Carlise Moreland and Joshua Pollock

CS 122L-1

Lab 9: Branch & Loop

16 April 2018

**Task Description**

In the first part of this lab, we will be implementing various mathematical and statistical calculations as functions. We are not allowed to use already created functions, such as geomean(), rms(), and harmmean(). We will be using for loops to perform these functions instead.

In the second part of the lab, we will be looking at some average rainfall data. The data file given will contain rainfall values from 2007 to 2013. The columns of this file are years, and the rows are months. We will be finding the average rainfall and performing some data manipulation to fulfill some other requirements of the lab.

**Learning Objectives**

There is a total of four learning objective for this lab. In this lab we will be learning how to read data from data files. In our case we will be reading from a ‘.txt’ file. From this data we will be learning how to perform data analysis to find certain statistical information of the data. Throughout the lab we will be improving our use of for loops and other conditional statements. We will also practice the use of matrix and vector operations.

**Approach**

To begin this lab, we first read through all the lab document to give us an idea of what we will need to do. We kept this document open to allow us to reference back to this information later in the lab. We also kept this document open to view the necessary equations. On part B, we looked up how the mean function works to properly find the mean of rows ve rsus columns.

**Mathematical Concepts**

We will be using many different statistical formulas to manipulate the data given to us. First, we will be calculating the geometric mean. This formula is given to us as:



Second, we will be calculating the root mean square (rms). The given formula is:



Lastly, we will be calculating the harmonic mean. The formula given to us was:



**Program Inputs**

**Lab9a**

Loads the file ‘lab9\_grades.txt’ into variable data using the load() function.

**geometric\_mean.m**

Takes in a vector of values stored within the variable named data.

**harmonic\_mean.m**

Takes in a vector of values stored within the variable named data.

**root\_mean\_squart.m**

Takes in a vector of values stored within the variable named data.

**Lab9b.m**

Loads the file 'lab9\_lake\_powell.txt' into variable data using the load() function.

**Program Outputs**

**Lab9a**

Prints out the geometric mean, root mean square, and harmonic mean using fprintf. Geometric mean is stored in g\_mean. Root mean square is stored in r\_m\_s. Harmonic mean is stored in h\_mean.

**geometric\_mean.m**

Outputs the geometric mean calculated from a vector passed through as the variable ‘data’. Calculated using the formula from mathematical concepts.

**harmonic\_mean.m**

Outputs the harmonic mean calculated from a vector passed through as the variable ‘data’. Calculated using the formula from mathematical concepts.

**root\_mean\_squart.m**

Outputs the root mean square calculated from a vector passed through as the variable ‘data’. Calculated using the formula from mathematical concepts.

**Lab9b.m**

Outputs the processed data to find the average rainfall using mean(). Outputs for which month and year was above the mean rainfall.

**Program Description**

**Lab9a**

Uses the load function to create a vector of data from a file. Finds the geometric mean, root mean square, and the harmonic mean. Prints out each of the means using fprintf.

**geometric\_mean.m**

Takes in a vector of data, and stores within the variable named ‘data’. Uses the formula in Mathematical Concepts to find the geometric mean.

**harmonic\_mean.m**

Takes in a vector of data, and stores within the variable named ‘data’. Uses the formula in Mathematical Concepts to find the harmonic mean.

**root\_mean\_squart.m**

Takes in a vector of data, and stores within the variable named ‘data’. Uses the formula in Mathematical Concepts to find the root mean square.

**Lab9b.m**

Uses the load function to create a vector of data from a file. Uses the mean() function to find the average levels of rainfall. Prints out the average overall rainfall. Prints out the average rainfall per year. Prints out the monthly average rainfall. Finally, prints out the months and years when the average rainfall was higher than the overall average.

**Source Code**

**Lab9a**

function [g\_mean,r\_m\_s,h\_mean] = Lab9a

data = load('lab9\_grades.txt');

g\_mean = geometric\_mean(data);

r\_m\_s = root\_mean\_square(data);

h\_mean = harmonic\_mean(data);

fprintf('Geometric Mean: %f\n',g\_mean);

fprintf('Root Mean Square: %f\n',r\_m\_s);

fprintf('Harmonic Mean: %f\n',h\_mean);

%fprintf('Actual Geometric Mean: %f\n',geomean(data));

%fprintf('Actual Root Mean Square: %f\n',rms(data));

%fprintf('Actual Harmonic Mean: %f\n',harmmean(data));

end

**geometric\_mean.m**

function g\_mean = geometric\_mean(data)

product=1;

for index = 1:length(data)

product = product\*data(index);

end

g\_mean = nthroot(product,length(data));

end

**harmonic\_mean.m**

function h\_mean = harmonic\_mean(data)

sum=0;

for index = 1:length(data)

sum = sum+(1/data(index));

end

h\_mean = length(data) / sum;

end

**root\_mean\_squart.m**

function r\_m\_s = root\_mean\_square(data)

sum=0;

for index = 1:length(data)

sum = sum+(data(index)\*data(index));

end

r\_m\_s = (1/length(data) \* sum);

r\_m\_s = sqrt(r\_m\_s);

end

**Lab9b.m**

data = load('lab9\_lake\_powell.txt');

yearly\_avg = mean(data);

avg\_level = mean(yearly\_avg);

monthly\_avg = mean(data,2);

fprintf('Average Overall Rainfall: %f\n',avg\_level);

year=2007;

for index = 1:length(yearly\_avg)

fprintf('Average Rainfall in %d: %f\n',year,yearly\_avg(index));

year=year+1;

end

month = 1;

for index = 1:length(monthly\_avg)

fprintf('Average Rainfall in Month %d: %f\n',month,monthly\_avg(index));

month=month+1;

end

for year = 1:length(yearly\_avg)

for month = 1:length(monthly\_avg)

if data(month,year) > avg\_level

fprintf( 'Average was exceeded for Month %d in %d\n',month,year+2006);

end

end

end

**Code Execution Results**

Average Overall Rainfall: 3612.508214

Average Rainfall in 2007: 3678.115000

Average Rainfall in 2008: 3665.321667

Average Rainfall in 2009: 3637.935000

Average Rainfall in 2010: 3607.919167

Average Rainfall in 2011: 3579.901667

Average Rainfall in 2012: 3563.730000

Average Rainfall in 2013: 3554.635000

Average Rainfall in Month 1: 3620.082857

Average Rainfall in Month 2: 3617.457143

Average Rainfall in Month 3: 3614.598571

Average Rainfall in Month 4: 3613.311429

Average Rainfall in Month 5: 3613.798571

Average Rainfall in Month 6: 3617.882857

Average Rainfall in Month 7: 3615.645714

Average Rainfall in Month 8: 3611.144286

Average Rainfall in Month 9: 3608.614286

Average Rainfall in Month 10: 3607.521429

Average Rainfall in Month 11: 3606.238571

Average Rainfall in Month 12: 3603.802857

Average was exceeded for month 1 in 2007

Average was exceeded for month 2 in 2007

Average was exceeded for month 3 in 2007

Average was exceeded for month 4 in 2007

Average was exceeded for month 5 in 2007

Average was exceeded for month 6 in 2007

Average was exceeded for month 7 in 2007

Average was exceeded for month 8 in 2007

Average was exceeded for month 9 in 2007

Average was exceeded for month 10 in 2007

Average was exceeded for month 11 in 2007

Average was exceeded for month 12 in 2007

Average was exceeded for month 1 in 2008

Average was exceeded for month 2 in 2008

Average was exceeded for month 3 in 2008

Average was exceeded for month 4 in 2008

Average was exceeded for month 5 in 2008

Average was exceeded for month 6 in 2008

Average was exceeded for month 7 in 2008

Average was exceeded for month 8 in 2008

Average was exceeded for month 9 in 2008

Average was exceeded for month 10 in 2008

Average was exceeded for month 11 in 2008

Average was exceeded for month 12 in 2008

Average was exceeded for month 1 in 2009

Average was exceeded for month 2 in 2009

Average was exceeded for month 3 in 2009

Average was exceeded for month 4 in 2009

Average was exceeded for month 5 in 2009

Average was exceeded for month 6 in 2009

Average was exceeded for month 7 in 2009

Average was exceeded for month 8 in 2009

Average was exceeded for month 9 in 2009

Average was exceeded for month 10 in 2009

Average was exceeded for month 11 in 2009

Average was exceeded for month 12 in 2009

Average was exceeded for month 1 in 2010

Average was exceeded for month 2 in 2010

Average was exceeded for month 6 in 2010

Average was exceeded for month 7 in 2010

**Conclusions**

Concluding this lab, we are much more comfortable with for loops, matrices, and vertices.

We now know how to use loops to perform statistical analysis on data files. We are also now comfortable with using the mean function to find the averages of data files. This lab was very insightful in how MATLAB handles data file input. We really liked how easy this lab was to understand but was also very informative.