New York City College of Technology
MAT 3770/D676 - Fall 2019
Project 2

Project 2 consists of Problems 7 and 8, Section 2.4.
Make sure to follow the instructions:

- I will be collecting this project on CoCalc in two parts.
- One pdf file per submission.
- The collection will be done on CoCalc only. Go to the course project (not the shared project) and look for the folder named Project 2. This is where you should upload your pdf files.
- E-mail submission will not be accepted.
- No late submission will be accepted.
- Include your name in both files, and name them as explained below.
- For the second and final submission, include the coding part and a technical report (as if you were a consultant) addressing the questions in each item. One paragraph for each item.
  - By **11/6, 9:30 am**, submit a list of variables and assumptions for Problems 7 and 8. One file only. Download your ipynb file as pdf. Name your file as "yourlastname_proj2_assumptions" and upload it on CoCalc. During our class on 11/6, we will go over Problems 7 and 8 to ensure that all students have the correct list of variables and assumptions for the rest of the project.
  - By **11/13, 9:30 am**, download your complete solution to both problems in a single pdf file. Name it as "yourlastname_proj2" and upload it on CoCalc.

Problem 7. A local daily newspaper has recently been acquired by a large media conglomerate. The paper currently sells for \$1.50/week and has a circulation of 80,000 subscribers. Advertising sells for \$250/page, and the paper currently sells 350 pages/week (50 pages/day). The new management is looking for ways to increase profits. It is estimated that an increase of ten cents/week in the subscription price will cause a drop in circulation of 5,000 subscribers. Increasing the price of advertising by \$100/page will cause the paper to lose approximately 50 pages of advertising per week.

The loss of advertising will also affect circulation, since one of the reasons people buy the paper is for the advertisements. It is estimated that a loss of 50 pages of advertisements per week will reduce circulation by 1,000 subscriptions.

(a) Find the weekly subscription price and the advertising price that will maximize profit. Use the five-step method, and model as an unconstrained optimization problem.

(b) Examine the sensitivity of your conclusions in part (a) to the assumption of 5,000 lost sales when the price of the paper increases by ten cents.

(c) Examine the sensitivity of your conclusions in part (a) to the assumption of 50 pages/week of lost advertising sales when the price of advertising is increased by \$100/page.

(d) Advertisers who currently place advertisements in the newspaper have the option of using direct mail to reach their customers. Direct mail would cost the equivalent of \$500/page of newspaper advertising. How does this information alter your conclusions in part (a)?

Problem 8. Reconsider the newspaper problem of Exercise 7, but now suppose that advertisers have the option of using direct mail to reach their customers. Because of this, management has decided not to increase the price of advertising beyond \$400/page.

(a) Find the weekly subscription price and the advertising price that will maximize profit. Use the five-step method, and model as a constrained optimization problem. Solve by the method of Lagrange multipliers.

(b) Determine the sensitivity of your decision variables (subscription price and advertising price) to the assumption of 5,000 lost sales when the price of the paper increases by ten cents.

(c) Determine the sensitivity of the two decision variables to the assumption of 50 pages of advertisements lost per week when the advertising price increases by \$100/page.

(d) What is the value of the Lagrange multiplier found in part (a)? Interpret this number in terms of the sensitivity of profit to the \$400/page assumption.