Department of Industrial Engineering & Operations Research

IEOR 162 Linear Programming and Network Flows (Spring 2022)

1 Linear programming modeling examples

1.1 Bakery problem

You are the owner of Cal Bakery, that can bake: cookies, breads or cakes. You have limited resources as given in the table. You want to maximize your profit for the operation of the bakery.

	Cake	**Bread**	**Cookie**	**Resource limit**
Profit	\$1.00	\$0.20	\$0.10	N/A
Use of Shelf Space	20	10	1	1000 sq.in.
Use of Labor Hours	0.25	$\frac{1}{12}$	0.05	16 hours

a) Which is the best production plan that you can come up with?

b) Write a linear programming formulation to get the best production plan.

1.2 Solution

Decision variables:

- x_1: Number of cakes to bake
- x_2: Number of breads to bake
- x_3: Number of cookies to bake

Formulation:

$$\begin{aligned}
\max \quad & x_1 + 0.20x_2 + 0.10x_3 && && (1)\\
\text{s.t.} \quad & 20x_1 + 10x_2 + x_3 \leq 1000 && && (2)\\
& 0.25x_1 + \frac{1}{12}x_2 + 0.05x_3 \leq 16 && && (3)\\
& x_i \geq 0 && \text{for } i = 1, 2, 3 && (4)
\end{aligned}$$

Optimal solution: Bake 45.333 cakes, 0 breads, and 93.333 cookies. With this production plan we will make \$54.667.

Important presentation of solution: In general you will be asked to present the optimal (production) plan in words, rather than list the variables' values, or the output of the optimization program used to solve the model.

1.3 Illustrating the importance of non-negativity constraints

The following is an example of a solution with negative number of units of bread (therefore an infeasible solution) that achieves a better objective value than the optimal solution:

Bake 64 cakes, -28 breads, and 0 cookies. With this production plan we bake negative number of breads and make more money than the optimal solution among nonnegative quantities of production \$58.4.