1 Section 1.1: What is Deterministic Operations Research?

Operations Research is the study of how to form mathematical models of complex science, engineering, industrial, and management problems and how to analyze them using mathematical techniques.

In other words, OR is:

History

Cycle of Operations Research

General Approach to Operations Research

1. Problem Definition and Data Gathering:

2. Create the Mathematical Model
3. Solve the Mathematical Model

4. Use the Model to Make Real World Predictions

5. Done?
Example 1. (Example 1.1 on page 5 in the book) Farmer Jones decides to supplement his income by baking and selling two types of cakes, chocolate and vanilla. Each chocolate cake sold gives a profit of $3, and the profit on each vanilla cake sold is $5.

Each chocolate cake requires 20 minutes of baking time and uses 4 eggs and 4 pounds of flour, while each vanilla cake requires 40 minutes of baking time and uses 2 eggs and 5 pounds of flour. If Farmer Jones has available only 260 minutes of baking time, 32 eggs, and 40 pounds of flour, how many of each type of cake should be baked in order to maximize Farmer Jones’ profit?

Problem definition and Data Gathering
What are we trying to solve?

Creating the Mathematical Model
Create Decision Variables

What else do we know? What are some of the constraints of the problem?

What is our objective again?

Therefore, written as a mathematical model we get:
Solving the Mathematical Model
Using the Mathematical Model to Make Real-World Predictions

What does our solution tell us?

What happens if the profit from selling Vanilla cakes is $8 instead of $5?
Sensitivity Analysis

Are we done?
3 Definitions

**Decision Variable:** These are the variables that represent the decisions to be made. 
*e.g.* How many chocolate and vanilla cakes should we bake?

**Continuous Variable:** A variable that

**Discrete Variable:** A variable that

**Solution:** A solution to an optimization problem is a collection of values of the decision variables.

**Feasible Solution:** A solution that

**Feasible Region:** The set of all feasible solutions.

**Value:** The value of a feasible solution is its objective function value.

**Optimal Solution:** A feasible solution that is at least equal to all other solutions.

If our optimization problem is a maximizing problem, then:

If our optimization problem is a minimizing problem, then:

**Unbounded Problem:**
4 GUSEK

var C >= 0;
var V >= 0;

maximize total_profit: 3*C + 5*V;
subject to eggs: 4*C + 2*V <= 32;
subject to flour: 4*C + 5*V <= 40;
subject to baking: 20*C + 40*V <= 260;

end;