OPERATIONS RESEARCH

ENIE 352

Lecture	**: 3**	**Year : III**
Tutorial	**: 1**	**Part : II**
Practical	**: 3/2**	

Course Objectives:

The objective of this course is to provide foundational knowledge of operations research, enabling students to manage and analyze data, apply forecasting techniques and use optimization models in areas such as production, transportation and finance. It also equips students with skills in inventory management, simulation and systems modeling to support effective decision-making under risk and uncertainty using relevant software tools.

1 Introduction (4 hours)

- 1.1 Operations research: Historical background and applications
- 1.2 Model types, characteristics and benefits
- 1.3 Mathematical modeling
- 1.4 Problem solving process
- 1.5 Interpretation and use of model results
- 1.6 Interface between data and model
- 1.7 Applications of data management and analysis
- 1.8 Data storage and retrieval
- 1.9 Spreadsheet in data management

2 Optimization (12 hours)

- 2.1 Limited resources and introduction to optimization
- 2.2 Characteristics of optimization problems
  - 2.2.1 Identification of decision variables
  - 2.2.2 Objective functions and constraints
  - 2.2.3 Formulation of mathematical model
- 2.3 Linear programming
  - 2.3.1 Simplex method, computer model
  - 2.3.2 Steps for formulating linear models
  - 2.3.3 Solving optimization problems in spreadsheet environment
- 2.4 Special conditions: Degeneracy, unbounded, infeasible solutions
- 2.5 Sensitivity analysis: Shadow prices and reduced costs concepts
- 2.6 Modeling linear programming problems in spreadsheets
- 2.7 Network modeling and integer programming
- 2.8 Goal programming and multiple objective optimization
- 2.9 Non-linear programming

3 Regression and Time Series Analysis (10 hours)

3.1 Fundamental concepts and theories
3.2 Simple regression analysis
3.3 Multiple regression analysis and multi-collinearity
3.4 Polynomial regression
3.5 Time series data: Stationary, non-stationary, seasonal data
3.6 Analysis of stationary models, seasonality models and trend models
3.7 CRYSTAL BALL -predictor for time series analysis

4 Decision Analysis and Multi-Criteria Decision Analysis (5 hours)

4.1 Characteristics of decision problems
4.2 Construction of payoff and regret matrix
4.3 Non-probabilistic decision rules: Maximax, maximin, minimax regret
4.4 Probabilistic decision rules: Expected monetary value, expected opportunity loss
4.5 Decision tree
4.6 Multi-criteria decision analysis (MCDA)
4.7 Game theory: Pure and mixed strategies, principles of dominance

5 Inventory Control and Queuing Theory (5 hours)

5.1 Inventory control models
  5.1.1 Types of inventories
  5.1.2 Economic order quantity (EOQ) model
  5.1.3 EOQ with and without shortages
  5.1.4 Quantity discount models
  5.1.5 Probabilistic inventory models
5.2 Queuing theory
  5.2.1 Basic components of a queuing system
  5.2.2 Kenel notation of queuing model
  5.2.3 Steady-state solution of Markovian queuing models
  5.2.4 Economic analysis of queuing system

6 Risk and Uncertainty Analysis (9 hours)

6.1 Monte Carlo simulation
6.2 Applications of Monte Carlo simulation
6.3 Different probability distributions
6.4 Building Simulation Models with CRYSTAL BALL
6.5 Decision and risk analysis
6.6 Application of decision and risk analysis

Tutorial (15 hours)

1. Exercises on basic and advanced functions in spreadsheets

2. Problems related to linear programming and developing models in spreadsheet
3. Problems related to network models and solving it in in spreadsheet
4. Problems related to multi objective programming and solving it in in spreadsheet
5. Exercises related to regression analysis in spreadsheets
6. Exercises related to time series analysis in spreadsheets
7. Problems related to risk analysis and solving it in in spreadsheet using Monte Carlo simulation
8. Exercises related to decision analysis in spreadsheets

Practical **(22.5 hours)**

1. Development of spreadsheet model for optimization problem
2. Spreadsheet model for regression and time series problem
3. Spreadsheet model for risk analysis and uncertainty analysis
4. Spreadsheet model for decision analysis problems
5. Case studies and group presentation on mathematical formulation of real-world problems and solutions through spreadsheet modeling

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1 and 2	16	24
3	10	12
4 and 5	10	12
6	9	12
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Ragsdale, C. T. (2018). Spreadsheet modeling and decision analysis: A practical introduction to management science. Cengage Learning.
2. Camm, J. D., Evans, J. R. (2000). Management science and decision technology (Latest Edition). Cengage Learning.
3. Taha, H. A. (2024). Operations research: An introduction. Pearson.
4. Bertsimas, D., Freund, R. M. (2019). Data, models, and decisions: The fundamentals of management science. Dynamic Ideas.