

# Assignment 8

Due Friday, April 19 at 11:59 pm.

*Please submit all work on Canvas as a PDF or Word file. Make sure you clearly label each solution, and include the answers to the in-class quiz at the beginning of the assignment.*

## Sensitivity Analysis

**1) Diet, Revisited** Suppose you are trying to construct the optimal lunch bowl using various ingredients. Their nutritional facts and cost per serving are shown below.

	Rice	Black Beans	Corn	Chicken
Calories	200	90	100	190
Fat	0.4g	0.5g	1.5g	11g
Carbohydrates	45g	19g	22g	0g
Protein	4.3g	7g	3.5g	20g
Cost	\$0.20	\$0.30	\$0.10	\$0.75

Suppose you want to make sure that the lunch bowl has at least 600 calories and 18 grams of protein, with less than 20 grams of fat and 60 grams of carbohydrates.

- (a) What is the best way to construct the bowl? That is, how many servings of each ingredient should you use? How much would it cost? Assume that you can measure out continuous values of servings (it does not need to be an integer). Round each answer to two decimal places. (3 points)
- (b) How much could each ingredient increase in price by without changing the solution? (2 points)
- (c) Suppose you are willing to accept eating a few more carbs if the resulting bowl will cost less. What is the decrease in price for each unit increase in carbs that you're willing to consume? (2 points)
- (d) Suppose there is a sale that decreases the price of chicken by 50 cents per serving. What would you expect would happen to the optimal solution? (2 points)
- (e) Change the cost to reflect the sale on chicken and run Solver again. What is the optimal solution? Does it line up with you responded in the previous question? (2 points)
- (f) Suppose there is instead a sale on black beans and not chicken such that black beans cost 20 cents less per serving. What would you expect would happen to the optimal solution? (2 points)
- (g) Change the cost to reflect the sale on black beans (making sure to revert the price of chicken back to \$0.75) and run Solver again. What is the optimal solution? Does it line up with you responded in the previous question? (2 points)

**2) Pizza and Calzones, Revisited** A pizza vendor sells pizzas and calzones at a sporting event. Since it is very well attended, the vendor is certain all of their pizzas and calzones will sell out. Pizzas can be sold for a profit of \$3.50 and use 500 grams of dough, 300 grams of sauce, and 150 grams of cheese. Calzones can be sold for a profit of \$2.50 and use 750 grams of dough, 200 grams of sauce, and 250 grams of cheese. If the vendor has 112,500 grams of dough, 60,000 grams of sauce, and 36,000 grams of cheese, how many pizzas and calzones should they make?

- (a) How many pizzas and calzones should they make? What is the profit they would make from this? Use Solver to find the answer. (3 points)
- (b) If you were to have a sale on pizza of \$1.50 off, would the optimal number of pizza and calzones you should make change? Why or why not? (2 points)
- (c) Your manager is worried about wasting ingredients and tasks you with coming up with new amounts of dough, sauce, and cheese to order for the next day assuming everything remains the same. If you want to keep the same optimal solution, what ingredient(s) can you order less of, and how much less can you afford to order? (2 points)
- (d) What is the most you could increase the price (which would increase the profit by the same amount) of pizza by without changing the optimal solution? What about the price of calzones? (2 points)
- (e) Your manager suggest making a new item: Cheesy breadsticks. This item can generate \$1 of profit and uses 200 grams of dough and 200 grams of cheese, along with 50 grams of sauce for the dipping sauce. Would it be worth it to produce cheesy breadsticks as well? (2 points)
- (f) Another option is to instead make regular breadsticks. This would take 200 grams of dough and 50 grams of sauce, but only generate \$0.50 of profit. Would it be worth it to produce breadsticks? (2 points)

**3) Training Programs, Revisited** As part of a quality improvement initiative, Consolidated Electronics employees complete a three-day training program on teaming and a two-day training program on problem solving. The manager of quality improvement requested that at least 10 training programs on teaming and at least 10 training programs on problem solving be offered during the next six months. In addition, senior-level management specified that at least a total of 25 training programs must be offered during this period. Consolidated Electronics uses a consultant to teach the training programs. During the next six months, the consultant has 64 days of training time available. Each training program on teaming costs \$12,000 and each training program on problem solving costs \$6,000.

- (a) How many training programs of each type should be offered? What would be the total cost of this? (3 points)
- (b) Would the optimal number of training programs for each type change if the cost of problem solving trainings went up by \$5000? Why or why not? (2 points).
- (c) If management decided to relax the total number of trainings necessary by 3 to only 22 total trainings, what would you expect the reduction in cost to be? (2 points)