DegreeLive

DECISION SCIENCE

BBA Semester 4 – Calicut University

MODULE 1: INTRODUCTION TO OPERATIONS RESEARCH

Operations Research (OR)

1. Operations Research is the scientific approach to decision-making using mathematical models and analytical techniques.
2. Helps managers select the best solution among alternatives.
3. Focuses on optimum use of resources.

Scope

1. Production planning.
2. Inventory control.
3. Transportation.
4. Scheduling.
5. Project management.
6. Resource allocation.

Limitations

1. Depends on accurate data.
2. Mathematical models may not reflect real-world complexity.
3. Costly and time-consuming.
4. Human factors are difficult to quantify.

OR Models, Applications and Ethics

OR Models

1. Simplified representation of real-world problems.
2. Types:
   a. **Physical Models:** Scaled representation of objects.
   b. **Analog Models:** One system represents another.
   c. **Mathematical Models:** Uses equations and symbols.

Applications of OR

1. Production decisions.
2. Transportation planning.
3. Inventory management.
4. Marketing decisions.
5. Financial planning.

Ethics in OR

1. Use accurate and unbiased data.
2. Avoid manipulation of results.
3. Ensure fairness in decision making.
4. Maintain confidentiality.

Methodology of OR

Steps

1. Identify problem.
2. Collect relevant data.
3. Formulate model.
4. Obtain solution.
5. Test solution.
6. Implement decision.
7. Monitor and review.

Importance

1. Structured decision-making.
2. Better utilization of resources.
3. Improved efficiency.

Linear Programming (LP)

1. Mathematical technique used to maximize profit or minimize cost under given constraints.

Applications

1. Production planning.
2. Resource allocation.
3. Transportation.
4. Scheduling.

Components

1. **Decision Variables:** Unknown values to be determined.
2. **Objective Function:** Quantity to maximize or minimize.
3. **Constraints:** Limitations or restrictions.
4. **Non-Negativity Condition:** Variables cannot be negative.

Mathematical Formulation and Graphical Solution

Mathematical Formulation

Steps:

1. Define decision variables.
2. Form objective function.
3. Form constraints.
4. Apply non-negativity restrictions.

Graphical Solution Method

1. Used when there are two decision variables.
2. Constraints plotted on graph.
3. Feasible region identified.
4. Optimal solution found at corner points.

Advantages & Limitations

1. **Advantages:** Easy visualization, Simple for small problems.
2. **Limitation:** Not suitable for more than two variables.

MODULE 2: TRANSPORTATION AND ASSIGNMENT PROBLEMS

Transportation Problem

1. Determines the least-cost method of transporting goods from sources to destinations.

Objectives

1. Minimize transportation cost.
2. Minimize time.
3. Optimize resource utilization.

Initial Basic Feasible Solution (IBFS)

1. Initial solution before testing optimality.
2. **North West Corner Rule (NWCR):** Allocation begins from top-left corner. Simple but may not give best solution.
3. **Vogel's Approximation Method (VAM):** Uses penalty values for allocation. Usually provides better initial solution than NWCR.

MODI Method

1. MODI (Modified Distribution Method).
2. Used to test optimality of transportation solutions.

Purpose

1. Determines whether current solution is optimal.
2. Helps improve transportation plan if required.

Advantage

1. Reduces transportation cost systematically.

Assignment Problem

1. Special case of transportation problem.
2. Assigns jobs to persons or machines to tasks.

Objective

1. Minimize cost or time.
2. Maximize efficiency.

Hungarian Method

Steps:

1. Row reduction.
2. Column reduction.
3. Cover zeros.
4. Make assignments.
5. Obtain optimal solution.

Advantage

1. Provides optimal assignment efficiently.

Maximization and Unbalanced Assignment Problems

Maximization Assignment Problem

1. Objective is maximizing profit or benefit.
2. Converted into minimization form before applying Hungarian Method.

Unbalanced Assignment Problem

1. Number of jobs and persons are unequal.
2. **Solution:** Add dummy row or dummy column to balance the matrix.

Travelling Salesman Problem (TSP)

1. Determines shortest route covering all cities exactly once and returning to starting point.

Objectives

1. Minimize distance.
2. Minimize cost.
3. Minimize travel time.

Applications

1. Delivery routing.
2. Logistics planning.
3. Sales route planning.

MODULE 3: NETWORK ANALYSIS

Network Analysis

1. Technique used for planning, scheduling and controlling projects.

Network

1. Graphical representation of project activities and events.

Rules for Constructing Network

1. Activities flow from left to right.
2. No loops allowed.
3. Each activity represented clearly.
4. Logical sequence must be maintained.

Time Calculations

1. **Earliest Start Time (EST):** Earliest time an activity can begin.
2. **Earliest Finish Time (EFT):** Earliest time activity can be completed.
3. **Latest Start Time (LST):** Latest time activity can start without delay.
4. **Latest Finish Time (LFT):** Latest completion time without delaying project.

CPM and PERT

CPM (Critical Path Method)

1. Used when activity times are known with certainty.

PERT (Program Evaluation and Review Technique)

1. Used when activity times are uncertain.

Time Estimation in PERT

Uses three estimates:

1. Optimistic Time (O).
2. Most Likely Time (M).

3. Pessimistic Time (P).

Critical Path

1. Longest path in network.
2. Determines minimum project completion time.
3. Activities on critical path have zero slack.

Merits and Demerits of CPM and PERT

Merits

1. Better planning.
2. Effective scheduling.
3. Resource control.
4. Identifies critical activities.
5. Improves project monitoring.

Demerits

1. Time-consuming for large projects.
2. Requires accurate data.
3. Complex networks may be difficult to manage.

Difference Between CPM and PERT

CPM	PERT
Deterministic	Probabilistic
Time known	Time uncertain
Suitable for routine projects	Suitable for research projects
Cost-oriented	Time-oriented

MODULE 4: DECISION THEORY AND REPLACEMENT MODELS

Decision Theory

1. Study of choosing the best alternative among available options.

1. **Decision Under Certainty:** Outcome is known with certainty.
2. **Decision Under Uncertainty:** Outcome is unknown and probabilities are not available.
3. **Decision Under Risk:** Probabilities of outcomes are known.
4. **Decision Under Conflict:** Decisions influenced by competitors or opponents.

Payoff Matrix and Decision Tree

Payoff Matrix

1. Table showing outcomes of different decisions under various situations.
2. **Uses:** Compare alternatives, Select best strategy.

Decision Tree

1. Graphical representation of decisions and possible outcomes.
2. **Components:** Decision Node, Chance Node, Outcome Branches.
3. **Advantages:** Easy visualization, Useful under risk and uncertainty.

Game Theory

Meaning

1. Study of strategic decision-making where outcome depends on actions of competitors.

Applications

1. Pricing decisions.
2. Market competition.
3. Business strategy.
4. Negotiation.

Assumptions

1. Rational players.
2. Conflicting interests.
3. Defined strategies and payoffs.

Pure Strategy Games and Saddle Point

Pure Strategy

1. Player consistently follows one strategy.

Saddle Point

1. Point where: Maximin Value = Minimax Value.

Significance

1. Indicates stable solution.
2. Players need not change strategies.

Saddle Point Conditions

1. **If Saddle Point Exists:** Optimal strategy is immediately identified.
2. **If Saddle Point Does Not Exist:** Mixed strategy may be required.

Theory of Replacement

Meaning

1. Determines when existing equipment or assets should be replaced.

Objectives

1. Minimize maintenance cost.
2. Improve efficiency.
3. Reduce operating expenses.

Importance

1. Better investment decisions.
2. Increased productivity.

Replacement Models

1. **Items that Deteriorate Gradually:** Examples: Machines, Vehicles, Equipment.

2. **Items that Fail Suddenly:** Examples: Bulbs, Electronic components.

Purpose

1. Determine economical replacement time.

Replacement of Items that Deteriorate Gradually

1. Applicable when maintenance cost increases over time.
2. Assumes value of money remains constant.
3. Replacement decision is based on total operating and maintenance cost.

Principle

1. Continue using asset while average annual cost decreases.
2. Replace asset when average annual cost begins to increase.

Benefits

1. Cost reduction.
2. Better resource utilization.
3. Improved operational efficiency.