# BABI – Optimization Techniques – Assignment

1. The U-save company is planning its operations for the next year. The company is considering investing in four types of securities. The company has $1 million available for investment. The expected annual return and the “risk index” of each security are as follows:

Expected return Risk index

(%)

Long-term Bonds 15% 3

Medium-term Bonds 12% 4

Government Bonds 9% 7

Short-term Bonds 10% 9

The company wants to maximize the expected return from its bond investments, subject to the following restrictions:

* The average risk index of the portfolio should not exceed 6
* At most 45% of the total amount invested can be invested in any single bond
* The expected return of the Government bond portfolio should be at least 1.2 times the return of the Long term and medium term bond portfolio.

Formulate the problem as a LP problem. Define the decision variables carefully. Use any software at your disposal to obtain an optimal solution.

1. The Crazy Nut company wishes to market two special nut mixes during the holiday season. Every pound of mix 1 contains 0.5 pound of peanuts and 0.5 pound of cashews; Every pound of Mix 2 contains 0.6 pound of peanuts, 0.25 pound of cashews, and 0.15 pound of almonds. Mix 1 sells for $1.49 per pound; Mix 2 sells for $1.69 per pound. The data pertinent to the raw ingredients appear in the table

Ingredient Amount available Cost per lb.

(lb) ($)

Peanuts 30,000 $0.35

Cashews 12,000 $0.50

Almonds 9,000 $0.60

Assuming that Crazy can sell all cans of either mix that it produces, formulate an LP model to determine how much of mixes 1 and 2 to produce. Use any software at your disposal to obtain an optimal solution.

1. You have decided to enter the candy business. You are considering producing two types of candies: Slugger Candy and Easy Out Candy, both of which consist solely of sugar, nuts, and chocolate. At present, you have in stock 100 oz of sugar, 20 oz of nuts, and 30 oz of chocolate. The mixture used to make Easy Out candy must contain at least 20% nuts. The mixture used to make Slugger Candy must contain at least 10% nuts and 10% chocolate. Each ounce of Easy Out Candy can be sold for 25 cents, and each ounce of Slugger Candy can be sold for 20 cents. Formulate an LP that will enable you to maximize your revenue from candy sales. Use any software at your disposal to obtain an optimal solution.
2. Consider the staffing problem faced by the Great Lakes Bus Company that requires the following number of drivers on each day.

Day Mon Tue Wed Thu Fri Sat Sun

Number needed 19 16 14 16 19 14 10

Each driver works for 5-consecutive days in a week and then receives two days off. The company assumes that if more than required number of drivers are scheduled to work on any given day, then the extra drivers will be given a paid day off. The company solves the following linear program to determine the optimal staffing plan

MIN Z = X1 + X2 + X3 + X4 + X5 + X6 + X7

Subject to

X1 + +X4 + X5 + X6 + X7 > 19

X1 + X2 + X5 + X6 + X7 > 16

X1 + X2 + X3 + X6 + X7 > 14

X1 + X2 + X3 + X4 + X7 > 16

X1 + X2 + X3 + X4 + X5 > 19

+ X2 + X3 + X4 + X5 + X6 > 14

X3 + X4 + X5 + X6 + X7 > 10

X1, X2, X3, X4, X5, X6, X7 > 0

Using a linear programming software, the optimal solution was found to be:

X1 = 8; X2 = 3; X3 = 0; X4 = 5; X5 = 3; X6 = 3; X7 = 0

Answer the following questions based on the above information.

1. What is the definition of the decision variables in the linear program used by the company?
2. Describe the objective function (in words) that the company uses in the linear program
3. Determine the optimal value of the objective function
4. Based on the optimal solution, how many drivers will be scheduled to work on Monday?
5. Based on the optimal solution, how many drivers will be scheduled to work on Tuesday?
6. Suppose the drivers were paid $ 50 per weekday and $ 80 for Saturday or Sunday, What is the total money paid to the drivers if the optimal plan determined above was implemented.

# Company XYZ is facing network coordination issues and is contemplating to move from multi-sourcing to single sourcing. Currently, they have five suppliers shipping parts to three of their manufacturing plants.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Supplier data | |  | |  |
| **Supplier** | | **Annual Fixed Cost in Coordinating with Supplier ($)** | | **Annual Capacity of Supplier (units)** |
| A | | **20,000** | | **5000** |
| B | | **25,000** | | **3000** |
| C | | **20,000** | | **7000** |
| D | | **18,000** | | **5000** |
| E | | **27,000** | | **6000** |
| Plant data | |  | |  |
|  |  | |
| **Plant** | **Annual Demand at Plant** | |
| X | **5000** | |
| Y | **3000** | |
| Z | **2000** | |

Production and Transportation Cost Data:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| **Supplier/ Plant** | X | Y | Z |
| A | **$5** | **4** | **5** |
| B | **4** | **6** | **5** |
| C | **5** | **4** | **12** |
| D | **8** | **7** | **3** |
| E | **10** | **7** | **3** |
|  |  |  |  |

5a.The company wants to reduce their supply base for better coordination by single sourcing, i.e., a single supplier sources each plant. Develop a model that would identify an optimal solution for the company.

5b. Formulate problem 3a as a multiple supplier sourcing model, i.e., you are removing the restriction that a plant can only be sourced from a single supplier.