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# Final Project: Part 2

## Further Exploration of Grand River Flow and Height

Technical Problem Solving - Fall, 2010

Lansing Community College

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**USGS Real-Time Water Data for the Nation**

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Introduction    -- no grouping --    go

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**Daily Streamflow Conditions**

Sunday, November 28, 2010 18:30ET

**Select a state from the map to access real-time data**

Real-time data typically are recorded at 15- to 60-minute intervals, stored onsite, and then transmitted to USGS offices every 1 to 4 hours, depending on the data relay technique used. Recording and transmission times may be more frequent during critical events. Data from real-time sites are relayed to USGS offices via satellite, telephone, and/or radio telemetry and are available for viewing within minutes of arrival.

USGS

AK HI VT NH MA RI CT NJ DE MD DC PR-VI

## General Direction for Part 2

Your task in Part 2 is to further explore the water flow at the Lansing recording station on the Grand River. You will perform a number of steps using the data set you used in Part 1, and one other data set from the same USGS website used in Part 1.

A core activity you will need to do in Part 2 is to look up, learn, and use concepts/functions in MATLAB you have not used before. As we talked about in Part 1, you cannot possibly learn all there is to know about MATLAB in one semester - or for that matter probably in one lifetime. But what you can do - and are expected to do - is to learn enough of MATLAB so you can build on what you know and use the facilities MATLAB offers (largely HELP) to extend your knowledge when you need a particular operation. This is an example of what it means to be a “life long learner.”

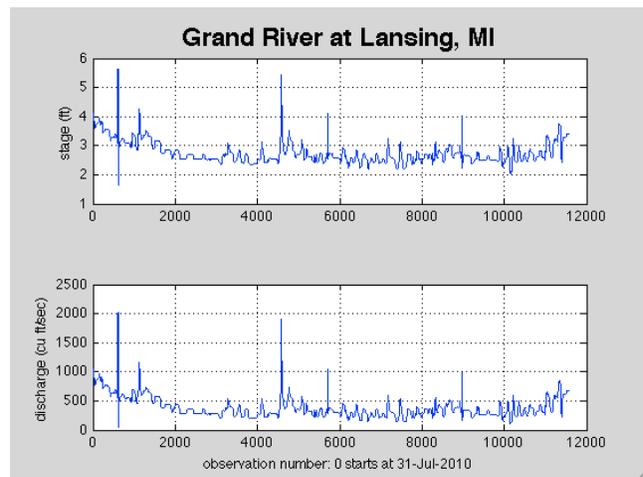
Most of the steps below will consist of (a) a short statement of the operation you are to perform, (b) a short elaboration of what you need to do to perform the step, and (c) a pointer (or pointers) to the capabilities of MATLAB you need to leverage to answer the question.

***STEP 1: For the two variable dataset you already have downloaded for river height and river flow as functions of time at the Lansing reporting station create two 2-D plotting displays as described below. Your purpose is to get a snapshot of how correlated the river flow and the river height are.***

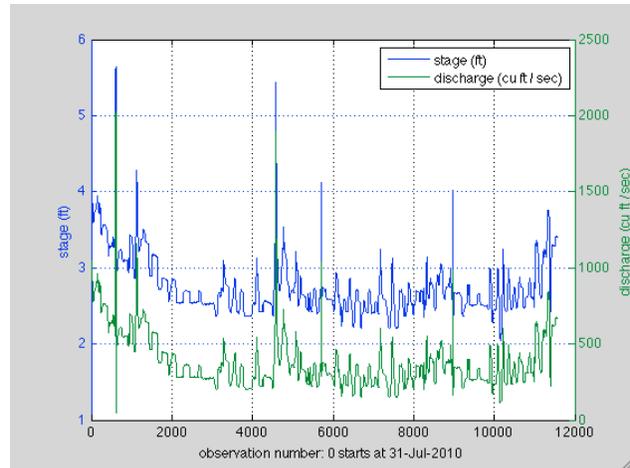
The river height (stage) is measured in feet. The river flow (discharge) is measured in cubic feet per second. So a simple overlay graph will not work.

First create a subplot display. Your graph should have the elements of the graph shown to the right.

Using the capability that MATLAB gives you for creating multiple subplots in the same graphic window helps you determine the correlation because you are “lining up” the dates/times of the various observations. But for two variable data sets, there is an even better way.



Look up the plotYY function in MATLAB HELP. Use plotYY to produce a graph like the one to the right. This graph shows the Grand River stage in blue and with the Y **left** axis, and the Grand River discharge in green with the Y **right** axis.



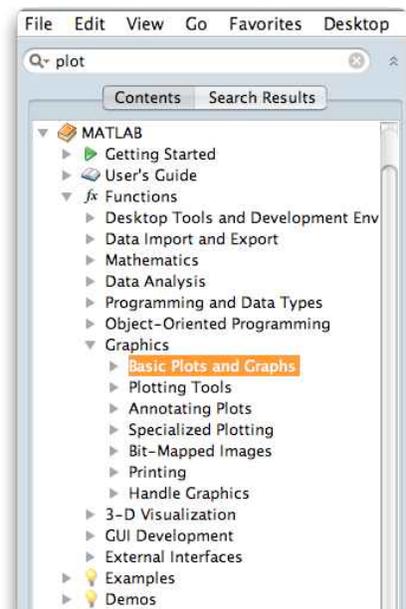
Characterize the general situation when you would consider using a YY graph to show a two independent variable data set.

Plotting data can give you strong clues about the relationships for the variables plotted. But you have an array of numerical tools available in MATLAB too. Now that you believe that stage and discharge might be strongly correlated for the Grand River observations going back 120 days at Lansing, test your belief by using the appropriate tool in MATLAB. (I.e., determine what functionality you are looking for in MATLAB, then go search for that functionality in MATLAB HELP.)

Once you identify a tool you want to use in MATLAB, then incorporate the use of that tool into the function you write for the YY plot, and in your function annotate the graph with the numerical value you compute for the stage VS discharge correlation. (You will need to find a MATLAB built in function to put the annotation on your graph.)

**Step 2: Write an interactive MATLAB function that will tell you the date of a given observation in your YY plot.**

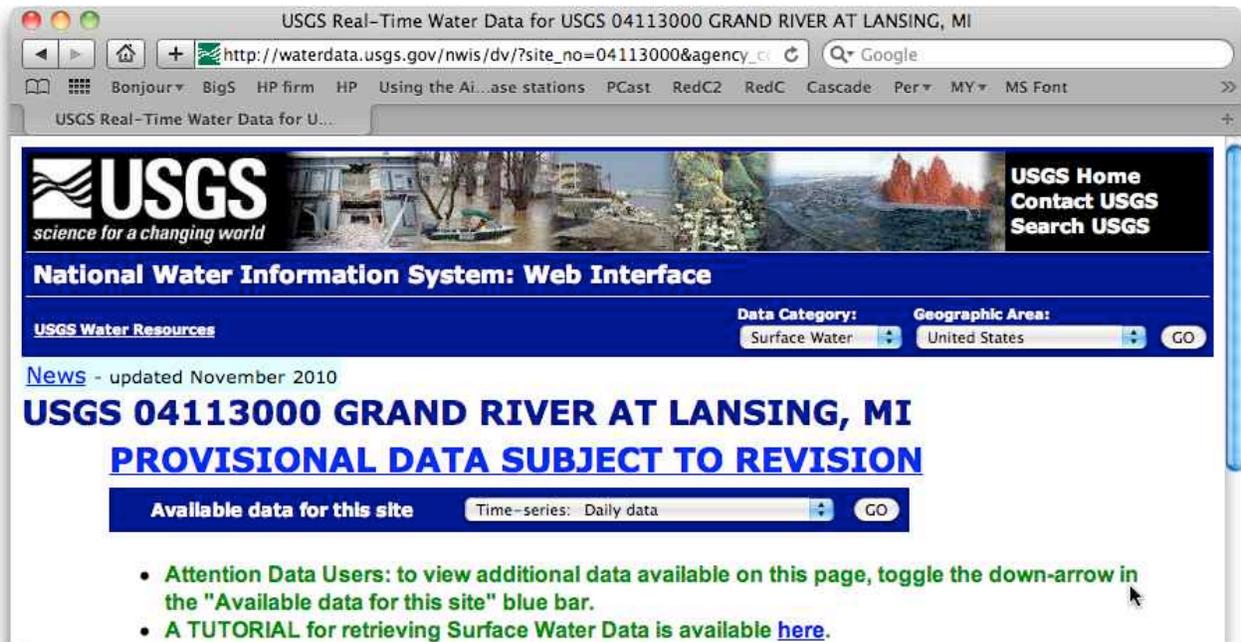
MATLAB offers a wide range of interactive tools to help you analyze a graph. One of those tools allows you in a function you write to click inside a graph on a given data point, and get the XY coordinates of that point. For your YY plot, you can use the MATLAB capability to determine the date/time of a given observation. Use the “contents” tab of MATLAB and find this inbuilt function.



Then write a function that can be used to find the date for a given observation in your YY plot for Grand River data. (Hint: when you “click” in your graph, you will be returned an XY pair that is the coordinates of the point you clicked. Your observation numbers (X axis) are discrete - there is no such thing as an observation number 1255.25. Its either 1255 or 1256. You just clicked in between.)

**Step 3: Write a MATLAB function to load in the “historic data” for the discharge of the Grand River and Lansing.**

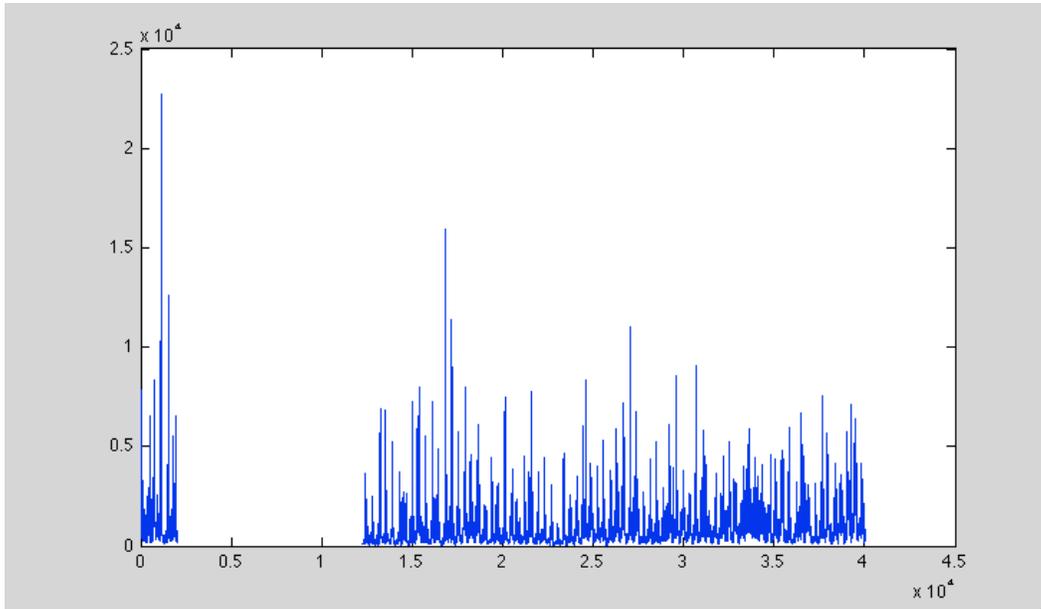
Go back to the same USGS website that you used in Part 1. Once you get to the page for the Grand River at Lansing, change the setting for the data to read “Time-series: Daily Data” as shown in the figure below.



Fetch all available data for the one independent variable data set: discharge. You should get over 40,000 data points extending back to 1901. Get the tab-delimited data file loaded into MATLAB similarly to the process you used for the two independent variable data set: height and discharge.

**Step 4: From the command window, just make a simple plot of flow**

You should see a figure like the one below.



There appears to be a large hole in the data. Examine your data and confirm for yourself that there is missing data.

**Step 5: Compute another dataset that excludes the data before the “gap”**

Write a MATLAB function that will take as input the historic data you have downloaded for the flow of the Grand River at Lansing, and from it output a modified dataset that includes only the data after any datagap.

**Step 6: Now create a plot using the modified dataset from Step 5**

Creating a final plot of the Grand River discharge should now be a piece of cake for you. But... lets make the graph more informative. Instead of showing the data observation on the X-axis, change the data “tic mark” to be labeled with dates. You are going to need to use MATLAB HELP again to do some research on how to get that to happen.

### **Step 7: Further analyze the discharge data**

The daily data you plotted in Step 6 is a good starting point. But suppose you are asking the question

***What was the wettest period over roughly the last hundred years in Lansing?***

There are a number of assumptions you need to make to answer that question given the Grand River discharge dataset that you have. Consider this situation, and write down all the assumptions you think you will need to make. Note that “wettest period” has not defined the length of one period. One day is almost surely too short. What is the appropriate length of period to use to answer the question. Is there “one” right answer?

What is a reasonable approach when there is more than one right answer to the way you set up a problem?

Once you define your approach, then construct a MATLAB function or set of functions to implement your approach. Your answer(s) should be generated from your function(s) as a starting date and length of period.

When you write up this project, one key ingredient is for you to state clearly your approach to this last step, and to argue for its applicability.