

CS 525 - Fall 2015 - Homework 2*

assigned 9/6/15 — due 9/16/15

1. A baker can make three types of products: cream buns, chocolate eclairs, and snack-sized chocolate tarts. He wants to figure out how much of each item to make to optimize his operations.
 - Each cream bun requires two ounces of sugar, three ounces of flour, one ounce of butter, and one ounce of cream.
 - Each chocolate eclair requires two ounces of sugar, two ounces of flour, two ounces of butter, one ounce of cream, and two ounces of chocolate.
 - Each chocolate tart requires one ounce of sugar, three ounces of flour, one ounce of butter, and three ounces of chocolate.
 - Sugar costs 10 cents per ounce, flour costs 8 cents per ounce, butter costs 20 cents per ounce, cream costs 22 cents per ounce, and chocolate costs 18 cents per ounce.
 - Cream buns sell for \$2.50 each, chocolate eclairs sell for \$2.50 each, and chocolate tarts sell for \$2.75 each.
 - The baker can purchase at most 1200 ounces of sugar, 1000 ounces of flour, 800 ounces of butter, 800 ounces of cream, and 1000 ounces of chocolate.

Formulate the problem of maximizing the baker's profit as a linear program. Proceed in the the following stages:

*Hard copy to be submitted **in class** on the due date. Hand in a printout of your code, a diary file of the output, and your written formulation of the problem. No late homework accepted.

- (a) Identify the variables in the problem. Hint: It will simplify your formulation if you take the amounts of all three products and all five raw materials as the variables, and use equality constraints to formulate the relationships between them. For example, one of the constraints would capture how much sugar is used in producing the chosen quantities of each of the three products.
 - (b) Write down the linear function that defines the total profit from the baker's operations. Hint: write down the total revenue obtained from selling the items (buns, eclairs, tarts), then subtract the costs of the raw materials (sugar, flour, etc).
 - (c) Write down *all* the constraints on the variables.
2. Use `cvx` to solve the baker's problem, that is, determine how many of each item he should produce so as to maximize profits. What is his total profit, in this optimal scenario?
 3. Use your `cvx` code to answer the following question: What is the lowest price the baker can set for a cream bun, such that his optimal production strategy requires him to make some cream buns?