

Math 251 X02  
Assignment 1: MATLAB

Name: \_\_\_\_\_

Due: At the beginning of class, Monday October 21

Total: 25 marks

INSTRUCTIONS

- \* Submit your work on this paper.
- \* If you are away on the due date then submit via the D2L Dropbox.
- \* You may discuss with others but your write-up must be your own work.
- \* Show all your work for full marks.

1. [5 marks] Given  $A = \begin{bmatrix} 1 & 3 \\ 1 & -4 \\ 1 & 7 \\ 1 & -8 \end{bmatrix}$  and  $\mathbf{b} = \begin{bmatrix} 68 \\ 126 \\ 34 \\ 160 \end{bmatrix}$ ,

we want to compute  $(A^T A)^{-1} A^T \mathbf{b}$ .

a) Write down the MATLAB commands for inputting  $A$ , inputting  $\mathbf{b}$ , and calculating  $(A^T A)^{-1} A^T \mathbf{b}$ .

b) Perform the calculation in Octave Online. Then write down your answer, rounding your vector components to two decimal places.

2. [5 marks] Given  $\mathbf{a} = \begin{bmatrix} 7 \\ -3 \\ 9 \end{bmatrix}$  and  $\mathbf{b} = \begin{bmatrix} 21 \\ -36 \\ 5 \end{bmatrix}$ , we want to compute  $\mathbf{b} - \text{proj}_{\mathbf{a}}\mathbf{b}$ .

a) Write down the MATLAB commands for inputting  $\mathbf{a}$ , inputting  $\mathbf{b}$ , and calculating  $\mathbf{b} - \text{proj}_{\mathbf{a}}\mathbf{b}$ .

b) Perform the calculation in Octave Online. Then write down your answer, using exact values.

3. [4 marks] Let  $a, b, c, d, u$  and  $v$  be real numbers. If  $\det \begin{bmatrix} a & b \\ c & d \end{bmatrix} \neq 0$  then the values of  $x$  and  $y$  that solve

$$ax + by = u$$

$$cx + dy = v$$

$$\text{are } x = \frac{\det \begin{bmatrix} u & b \\ v & d \end{bmatrix}}{\det \begin{bmatrix} a & b \\ c & d \end{bmatrix}} \text{ and } y = \frac{\det \begin{bmatrix} a & u \\ c & v \end{bmatrix}}{\det \begin{bmatrix} a & b \\ c & d \end{bmatrix}}.$$

We want to use these formulas to find the values of  $x$  and  $y$  that solve

$$-19x + 6y = \frac{1797}{7}$$

$$25x + 8y = \frac{2809}{21}$$

a) Write down the MATLAB commands for inputting the appropriate matrices and calculating the exact values of  $x$  and  $y$ .

b) Perform the calculation in Octave Online. Then write down the exact values of  $x$  and  $y$ .

4. [5 marks] We want to find all curves  $y = c_0 + c_1x + c_2x^2 + c_3x^3$  that pass through both the points  $(2, 9)$  and  $(3, 8)$ .

a) Write down the augmented matrix for the appropriate system of equations.

b) Calculate the RREF of the augmented matrix in Octave Online. Write the RREF below. Then find all the possible values of  $c_0, c_1, c_2$  and  $c_3$  by hand.

5. [6 marks] We want to balance  $S + HNO_3 \rightarrow H_2SO_4 + NO_2 + H_2O$ .

a) Write down the augmented matrix for the appropriate system of equations.

b) Calculate the RREF of the augmented matrix in Octave Online. Write the RREF below. Then finish balancing the chemical equation by hand.