COMP 016

Jan 18th, 2011

# Assignment #2: NC Water data, due Feb 3rd

This assignment involves working with and plotting data in vectors and matrices. On sakai, you can find ‘water08.mat’, which you should download to your computer. (Be sure it keeps the .mat extension: on PCs, right click and below the file name select save as “all files”; on Macs you may need to get info (command-I) on the downloaded file and strip off a .txt extension if that was added.) Then in MATLAB, browse to the directory where you saved and type **load water08** to read in these vectors and matrices:

**>> clear % clear out all variables**

**>> clc % start at top of Command window**

**>> load water08 % load in saved MATLAB variables from water08.mat**

**>> whos % show all variables in Workspace (IE water08.mat)**

**Name Size Bytes Class Attributes**

**depth 288x2 4608 double**

**hawgage 365x4 11680 double**

**hawrain 365x2 5840 double**

**rain 288x2 4608 double**

**Monthly Jordan and Falls Lake data (from Army Corps of Engineers):**

*depth*: a 288x2 matrix with depth of Jordan and Falls lakes for each month from Jan 1985 to Dec 2008, which is 24 years. Data that is not available is listed as *NaN*.

*rain*: a 288x2 matrix with total rainfall at the lakes in inches for each month from Jan 1985 to Dec 2008.

**Daily Haw river/Jordan Lake data (from USGS):**

*hawgage*: a 365x4 matrix of daily average river or lake height (ft) at Haw River, Bynum, and above & below the Jordan Lake Dam by Moncure. (**These sites are listed upstream to downstream, but the gauge data in the matrix is not in that order.**)

*hawrain*: a 365x2 matrix of daily rainfall (in) measured at two raingauges from 29 Aug 07 –28 Aug 08.

**Tasks on Monthly Jordan and Falls Lake data (uses depth and rain):**

1. Plot a line graph of depths for both lakes.
2. The targets for Jordan and Falls lakes are 216*ft* and 251.5*ft*, respectively. For how many months was each lake over its target?
3. Plot the rain in August as a line graph over years for both lakes.
4. Compute the average height that Falls Lake is above its target for each month over the 23 years from 1985-2008, and display as bar chart with a bar for each month. Plot the line for 2008 in red on top of this bar chart.

**Tasks on Daily Haw river/Jordan Lake data (uses hawgage and hawrain):**

1. Determine how many days had more than 1 *in* of precipitation at the two sites in *hawrain*, and how many days had less than ¼ *in*.
2. Plot line graphs showing the cumulative amount of rain over the past year at both sites. Which of the two locations (1 or 2) received the most rain?
3. Determine (and output) the lowest height for each gauge (hawgage), and create a matrix or vectors of adjusted heights by subtracting the corresponding lowest heights. Plot these adjust heights as a line graph.
4. Determine the maximum increase and maximum decrease in height from one day to the next for each of the four gauges in *hawgage*.
5. ***"The purpose of computing is insight, not numbers"*** *--Richard Hamming*   
   From the data and your solutions to tasks 7 & 8, can you determine the order of the gauges from upstream to downstream? Hint: Look at the water levels and at what point they change relative to each other.

## There are sample solutions on sakai that I hope will resolve question about what is being asked for.

## MATLAB commands

You’ll probably use some (but not all) of the MATLAB commands: arithmetic (+, -, \*, /, .\*, ./ ), mean(), sum(), min(), max(), diff(), and cumsum(), and shape-changing operations: Colon (:) for indexing, transpose ('), repmat(), and reshape(). Check your book or MATLAB’s doc for more information on each of these. The Graphing commands bar() , plot(), and hist() are the main plotting methods you should use. All plots should be given meaningful titles and axes labels, using title(), xlabel(), ylabel(), and legend().

## Vectors vs. Matrices

You can use indexing with colon to pull particular columns out of a matrix and operate on them as vectors: e.g., gage2 = hawgages(:,2); would pull out the heights for the second gauge. You can also use brackets [] to put columns together into new matrices, which is how I built hawgages. You can answer these questions just with vectors, but it involves less typing to use matrices because all depths or gauge values can be operated on in parallel. Remember that MATLAB operates on columns of a data matrix for plot, mean, min/max, and sum, so the transpose operator can come in handy.

You can do this assignment without the reshape()command, but if you want to use it, **remember that MATLAB internally stores matrices as a list of columns**. See the examples in doc reshape for how to use it. The transpose operator (') can help make reshape work the way you want it to.

## Plots

Here is the essential line from the help for **plot**:

plot(Y) plots the columns of Y versus their index if Y is a real number.

You can select colors/markers, etc. As an example, for city1 maximum temperatures in red, plot(city1(1:366,1), 'r'), or if you created the vector city1\_max\_temp as shown above you can input plot(city1\_max\_temp, 'r'). For more details, see help LineSpec.

Remember the plot command erases the screen unless you have said hold on. Thus, to put more than one line on the same figure, either put them as columns in a matrix and plot once, or type hold on and plot several times. Type hold off to cancel the hold, or clf to clear the figure.

Please use title, xlabel, and ylabel to add titles and axes labels to each plot. When appropriate, you can use legend(’name1’, ’name2’, …) to add a legend.

E.g., to plot and label the adjusted height for the four gauges:

**>> plot(adjustedGage)**

**>> legend('gauge1', 'gauge2', 'gauge3', 'gauge3')**

**>> title('Adjusted water height')**

**>> ylabel('Adjusted height (ft)')**

**>> xlabel('Day since 28 Aug 07')**

## Hand in Hard copies (printout) and Soft copies (submit via Sakai)

You should make a word or pdf document by using the publish command. Make sure to include the working MATLAB commands to generate the plots, for each of the tasks. A sample can be found under Assignment #2. Make sure you submit your hard and soft copies for this assignment by midnight Feb 3rd.

**Data sources**

USGS Surface-Water Data for North Carolina, Daily Data <http://waterdata.usgs.gov/nc/nwis/sw>

US Army Corps of Eng., Wilmington Dist. Water Manag. Unit<http://epec.saw.usace.army.mil>