Operations Research(作業研究)

Operations research (OR) (often as management science(MS)) is simply a **scientific approach to decision making(決策)** that seeks to best design and operate a system, usually under conditions requiring the allocation of scarce(缺乏的)resources.

The term operations research was coined during World War II when British military leaders asked scientists and engineers to analyze several military problems such as the deployment of radar and the management of convoy(護航艦隊), bombing(投彈), antisubmarine(反潛艇的), and mining(佈雷)operations. Following the end of the war, the ideas advanced in military operations were adapted to improve efficiency and productivity in the civilian sector. Today, OR is a dominant and indispensable decision making tool.

Taxonomy(分類)：

- **Linear**(線性) and **Nonlinear**(非線性) Models:
  Suppose that whenever **decision variables**(決策變數) appear in the **objective function**(目標函數) and in the **constraints**(限制式) of an **optimization**(最佳化) model, the decision variables are always multiplied by constant and added together. Such a model is a linear model. If an optimization model is not linear, then it is a nonlinear model.
- **Static**(靜態) and **Dynamic**(動態) Models:
  A static model is one in which the decision variables do not involve sequences of decision over multiple period. A dynamic model is a model in which the decision variables do involve sequence of decisions over multiple periods.
- **Integer**(整數) and **Noninteger**(非整數) Models:
  If one or more decision variables must be integer, then we say that an optimization model is an integer model. If all the decision variables are free to assume fraction values, then the optimization model is a noninteger model.
- **Deterministic**(確定) and **Stochastic**(隨機) Models:
  Suppose that for any value of the decision variables the value of the objective function and whether or not be constraints are satisfied is know with certainty. We then have a deterministic model. If this is not the case, then we have a stochastic model.

The Six-Step Model-Building Process:

- Define the problem of interest and gather relevant data
- Formulate a mathematical model to represent the problem
- Develop a computer-based procedure for deriving solutions to the problem from the model
- Test the model and refine it as needed.
- Prepare for the ongoing application of the model as prescribed(指定)by management
- Implement

The Impact of Operations Research:

Operations research has had an impressive(予人深刻印象的)impact on improving the efficiency of numerous organizations around the world. In the process, OR has made a significance contribution to increasing the productivity of the economies of various countries. There now are a few dozen member countries in the International Federation(聯盟)of Operational Research Societies (IFORS), with each country having a national OR society. Both Europe and Asia have federations of OR societies to coordinate holding international conferences and publishing international journal in those continents.

Table Some applications of operations research

Organization	Nature of Application	Year of Publication	Related Chapters	Annual Savings
Continental Airlines(美國大陸航空公司)	Optimize the reassignment of crews to flights when schedule disruptions occur.	2003	IP	$40 million
Samsung Electronics (三星電子)	Develop methods of reducing manufacturing times and inventory levels.	2002	LP	$200 million more revenue
Merrill Lynch (美林證券公司)	Design asset-based and direct online pricing options for providing financial services	2002	Simulation	$80 million
IBM(International Business Machine 國際商務機器公司)	Reengineer its global supply chain to respond quicker to customers while holding minimal inventory	2000	Inventory	$750 million in first year

Algorithms and OR Courseware:

- Lindo: Lindo is the linear, non-linear, and integer programming solver with mathematical modeling language
- Lingo: LINGO is a comprehensive tool designed to make building and solving linear, nonlinear and integer optimization models faster, easier and more efficient.
- Excel
- CPLEX: CPLEX Optimization, Inc., was founded in 1988 with the mission of providing the highest-performance optimizers for linear programming. CPLEX was the first commercial linear programming optimizer developed in the C programming language.
- MPL: MPL (Mathematical Programming Language) is an advanced modeling system that allows the model developer to formulate complicated optimization models in a clear, concise, and efficient way. Models developed in MPL can then be solved with any of the multiple commercial optimizers available on the market today.