PENELITIAN OPERASIONAL I

(TIN 4109)

Course Logistics

- **Course structure:**
  - RPKPS
- **Score:**
  - Assignment (In class & Homework) (30%)
  - Quiz 1 (20%)
  - Quiz 2 (20%)
  - Final Test (30%)
- **References:**
  - Frederick Hillier and Gerald J. Lieberman. *Introduction to Operations Research*. 7th ed. The McGraw-Hill Companies, Inc, 2001.
  - Hamdy A. Taha. *Operations Research: An Introduction*. 8th Edition. Prentice-Hall, Inc, 2007.
  - Mokhtar S. Bazaraa. Linear Programming and Network Flow. John Wiley and Sons, Inc., 2004.
- **Other Rules:**
  - Class start at: 18:15
  - 80% minimum attandance
  - No cheat in test and individual assignment

Lecture 1

INTRODUCTION to **OPERATION RESEARCH**

Outline

- History of OR
- Phases of an OR Study
- Software for OR

History of Operations Research

World War II : British military leaders asked scientists and engineers to analyze several logistic problem in some locations to optimize the limited resources.

The result was called *Military Operations Research*, later Operations Research

History of Operations Research

Today Operations Research …

*"the use of **mathematical models** in providing guidelines to managers for making **effective decisions** within the state of the current information, or*

in seeking further information if current knowledge is insufficient to reach a proper decision."

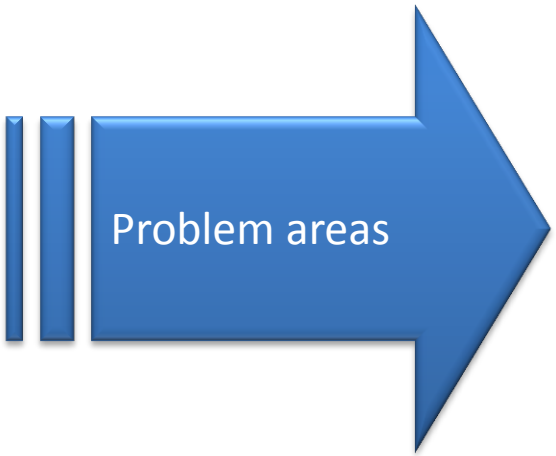
Operation Research is also called…

Management Science, Decision science, Quantitative Management, Systems Analysis, Systems Engineering, Operational analysis, engineering systems, and more.

Phases of an OR Study

1. Recognize the problem
2. Formulate the problem
3. Construct a model
4. Find a solution
5. Testing the solution
6. Implement the solution

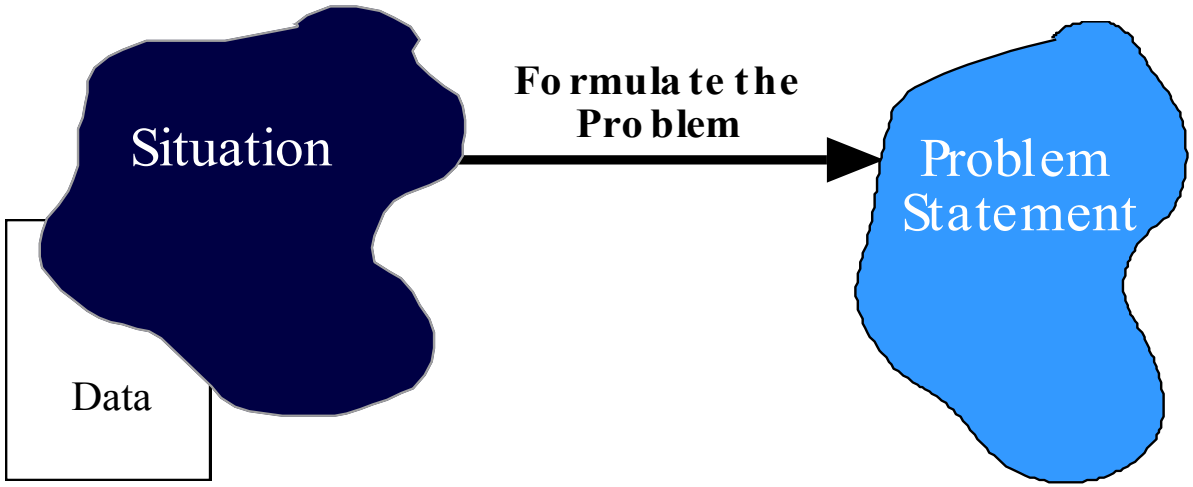
1. Recognize the Problem



- Manufacturing
  - Planning
  - Design
  - Scheduling
  - Dealing with Defects
  - Dealing with Variability
  - Dealing with Inventory
- Service Industries
- Logistics
- Transportation
- Environment
- Health Care
- Situations with complexity
- Situations with uncertainty

Example: Internal nursing staff not happy with their schedules; hospital using too many external nurses.

2. Formulate the Problem



1. Define the problem
2. Delimit the system
3. Determine variables
4. Identify constraints
5. Select measures and obtain input

Example: Maximize individual nurse preferences subject to demand requirements.

3. Construct a Model

- Problem must be translated from verbal, qualitative terms to logical, quantitative terms
- A mathematical model is a collection of functional relationships by which allowable actions are delimited and evaluated.
- A logical model is a series of rules, usually embodied in a computer program

Example:
Define relationships between individual nurse assignments and preference violations; define tradeoffs between the use of internal and external nursing resources.

Properties of Good Models

- **Simple**
- **Complete**
- **Easy to manipulate and communicate with**
- **Adaptive/robust**
- **Appropriate**
- **Produces information relevant and appropriate for decision making**

Deterministic vs. Stochastic model

Deterministic

assume all data are known with certainty

Stochastic

explicitly represent uncertain data via random variables or stochastic processes.

Deterministic models

involve **optimization**

Stochastic models

involve **estimation/prediction** of system performance

Deterministic vs. Stochastic Models

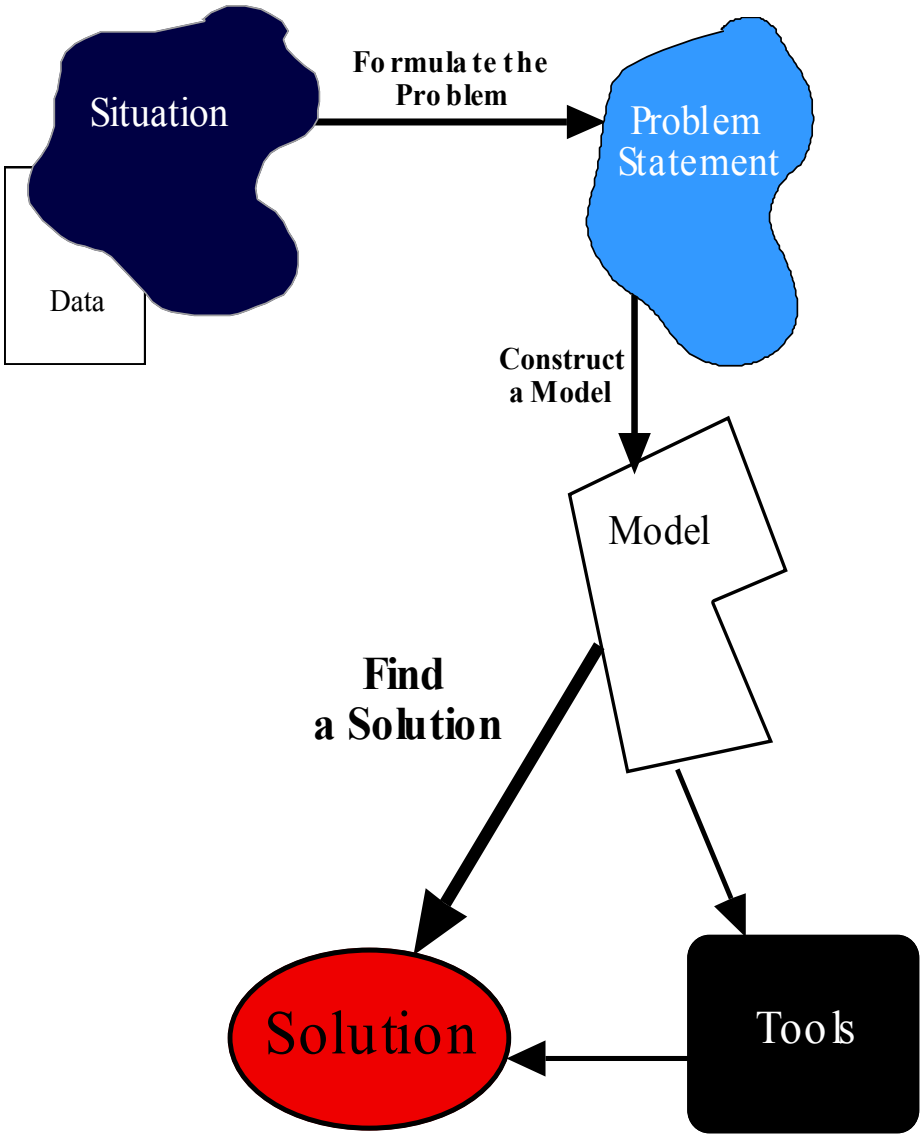
Deterministic Models

- Linear Programming
- Network Optimization
- Integer Programming
- Nonlinear Programming

Stochastic Models

- Discrete-Time Markov Chains
- Continuous-Time Markov Chains
- Queuing
- Decision Analysis

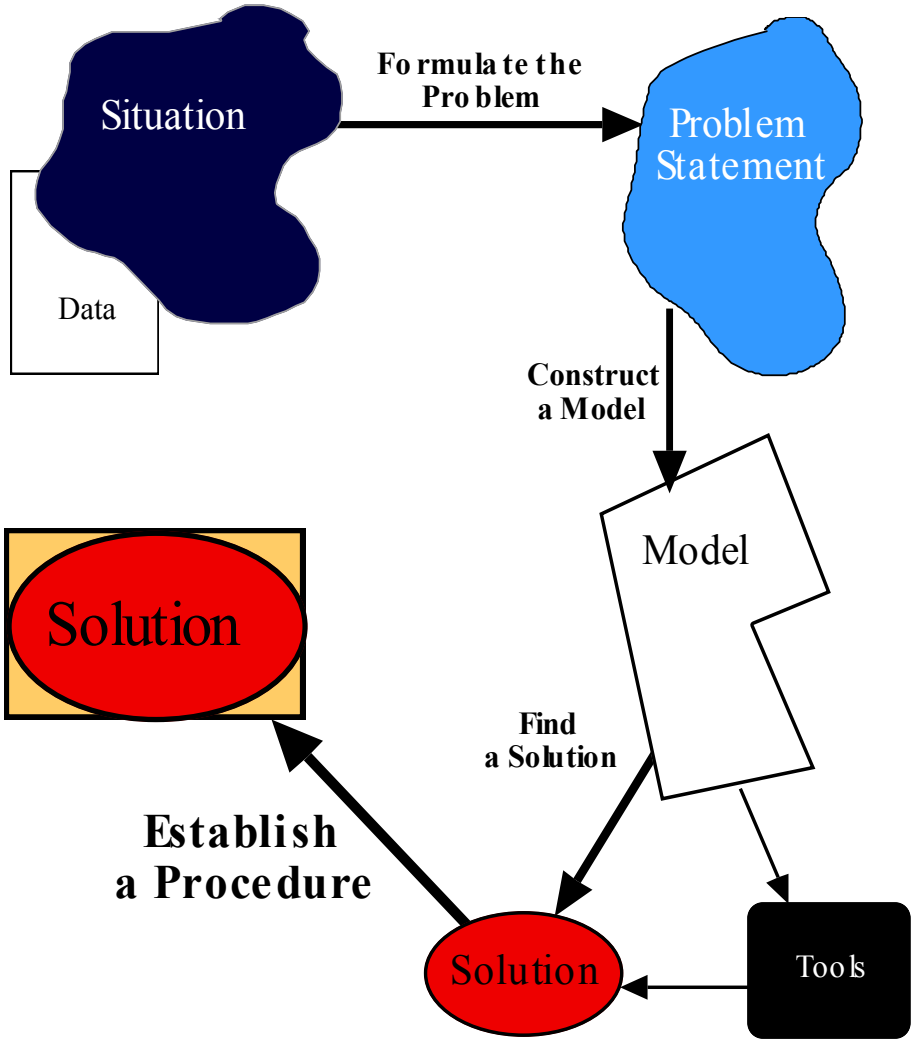
4. Find a Solution



- ❑ Linear Programming
- ❑ Nonlinear Programming
- ❑ Regression
- ❑ Direct Search
- ❑ Stochastic Optimization
- ❑ Trial and Error

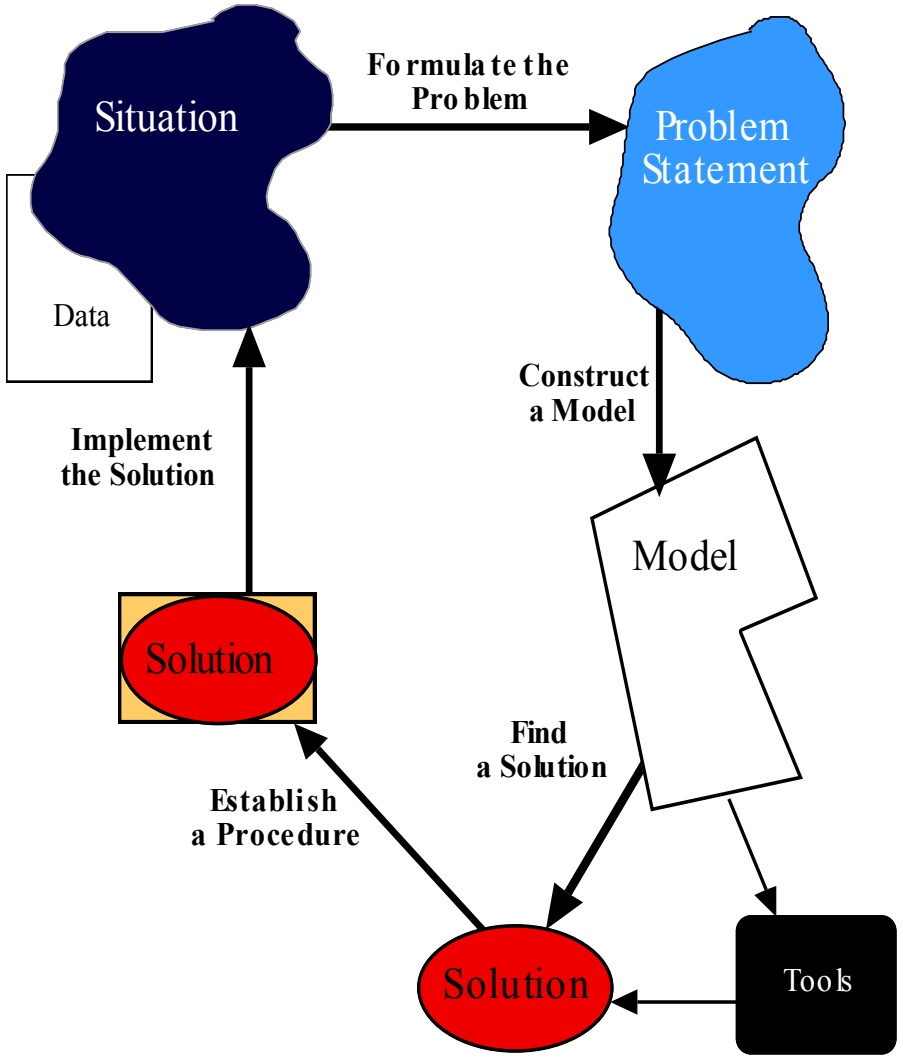
5. Testing the solution

- Checking accuracy of input data, and correctness of solution process
- May require refinement of model formulation and/or data acquisition
- Analyzing the results & sensitivity analysis → implication of solution for real problems



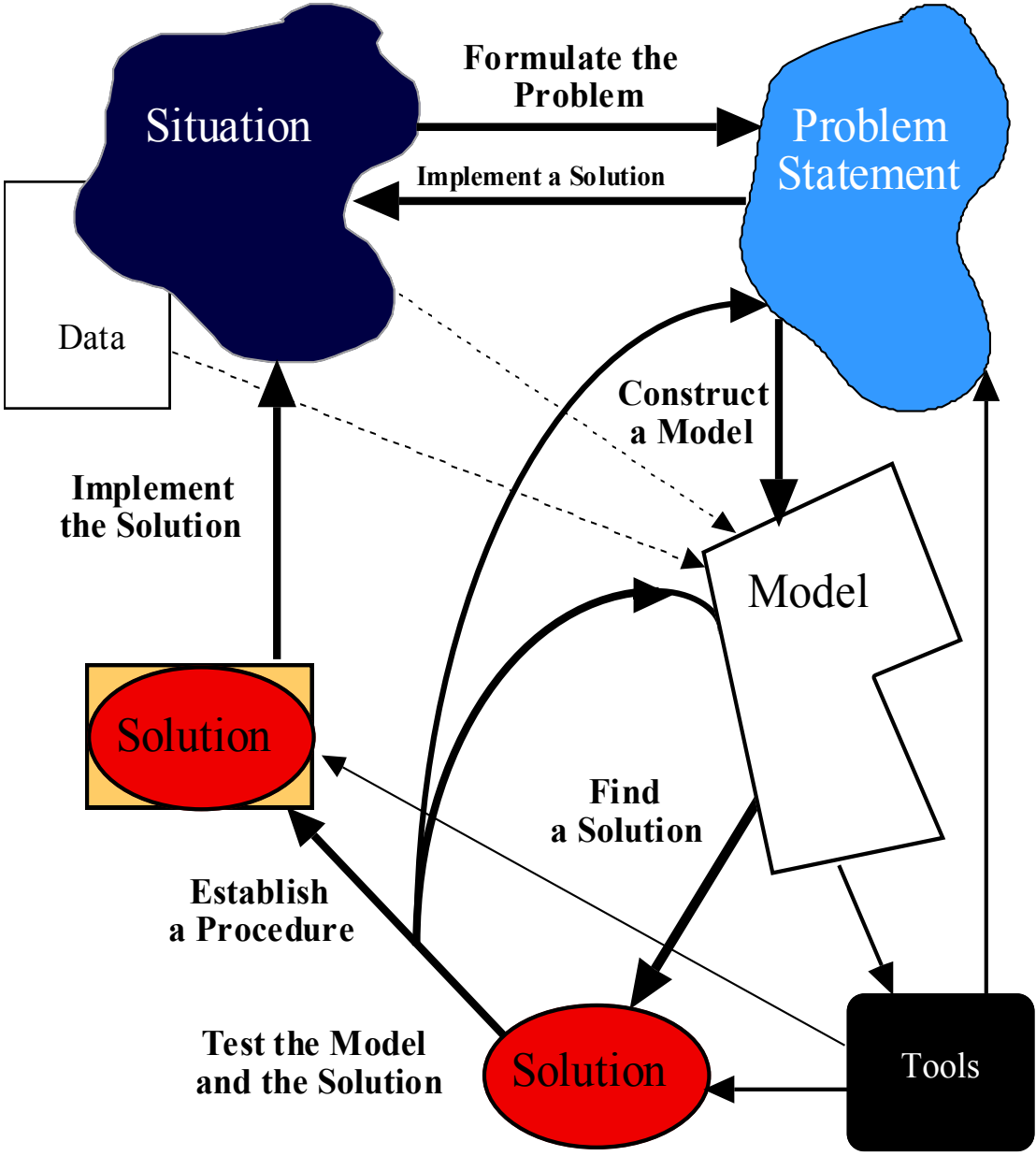
6. Implement the Solution

- Change for the organization
- Change is difficult
- Establish controls to recognize change in the situation
- Need to convince managers of correctness and practicality of proposed solution
- May need an ongoing monitoring and adjustment



The Goal is to Solve the Problem

- ❑ The model must be valid
- ❑ The model must be tractable
- ❑ The solution must be useful



Potential Problems

- Defining problem: conflicting viewpoints; impact on other departments, assumptions, dynamic environment
- Developing model: matching reality to “textbook” models; need for manager to understand model
- Acquiring data: applicability and validity; interpretation of data from one domain for use in another (e.g. accounting)

Potential Problems

- Developing solution: understanding of mathematics; single answer or range of solutions
- Testing solution: convincing managers about counter-intuitive solutions
- Analyzing results: predict impact on organization; who/what needs to change?
- Implementation: ensuring full benefit is realized; need to convince wider population within organization (managers and users)

Software OR

- Excel
- MPL/CPLEX/CONOPT
- LINDO/LINGO
- MATLAB

Lecture 2 - Preparation

- Read:
  - *Introduction to Operations Research.* Frederick Hillier and Gerald J. Lieberman. 2001. Page: 25-79.
- HW:
  - Problem 3.1-1 to 3.1-5

SEE YOU NEXT WEEK