MACM 203 Assignment 3
Spring 2025

This assignment is due Tuesday February 11th at 10pm. Upload your solutions to Crowdmark. Write your solutions as a single Matlab Live Script and export the script to PDF. Write the course number and assignment number as the title of the Matlab Live Script, followed by the table of contents, and then create a section for each part of the question.

Keep in mind that your assignment, including the source code, is a document that will be read in order to be marked. It has to be very clear and properly formatted.

Your Matlab code must be general enough to solve any other instance of the same problem *without modification.* That is, if you are asked to run your code on some data that are included with the assignment, then your code must run on any similar data set (or solve any similar problem) without modification.

Assignments should be written individually. You can discuss in groups, but you have to write your assignment yourself. In case of plagiarism SFU policies will be applied.

Preamble

This week's assignment focuses on curve fitting and on creating anonymous functions.

Question 1 (20 marks)

Part (a)

Download the data file `a3.mat` from Canvas. This file contains data points (x_i, y_i) where x_i is the i-th entry of array `x` and y_i is the i-th entry of array `y`. It is known that the dependence between y and x is of the form

$$y = \sqrt{\frac{ax+1}{b\cos(x)+c}} \tag{1}$$

where a, b, c are unknown real constants. It is known that all data points (x_i, y_i) satisfy equation (1) *up to small measurement errors.*

Transform equation (1) into a form in which it becomes a linear equation in the unknowns a, b, c after plugging in any of the data points (x_i, y_i). Now consider the overdetermined system of linear equations that consists of the equations obtained by plugging in all data points (x_i, y_i). Use Matlab's least-squares solver \ to find the least-squares approximate solution to this overdetermined system of linear equations. You must not use any for-loops or while-loops.

Part (b)

Use your answer to part (a) to find approximate values of a, b, c.

Part (c)

Plot the given data points (x_i, y_i) as circles. In the **same** figure, plot the fitting curve (1) with the values a, b, c determined in part (b), as a curve. You must not use any for-loops or while-loops. The plot of the fitting curve **must be smooth**. You should observe a good fit between the curve and the given data points.

Part (d)

Write an *anonymous* function (note that this is a special type of Matlab function) that accepts on input two positive integers m and n and it returns the $m \times n$ matrix such that the entry in row i and column j is the number $2i + j$. Your function must not contain any for-loops or while-loops. Use the sum of a suitable column vector and a suitable row vector. (Indeed it is possible in Matlab to add vectors/arrays of unequal shapes, read about it in documentation or experiment yourself.)

Part (e)

Make a call to the function written in part (d) to create the 2×3 matrix with the given property. That is, the output of this function call should be

$$\begin{pmatrix} 3 & 4 & 5 \\ 5 & 6 & 7 \end{pmatrix}.$$