure)
d. Healthcare (hospital management, facility design, machine lifetime, queuing theory)
e. Oil and gas company(Maximal flow model, decision trees)

Transportation (traffic control, network flow, airport terminal layout, travelling sales man,).

Service industries, electrical parts, machine tools (replacement and maintenance)

There are many mathematical techniques that were developed specifically for **Operation Research** applications. These techniques arose from basic mathematical ideas and became major areas of expertise for industrial operations.

One of important area of such techniques is optimization. Many problems in industry require to find the maximum or minimum of an objective function, subject to constraints on those variables. Typical objectives are maximum or minimum profit. Techniques of mathematical programming for optimization include linear programming (optimization where both the objective function and constraints depend linearly on the decision variables), non-linear programming (non-linear objective function or constraints), integer programming (decision variables restricted to integer solutions), stochastic programming (uncertainty in model parameter values) and dynamic programming (stage-wise, nested, and periodic decision-making).

The Related topic of stochastic processes is queuing theory (i.e., the analysis of waiting lines). A common example is the single-server system in which customer arrivals and service times are random. **Figure 1** illustrates the queue, and the curve shows the average queue length becomes under high traffic intensity conditions. Mathematical and simulation, are available for solving queuing models .The results have in many types of queues, such as customers at a bank or supermarket checkout, orders waiting for production, ships docking at a harbor, users of the internet, and customers served at a restaurant. Stocks in godown, parking area, cinema theatre , and how much space to allocate for waiting customers, what lead times to promise for production orders, and what server count to assign to ensure short waiting time

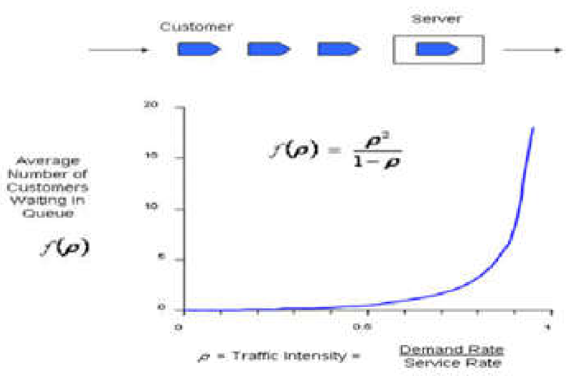

Figure 1: Single-Server Queuing System

Another real mathematical world, the common problem to many industries, is the distribution of material and products from Production Company to customers. For a network of origins to destinations, there are many shipping alternatives, including choices of transportation mode (e.g., road, rail, air) and geographical routes. Some key decisions are routing options over the network, and shipping frequencies on network links. As shown in **Figure 2**, routing options involve shipping direct, via a terminal to distribution center, and by a combination of routes. These options affect distances travelled and times in transit, which in turn affect transportation and inventory costs. Shipping frequency decisions also affect these costs. Transportation costs favor large infrequent shipments, while inventory costs favor small frequent shipments. Trade-offs between these costs is complex for large networks, and finding the optimal solution is a challenging mathematical problem. In addition to decisions for operations of a given network, there are major strategic decisions, such as the selection and location of distribution centers.

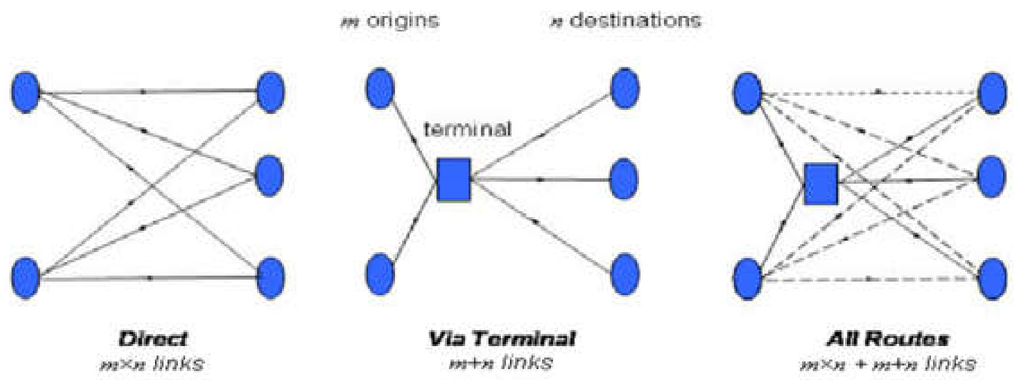

Figure 2: Network Routing Options

Other **Operations Research** topics requiring mathematical analysis are inventory control (when to reorder material to avoid shortages under deterministic order quantity), Economic production quantity model(what size of production run will minimize sum of inventory and production setup costs), Assignment problem(where to locate the hub to serve markets with minimal travel distances), and Network analysis (how to design airport terminals to minimize walking distances, maximize number of gates, total duration for project).

Operation Research analysts can modify the difficult practical problems and offer valuable solutions and valuable guidance for decision-makers. Constraints involving budgets, capital investments, number of items can make the successful implementation of results as challenging as the development of mathematical models and solution methods.

CONCLUSION

Most frequently, complicated real-world problems are analyzed using operations research in order to uncover solutions, improve or optimize performance, and identify crucial system factors. There are many applications for the knowledge and abilities that math students are learning. Operational research applied to business challenges will play an increasingly essential part in decision-making in industry as the world becomes more and more dependent on new technology.

REFERENCES

1. Allen, A. O. (1990). Probability, Statistics, and Queueing Theory - With Computer Science Applications (Second Edition). Academic Press, Orlando, Florida. Cohen, S. S. (1985). Operational Research. Edward Arnold, London.
2. ChvÃ¡tal, V. (1983). Linear Programming. W. H. Freeman, New York. Gross, D. and Harris, C. M. (1985). Fundamentals of Queuing Theory. Wiley, New York.
3. Hillier, F. S. and Lieberman, G. J. (2001). Introduction to Operations Research (Seventh Edition). McGraw-Hill, New York.
4. Hopp, W. J. and Spearman, M. L. (2000). Factory Physics: Foundations of Manufacturing Management (Second Edition). Irwin/McGrawHill, New York.
5. Larson, R. C. and Odoni, A. R. (1981). Urban Operations Research. Prentice Hall, Englewood Cliffs, New Jersey.
6. Lewis, C. D. (1970). Scientific Inventory Control. Elsevier, New York. Ross, S. M. (1983). Stochastic Processes. Wiley, New York.
7. Silver, E. A., Pyke, D, F. and Peterson, R. (1998). Inventory Management and Production Planning and Scheduling. (Third Edition). Wiley, New York.