**Optimization Methods for Business Analytics**

**INFO 582**

**Assignment – 2**

**Developing Mathematical Models**

**By**

**Group 3**

Sarju Tuladhar

Hema Ravi Teja Bollam

Tirumala Prasad Bade

Rakesh Koneru

ASSIGNMENT INSTRUCTIONS

In this assignment, you will formulate and solve the mathematical problems using python in google colab. You will submit two files:

1. A word file with the mathematical formulations of the problems,

2. An .ipynb file with solutions of each problem.

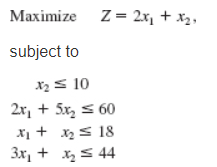
You are expected to type the mathematical formulations of questions 2, 3 and 4 using the Equation editor (under the Insert Menu). Also, once you solve the questions on a Colab Notebook, download the notebook as an .ipynb file. You can see the instructions for downloading a file in an .ipynb format here.

Name the files you are submitting with your name. For example if I submit a colab notebook, I should name it "Eyyub\_Kibis\_Assignment.ipynb" and If I submit an MS word file, the file name should read " Eyyub\_Kibis\_Assignment.docx".

Indicate the questions and your answers in the files properly so that I know which question your specific answer corresponds to.

QUESTIONS

1. Solve the following linear problem using pyomo package in python.



2. The SilverCo Company desires to blend a new alloy of 40 percent tin, 35 percent zinc, and 25 percent lead from several available alloys having the following properties:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Alloy** | | | | |
| **Property** | **1** | **2** | **3** | **4** | **5** |
| Percentage of tin | 60 | 25 | 45 | 20 | 50 |
| Percentage of zinc | 10 | 15 | 45 | 50 | 40 |
| Percentage of lead | 30 | 60 | 10 | 30 | 10 |
| Cost ($/lb) | 22 | 20 | 25 | 24 | 27 |

The objective is to determine the proportions of these alloys that should be blended to produce the new alloy at a minimum cost.

1. Formulate a linear programming model for this problem (You need to clearly define decision variables, generate the objective function and constraints).
2. Solve it using pyomo.

**Solution:**

**Decision variables:**

X1 = Proportion of alloy 1

X2 = Proportion of alloy 2

X3 = Proportion of alloy 3

X4 = Proportion of alloy 4

X5 = Proportion of alloy 5

**Objective function:**

Minimize cost: 22X1 + 20X2 + 25X3 + 24X4 + 27X5

**Constraints:**

Tin : 60X1 + 25X2 + 45X3 + 20X4 + 50X5 = 40

Zinc : 10X1 + 15X2 + 45X3 + 50X4 + 40X5 = 35

Lead: 30X1 + 60X2 + 10X3 + 30X4 + 10X5 = 25

**Non negative Constraints :**

X1, X2, X3, X4, X5 0

3. Back Savers is a company that produces backpacks primarily for students. They are considering offering some combination of two different models—the Collegiate and the Mini. Both are made out of the same rip-resistant nylon fabric. Back Savers has a long-term contract with a supplier of the nylon and receives a 5000 square-foot shipment of the material each week. Each Collegiate requires 3 square feet while each Mini requires 2 square feet. The sales forecasts indicate that at most 1000 Collegiates and 1200 Minis can be sold per week. Each Collegiate requires 45 minutes of labor to produce and generates a unit profit of $32. Each Mini requires 40 minutes of labor and generates a unit profit of $24. Back Savers has 35 laborers that each provides 40 hours of labor per week. Management wishes to know what quantity of each type of backpack to produce per week.

1. Formulate a linear programming model for this problem (You need to clearly define decision variables, generate the objective function and constraints).
2. Solve it using pyomo.

**Solution:**

**Decision Variables:**

X1 = Quantity of Collegiate backpack produced per week

X2 = Quantity of Mini backpack produced per week

**Objective function:**

Maximize profit: 32X1 + 24X2

**Constraints:**

Nylon material: 3X1 + 2X2 5000

Quantity limit of Collegiate : X1 1000

Quantity limit of Mini: X2 1200

Labor: 45X1 + 40X2 35 \* 40 \* 60 ~ 84,000

**Nonnegative constraint:**

X1 0

X2 0

4. Logan Manufacturing wants to mix two fuels, A and B, for its trucks **to minimize cost**. It needs no fewer than 3,300 gallons to run its trucks during the next month. It has a maximum fuel storage capacity of 4,300 gallons. There are 2,200 gallons of fuel A and 3,600 gallons of fuel B available. The mixed fuel must have an octane rating of no less than 78.

When fuels are mixed, the amount of fuel obtained is just equal to the sum of the amounts put in. The octane rating is the weighted average of the individual octanes, weighted in proportion to the respective volumes.

The following is known: Fuel A has an octane of 88 and costs $1.20 per gallon. Fuel B has an octane of 66 and costs $1.70 per gallon.

1. Formulate a linear programming model for this problem (You need to clearly define decision variables, generate the objective function and constraints).
2. Solve it using pyomo.

**Solution:**

**Decision variables:**

A : Gallons of fuel A

B: Gallons of fuel B

**Objective function:**

Minimize cost: 1.2 A + 1.7 B

**Constraints:**

Minimum gallon of fuel needed : A + B 3300

Maximum capacity of fuel: A + B 4300

Availability of Fuel A: A 2200

Availability of Fuel B: B 3600

88A / (A + B)+ 66 B/ (A + B) 78

OR (88A + 66 B) / (A + B) 78

**Non negative constraints :**

A 0

B 0