

MAE 3210 - Spring 2020 - Homework 4

Homework 4 is due **online** through Canvas in PDF format by 11:59PM on Monday March 16.

You are required to submit code for all functions and/or subroutines built to solve these problems, which is designed to be easy to read and understand, in your chosen programming language, **and which you have written yourself**. The text from your code should both be copied into a single PDF file submitted on canvas. **Your submitted PDF must also include responses to any assigned questions, which for problems requiring programming should be based on output from your code.** For example, if you are asked to find a numerical answer to a problem, the number itself should be included in your submission.

NOTE: For this homework you are welcome to solve problem 1 by hand, without using programming or submitting code. However, you are **required** to solve problems 3-4 with programming, and a copy of your code must be submitted. Use of MS excel (or equivalent software) is acceptable and encouraged for problem 2; please include a copy of your final spreadsheet within your submitted PDF.

1. Consider the optimization problem:

$$\begin{aligned} &\text{Maximize } f(x, y) = -3x + y \\ &\text{subject to the constraints } x^2 + y \leq 4, \\ &\quad -2x + y \leq 0, \\ &\quad x \geq 0.5, \\ &\quad y \geq 0. \end{aligned}$$

- (a) Plot the feasible solution space in the $x - y$ plane.
 - (b) Solve the optimization problem by using the graphical method.
2. An aerospace company is developing a new fuel additive for commercial airliners. The additive is composed of three ingredients: X , Y , and Z . For peak performance, the total amount of additive must be at least 6 mL/L of fuel. For safety reasons, the sum of the highly flammable Y and Z ingredients must not exceed 2.5 mL/L. In addition, for the additive to work, the amount of Z must be greater than or equal to twice the amount of Y , and the amount of X must be greater than or equal to three quarters of the amount of Y . If the cost per mL for the ingredients X , Y and Z is 20 cents, 3 cents, and 5 cents, respectively, use MS excel to determine the minimum cost of the additive mixture for each liter of fuel.

3. Use least squares regression to fit a straight line to the data

x	0	2	4	6	9	11	12	15	17	19
y	5	6	7	6	9	8	7	10	12	12

Along with the slope and intercept, compute the standard error of the estimate and the correlation coefficient. Plot that data and the regression line.

4. The following data are provided

x	1	2	3	4	5
y	2.2	2.8	3.6	4.5	5.5

Perform least squares regression to fit these data to the following model

$$y = a_0 + a_1x + \frac{a_2}{x}.$$

Note that this problem was solved in class, but here you are asked to reproduce the result on your own.