

APM 153 LECTURE FOUR – USB Drive, Editing Your Diary File, Inverse Matrices, Solving Systems of Linear Equations Using Matrix Math. Getting Ready for Lab.

Using your USB Drive

(1) When you start Matlab the Current Directory is set by default to the Matlab Work directory on the computer's hard drive and usually looks something like this.

C:\Program Files\MATLAB71\work

(2) To change the working directory to your USB drive, make sure your drive is active and then click on the icon to the right of the box showing the current directory. The icon looks like a rectangle with three dots in it. This is the “browse directory” icon.

(3) After clicking on the browse directory icon, navigate till you find your USB drive and select your drive by double clicking on the icon for the drive.

(4) Once you have set your USB drive as the working directory, you should be able to see a list of files on the drive in the Current Directory Window on the left hand side of the GUI. (Graphic User Interface)

(5) You can change what files and folders the Current Directory Window displays by clicking on the word **View** in the toolbar at the top of the GUI. You can choose to show only Matlab files or All files, and you can choose to show any Folders (also known as “subdirectories”) on your USB drive.

(6) Once you have set your USB drive as the Current Directory, when you open a diary file or create and new files in Matlab, they will be saved to the USB drive.

(7) Finally, when you are finished working on a computer and want to remove your USB drive, take the time to learn how to properly “eject” your drive from the computer's USB port.

Editing Your Diary File

(8) Once you have evaluated all the equations for assignment one in Matlab, you may close your diary file by typing **diary off**.

(9) Your diary file should be stored on your USB drive as **Assignment1.txt**. Open this file in MS Word and add your name, date, course number, and assignment number to the top of the first page.

(10) Edit out any mistakes that got recorded in the diary file. By mistake, I mean a place in the diary file where you typed in something incorrectly. It is okay to leave in the diary file those places where you tried to evaluate one of the equations, but Matlab said it could not.

(11) It is important to see the error messages so that you can understand what they mean.

(12) Next, add section numbers and letters to the different parts of the assignment such as, ... Part One. and (a), (b), (c)

This lets the people who will be grading your homework know which section is which.

(13) Last, answer any questions you were asked in the assignment in the proper place. Add your answers where you think they belong in the edited diary file. It is good practice to write the questions themselves as well as the answers.

(14) Save your new MS Word document as Assignment1.doc and print out a copy to turn in on Friday at the beginning of lab. Don't forget to **staple** all pages together.

Inverse Matrices

(15) In regular mathematics the inverse of a number is 1 divided by that number. For example, the inverse of 2 is $\frac{1}{2}$

(16) When you multiply a number by its inverse the product is 1. $2 * \frac{1}{2} = 1$.

(17) Another way to write the inverse of a number is to raise that number to the power of negative one. Therefore, the inverse of 2 may be written as 2^{-1} .

(18) Written this way using exponents, we can see again that the product of a number times its inverse should be 1. For example

$$(2^1 * 2^{-1}) = 2^{(1-1)} = 2^0 = 1$$

(19) When you multiply a matrix by its inverse the result is called an **identity matrix**. An identity matrix is a matrix that consists of all zeros except for ones running down the diagonal. The matrices below are identity matrices.

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

(20) Notice that the identity matrices are all **square** matrices, that is they have the **same number of rows and columns**.

(21) Only **square matrices** can have an inverse. When you multiply a matrix by its inverse, the result is an identity matrix of the same size.

(22) For example, let's say that A is a 2 by 2 matrix. Therefore, $A * A^{-1} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

(23) Inverses are important in Matrix Math because while it is not possible to perform matrix "division", it is possible to multiply a matrix by its inverse which accomplishes the same thing.

(24) Look again at the inverse of a regular number. The inverse of 2 is $\frac{1}{2}$, therefore if I multiply any number by the inverse of 2 the result is the same as if I were dividing by 2.

(25) Same thing with matrices. It is not possible to perform matrix division, but if we multiply a matrix by an inverse, it is the same thing as if we were performing a division operation.

Solving Systems of Linear Equations

(26) One of the most useful applications of using an inverse matrix is in solving systems of linear equations. Imagine you were given the following equations.

$$\begin{aligned} 2x + 5y &= 13 \\ x + y &= 5 \end{aligned}$$

You **could** solve for the "unknowns" (x and y) by hand using what is known as **Gauss-Jordan elimination**. You solve first for x or y and then you solve for the other.

(27) But what if you were given the following set of equations with **four** unknowns?

$$\begin{aligned}2a + 3b - 4c - 2d &= 12 \\-3a - 4b - 7c + d &= 17 \\12a - 3b + 4c - 2d &= 2 \\23a - b + c + 3d &= 7\end{aligned}$$

(28) You can solve the series easily using matrix math. First set up the matrices. The coefficients on the left hand side of the equation are entered into a 4 x 4 matrix.

$$A = \begin{bmatrix} 2 & 3 & -4 & -2 \\ -3 & -4 & -7 & 1 \\ 12 & -3 & 4 & -2 \\ 23 & -1 & 1 & 3 \end{bmatrix}$$

(30) The **results** from the right-hand side of the equation are put into a column vector.

$$b = \begin{bmatrix} 12 \\ 17 \\ 2 \\ 7 \end{bmatrix}$$

(31) We can now rewrite the system of equations as

$$\begin{bmatrix} 2 & 3 & -4 & -2 \\ -3 & -4 & -7 & 1 \\ 12 & -3 & 4 & -2 \\ 23 & -1 & 1 & 3 \end{bmatrix} * \begin{bmatrix} a \\ b \\ c \\ d \end{bmatrix} = \begin{bmatrix} 12 \\ 17 \\ 2 \\ 7 \end{bmatrix}$$

(32) To solve for the unknowns (a, b, c, and d) we need to multiply both sides of the equation by the **inverse of A** which gives us,...

$$\begin{bmatrix} a \\ b \\ c \\ d \end{bmatrix} = A^{-1} * \begin{bmatrix} 12 \\ 17 \\ 2 \\ 7 \end{bmatrix} = \begin{bmatrix} 0.5760 \\ -0.6943 \\ -2.4907 \\ -1.4840 \end{bmatrix}$$

Getting Ready for First Lab

(1) We will be in lab for the first time on Friday. We will be using the computers in Baker 149 and 143.

(2) Those students with names from ALI to LU will be in 149 Baker. Students with names from MADDEN to ZELASKO will be in 143 Baker.

(3) Make sure you bring your textbook, your 3-ring binder with all your notes, and especially your USB drive. If you have not purchased a USB drive yet, get one and learn how to use it before lab on Friday.

(4) In lab on Friday we will hand out a lab exercise and assignment #2. We will do the lab exercise together in lab. You will do the assignment on your own.

Standards of Professional Practice

(4) Make sure you have your homework assignment #1 printed out in time to hand in at the beginning of lab. The TA's and I want to get started on time and we cannot spend 10 minutes collecting homework or waiting for you to print out yours.

(5) Be prepared. Get to lab on time with all your stuff, ready to work

(6) Remember that food and drink are not allowed in the labs. Finish your coffee before entering the lab. Do not bring any food or drink into the lab.