SNU Fourth Industrial Revolution Academy

Basic Math for Big Data

Homework 4

Due: August 3, 10:00 AM

Reminders

- T.A.: Chiwan Park (chiwanpark@snu.ac.kr)
- The points of this homework add up to 100.
- This has to be done individually like all the homeworks.
- Please answer clearly; illegible handwriting may get no points.
- Whenever you are making an assumption, please state it clearly.
- If you have a question about assignments, please upload your question in FIRA portal.

Submissions

- You can submit your homework in the class or via email (only PDFs are accepted).
- Do not submit the homework in a photography form.

Question 1 [15 points]

Answer the following questions to solve the following linear programming problem containing two variables, x and y.

$$\begin{aligned} \text{maximize} \quad & 2x + 3y \\ \text{subject to} \quad & -3x + y \leq 2 \\ & 4x + 2y \leq 44 \\ & 4x - y \leq 20 \\ & -x + 2y \leq 14 \\ & 0 \leq x, y \end{aligned}$$

(a) Draw graphs of the linear constraints into an xy-plane and shade the feasible region. [10 points]

(b) Find the optimal solution of the problem and denote the solution in the graph of (a). [5 points]

Question 2 [15 points]

Consider a bakery which sells two types of bread, chocolate cream bread and baguette for 10 and 4 dollars, respectively. The chocolate cream bread consumes 100 grams of flour and 10 grams of chocolate, while the baguette consumes only 50 grams of flour. The bakery has 3 kilograms of flour and 100 grams of chocolate. Answer the following questions.

(a) Formulate an appropriate linear programming problem to maximize revenue. [10 points]

(b) Find the optimal solution for the problem in (a). [5 points]

Question 3 [30 points]

A bronze-medal manufacturing company can produce three types of the medal, A, B, and C which sell for 18, 29, and 25 dollars and consume 0.5, 0.2, and 0.75 kilograms of copper and 0.2, 0.4 and 0.2 grams of tin, respectively. The company has 0.6 kilograms of tin and 1500 kilograms of copper, and are required to produce at least 1000 medals of A, 200 medals of B, and 400 medals of C. Answer the following questions.

(a) Formulate an appropriate linear programming problem to maximize revenue. [15 points]

(b) Find the optimal solution for the problem in (a) using the linear programming solver in R. Note that you should submit your R script via email. [15 points]

Question 4 [40 points]

Table 1 shows the needs of couriers to provide delivery services for the following three months. The cost of a courier is $8000 per month. At the beginning of the first month, the delivery company has 20 staffs, but the number of staffs can be adjusted each month.

Table 1. Needs of couriers for the following three months

Month	1	2	3
Needed couriers	30	60	55

Couriers can be hired and fired at the beginning of each month. Newly hired couriers can start working at the same month, and fired couriers stop working the same day they are fired. The cost of firing a courier is $10000, and the hiring cost of a courier is $5000. If it is convenient, the company can have a staff of couriers larger than the actual needs. Answer the following questions.

(a) Formulate an appropriate linear programming problem to minimize costs. [25 points]

(b) Find the optimal solution for the problem in (a) using the linear programming solver in R. Note that you should submit your R script via email. [15 points]