OPERATIONS RESEARCH

"OR:THE SCIENCE OF BETTER"

"Operations Research is the discipline of applying advanced analytical methods to help make better decisions."

Operations Research: An Introduction

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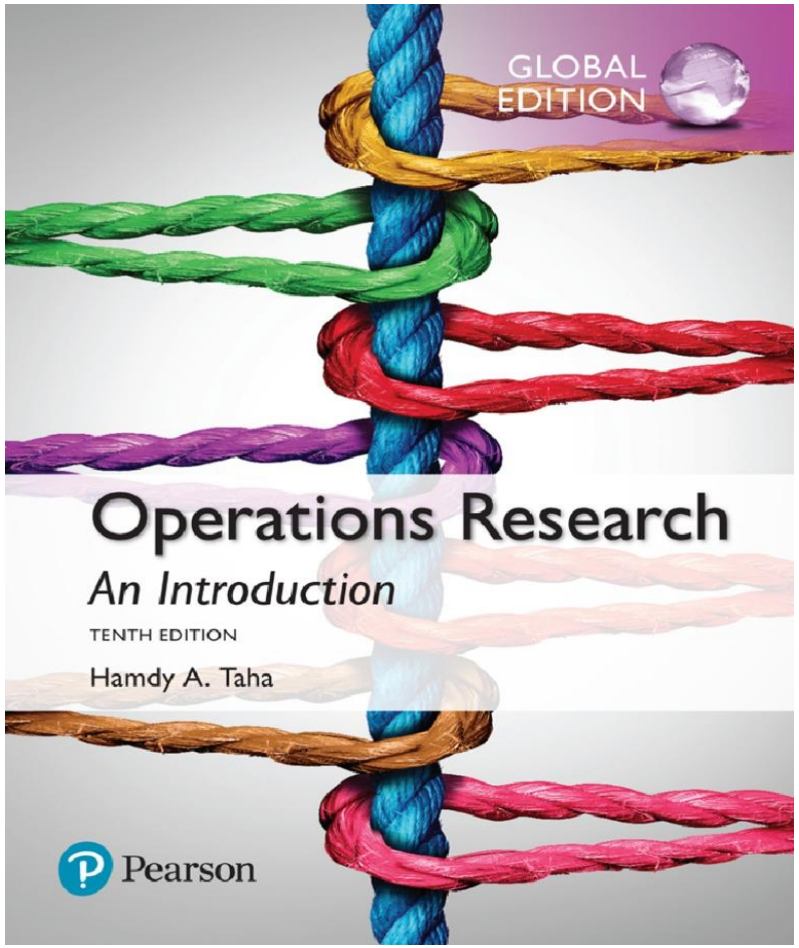
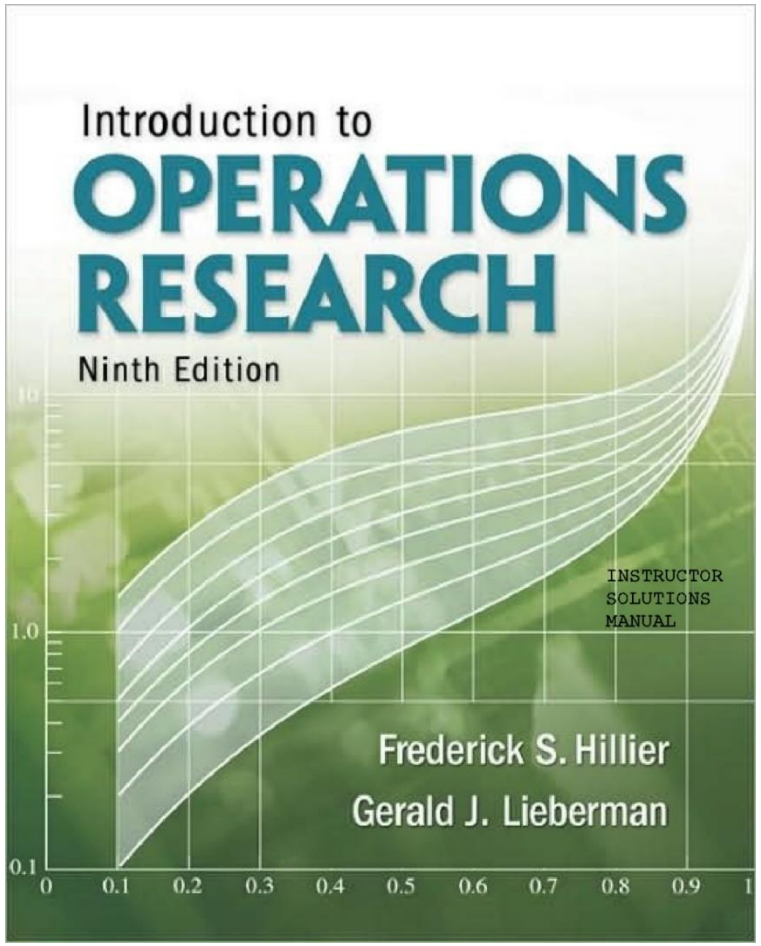
Marks Distribution

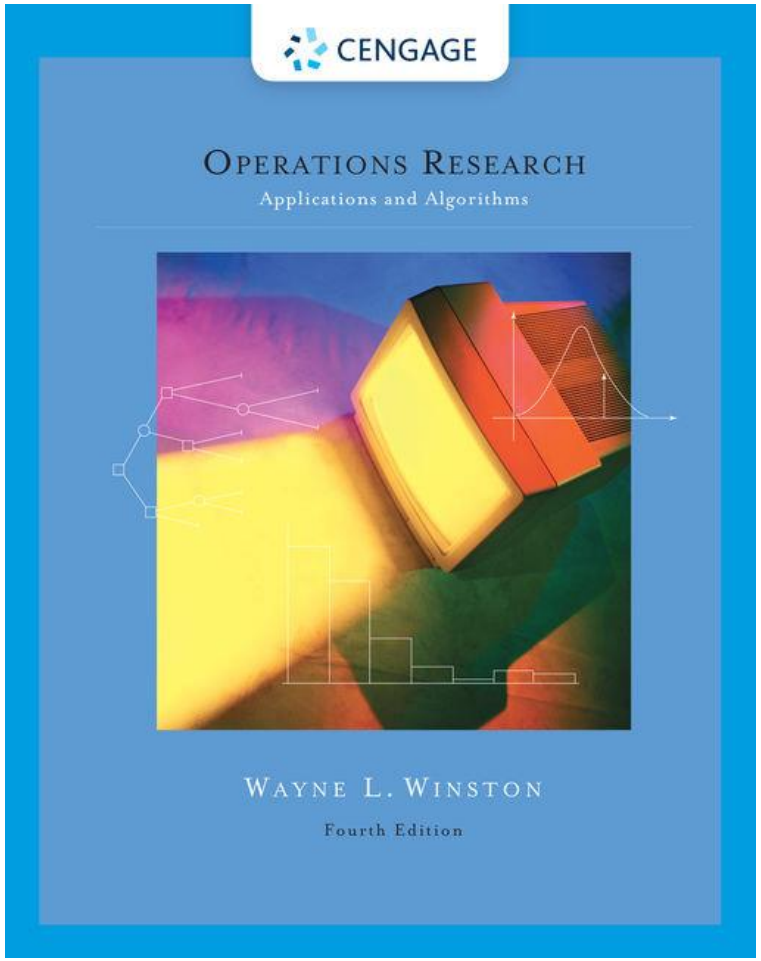
Sessional – I	**20**
Sessional – II	**20**
Project	**20**
Final Exam	**40**

- Absolute Grading Scheme

Recommended Books

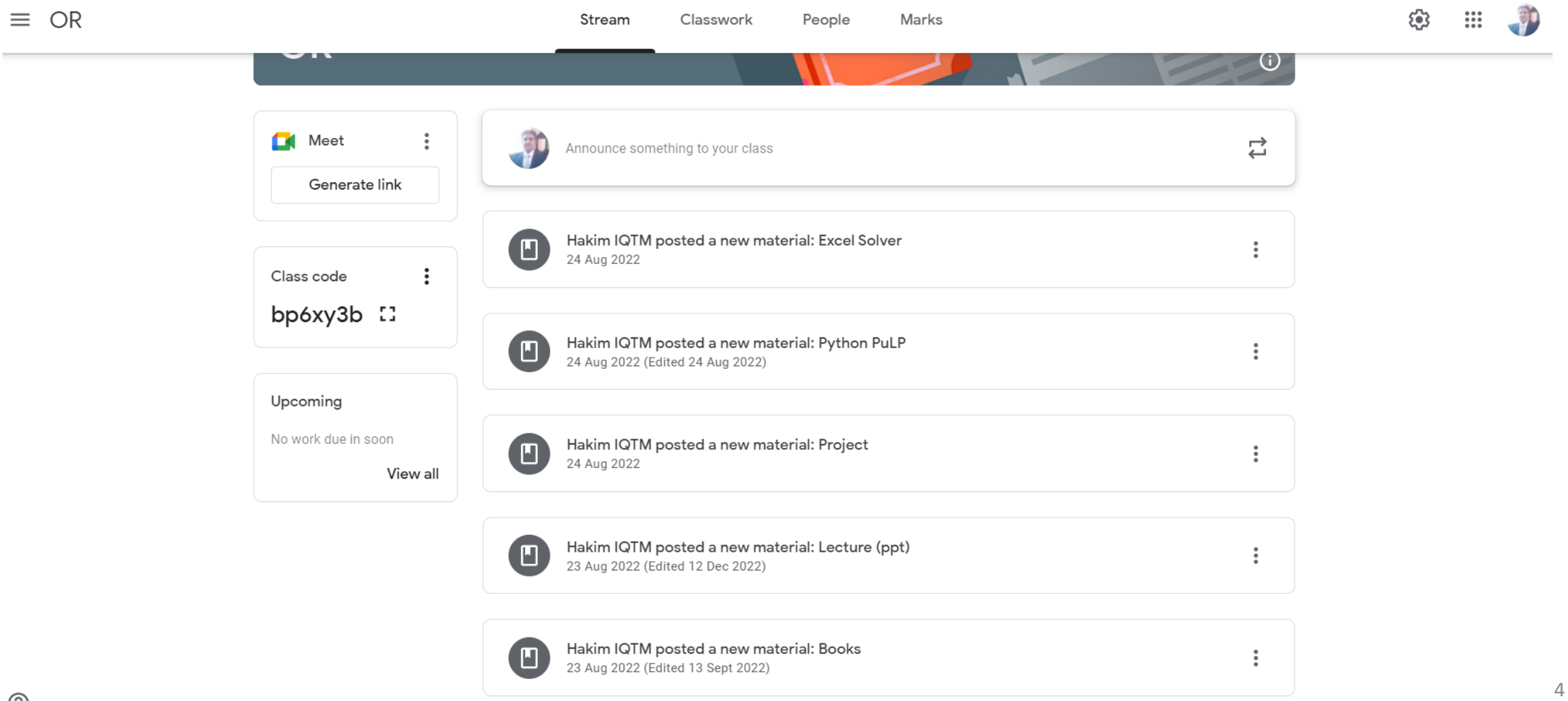




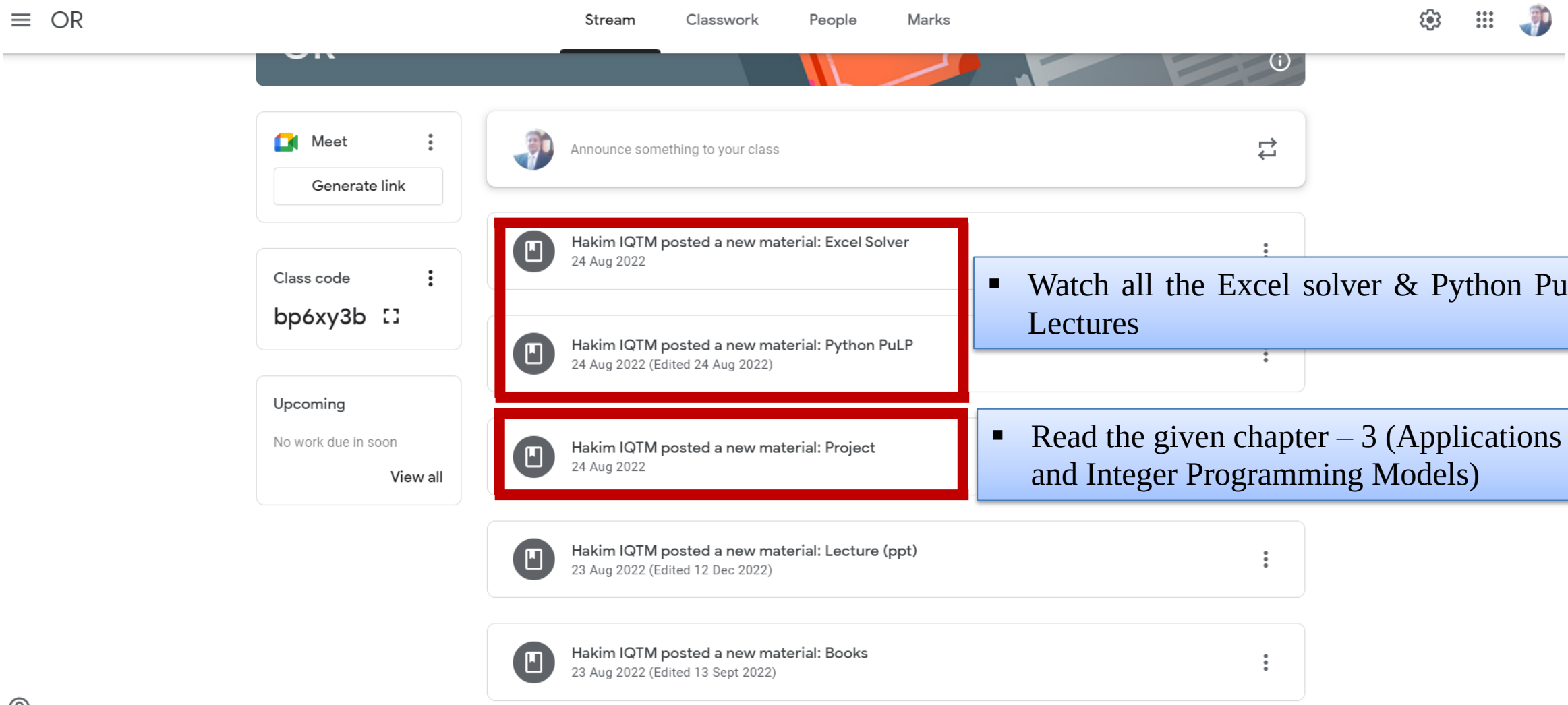


Google Class Room: Class Code

Class Code: bp6xy3b



Term Project



- Watch all the Excel solver & Python Pulp Video Lectures

- Read the given chapter – 3 (Applications of Linear and Integer Programming Models)

- Solve Chapter 3 (Case-1,2 & 3) Using Excel Solver & Python (PuLP).

Operations Research (OR): An Introduction

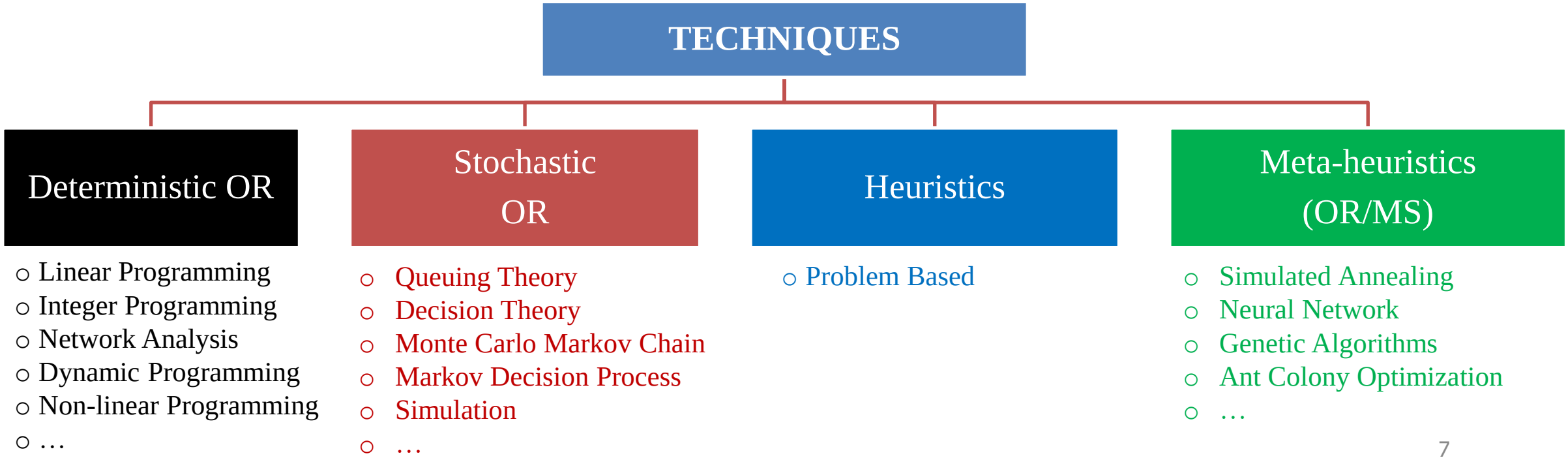
- The British / Europeans refer to “Operational Research", the Americans to “Operations Research" - but both are often shortened to just "OR".
- Another term used for this field is “Management Science" ("MS"). In U.S. OR and MS are combined together to form "OR/MS" or "ORMS".
- Yet other terms sometimes used are “Industrial Engineering" ("IE") and “Decision Science" ("DS").
- It is Often considered to be a sub-field of mathematics.

What is Operations Research (OR)?

- *Optimal decision-making in, and modeling of, deterministic and probabilistic systems that originate from real life.* These applications, which occur in government, business, engineering, economics, and the natural and social sciences, are *largely characterized by the need to allocate limited resources*. In these situations, considerable insight can be obtained from scientific analysis, such as that provided by Operations Research.

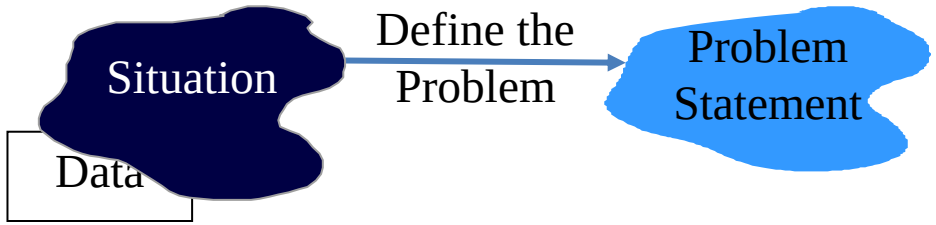
(Hiller–Lieberman).

- *OR: a new field which started in the late 1930's and has grown and expanded tremendously in the last 30 years*

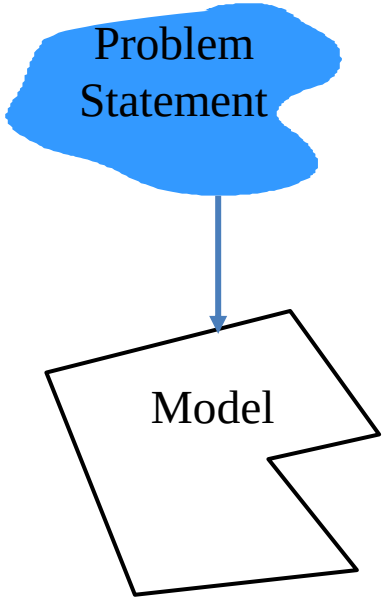


OR: Problem Solving Approach

1. **Define problem & gather data**
   - OR teams work in advisory capacity
   - Determine appropriate objectives from management
   - Concerned with the entire organization
   - Data gathering



2. **Formulate mathematical model**
   - Problem identified with <u>DECISION VARIABLES</u>
     - How many units to buy/sell ...
     - How much time to spend on a task ...
   - Measure of performance is the <u>OBJECTIVE FUNCTION</u>
     - What is the goal?; → Usually: Max/Min: profit/cost/time/units
     - A function of the decision variables
   - Restrictions of values of decision variables set in <u>CONSTRAINTS</u>
     - Min acceptable profit; Max available resources etc.
   - <u>PARAMETERS</u> are the constants of the objective function and the constraints



OR: Problem Solving Approach…

3. Develop a computer-based procedure for deriving solutions from the model

- Mathematical representations are always approximations of the real world
- Type of model dictates the type of algorithm to use to obtain solution
- Models can be:
  - DETERMINISTIC
  - STOCHASTIC

4. Testing the Model

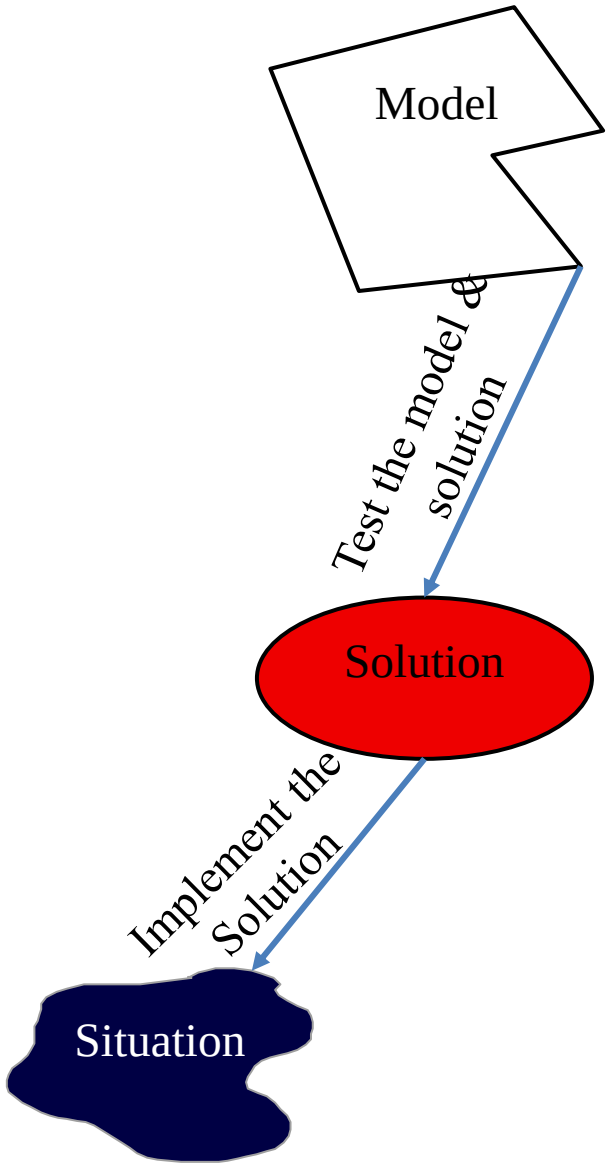
- Must ‘debug’ the model as with a computer program
- Process of testing/improving model is known as model validation

5. Preparing to Apply the Model

- Install a system for applying the model
- Usually computer-based systems that are provided with up-to-date input

6. Implementation

- OR team explains system to management
- Develop procedures required to put system into operation
- Management trains personnel



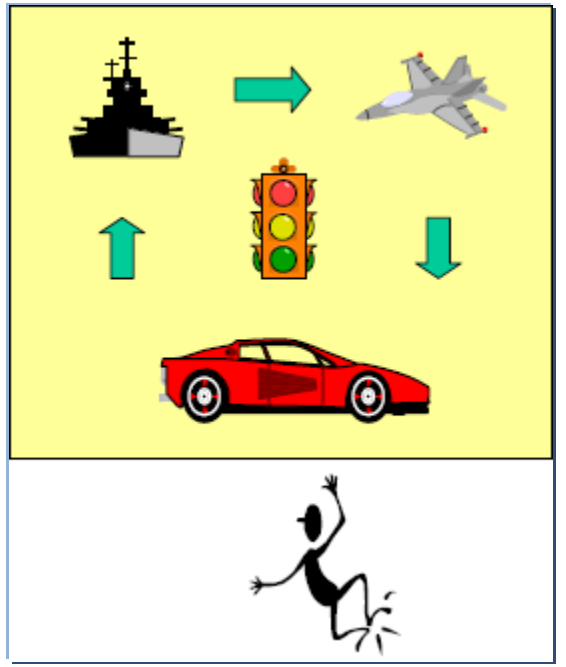
Operations Research Approach

SYSTEM Vs Its MODEL

REAL SYSTEM

- SIMPLIFICATION
- ABSTRACTION
- ASSUMPTIONS

MODEL



Model & Its Types

- **MODEL:** A model is a representation of the structure of a real life system.
  - In general, models can be classified as fellows:
    - Iconic models
    - Analogue models
    - Symbolic models

- **SYMBOLIC MODELS:** Symbolic (i.e., algebraic, numerical, logical) models represent the properties of the real life system through the means of symbols, mathematical equations, computer programs and simulation models are also symbolic models.
  - **DETERMINISTIC MODELS:** Deterministic models are models which do not contain the element of probability. Deterministic models involve optimization.
  - **STOCHASTIC MODELS:** stochastic models are models which contain the element of probability. Stochastic models characterize/estimate system performance.

Operations Research: Topics

- **Deterministic models:**
  - Linear Programming (LP)
  - Integer Programming (IP)
  - Dynamic Programming (DP)
  - Network Programming (NP)
  - Non-Linear Programming (NLP)
  - Goal Programming (GP)
- *Programming: planning of activities*
- **Stochastic models:**
  - Stochastic Programming
  - Markov chain
  - Monte Carlo Markov Chain
  - Queuing theory
  - Markov decision processes, and simulation
- **Decision making models:**
  - Decision analysis
  - multi-criteria and multi-objective decision making (e.g. AHP, GP etc.), and
  - game theory

OR: Programming Languages & Software

- **Optimization Software**
  - CPlex
  - Gurabi
  - AIMMS
  - Matlab
  - Lingo
  - R with Optimization packages (LpSolve, ROI etc.)
  - Excel Solver
  - Python with Optimization Libraries (PuLP, PyLPSolve etc.)

- **Simulation Software**
  - Arena
  - Simlu8
  - Simio
  - Flexsim, etc.

- **Computer Programming Languages**
  - C++
  - Java
  - Python etc.

QUESTIONS