**Operations Research**

**Lecture Notes**

Prepared & edited by

Tanmoy Das

Industrial Engineer & Jr. Data Scientist

Reference materials can be found at <https://github.com/tanmoyie/Operations-Research> <https://kaggle.com/tanmoyie>, www.linkedin.com/in/tanmoyie ­

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# Introduction to Operations Research

**Operations research** is a discipline that deals with the application of advanced analytical methods to help make better decisions. **Operational Research always try to find the best and optimal solution to the problem.** For this purpose, objectives of the organization are defined and analyzed. These objectives are then used as the basis to compare the alternative courses of action.

Approach:

**1.** Define the problem of interest and gather relevant data.

**2.** Formulate a mathematical model to represent the problem.

**3.** Develop a computer-based procedure for deriving solutions to the problem from the

model.

**4.** Test the model and refine it as needed.

**5.** Prepare for the ongoing application of the model as prescribed by management.

**6.** Implement.

* May involve current operations or proposed developments due to expected market shifts
* May become apparent through consumer complaints or through employee suggestions
* May be a conscious effort to improve efficiency or respond to an unexpected crisis



## Linear Programming

**Linear programming:** The general problem of *optimizing* a linear function of several variables subject to a number of *constraints* that are linear in these variables and a subset of which restrict the variables to be non-negative.

NOTE: The general mathematical formulation of the *linear programming* problem is the set of matrix relationships as follows:

**Optimizing** means obtaining the best possible mathematical solution to a given set of equations.

### Math Problem

## Graphical Solution

# Simplex, Dual, Sensitivity

## Simplex Method

### Big M

### Unbounded Solution

### Infeasible Solution

### Revised Simplex

### Dual Problem

## Python Projects

Python Code of Optimization Project 1: Revised Simplex

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# Transportation

## NorthWest Corner Method

## Assignment Problem

## Python Projects on Transportation

Python Project on Optimization 1: Transportation Network for distributing products from source to destination[[1]](#footnote-1)

**Problem Description**

A boutique brewery has two warehouses from which it distributes beer to five carefully chosen bars. At the start of every week, each bar sends an order to the brewery’s head office for so many crates of beer, which is then dispatched from the appropriate warehouse to the bar. The brewery would like to have an interactive computer program which they can run week by week to tell them which warehouse should supply which bar so as to minimize the costs of the whole operation. For example, suppose that at the start of a given week the brewery has 1000 cases at warehouse A, and 4000 cases at warehouse B, and that the bars require 500, 900, 1800, 200, and 700 cases respectively. Which warehouse should supply which bar?

**Formulation**

For transportation problems, using a graphical representation of the problem is often helpful during formulation. Here is a graphical representation of The Beer Distribution Problem.

# Optimization in Machine Learning/ Data Science

## Linear Regression

## Robust Regression

## Support Vector Machine

# Network Optimization

## Min Cost

## Max Flow

## Minimum Spanning Tree

## Python Projects on Network Optimization

Python Code of Optimization Project 2: Min Cost Flow problem

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1. Source: https://www.coin-or.org/PuLP/CaseStudies/a\_transportation\_problem.html [↑](#footnote-ref-1)