COMP1200-MatLab - Lab 03
Due 11:59pm – Thursday – September 15
Submit `Lab03.m` via Blackboard

Before you start writing your program:

Read these instructions including the development plan. A development plan is a process that guides you through solving a problem. Use it as a guide when writing the m-script file solution for the following problem.

NOTE: You will see later that the spelling and casing of file names is very important in MATLAB. Your submitted file(s) MUST be spelled and cased as instructed. [-5 points per file for not doing so.]

***Problem*:**

***Program*: Lab03.m**

On a hot Saturday afternoon, you and your friends notice an empty baby swimming pool on the lawn of your apartment complex. So, why not see if you can fill it with water from water balloons thrown from your second floor balcony.

In Lab03, you will continue computing the distance a water balloon will travel given the balloon launch angle (theta) in degrees, balloon launch velocity (v) in min/sec, and the thrower's height in feet.

You are to write a MATLAB program (m-script file) that manipulates the data in the vectors and matrix. Some statements in Lab02 can be used in Lab03. Do not include statements from Lab02 that do not apply to Lab03.

INPUT: You will begin by using the `rand()` function to build a 1 x 7 vector of random numbers for each of the following: angle theta, velocity, and thrower's height. The numbers returned by the `rand()` function are evenly distributed between 0 and 1. To obtain numbers in a different range use the range minimum and maximum and the equation in your text. Note the minimums and maximums given below are CONSTANT values.

	minimum	maximum	
theta	5	85	degrees
velocity	1	30	ft/sec
thrower's height	4.5	7.0	feet

There are four PARTS of COMPUTATION and OUTPUT.
Build your program one part at a time to limit the number of errors.

PART 1 Compute the horizontal distance using mean of each input vector.
Display a vector containing theta, velocity, thrower's height, and distance with column headers

PART 2 Compute a vector of horizontal distances using the input vectors
Combine the four vectors to create a table (2-D matrix).
Display the table containing theta, velocity, thrower's height, and distance with column headers

PART 3 Compute the values for the 4th column of a matrix (horizontal distance) using the columns 1-3 of the 2-D matrix created in PART 2; use colon notation, not vector names.
This will over-write the 4th column.
Display the 4-column matrix containing theta, velocity, thrower's height, and distance with column headers

PART 4 Display the mean of each column of the matrix created in PART 3 using nested functions, i.e. the argument of `disp()` should be another function.

***Problem Constants*:**

```
BAL_HEIGHT = 12;      % balcony height in feet
G = 32;               % gravitational acceleration in ft/s2
```

and the minimum and maximum values

***Problem Inputs*:**

balloon launch angle (theta) in degrees a vector
balloon launch velocity (v) in ft/sec a vector

thrower's height in feet a vector

Problem Outputs:

distances that a water balloon will travel a scalar or vector

Instructions:

- ☐ Insert comments at the top and throughout each file
  - Include the follow comments at the beginning of this (and ALL) files.
    - **%** your name
    - **%** assignment number
    - **%** date you completed the assignment
    - **%** a short narrative about what the file does
  - Use your development plan algorithm steps as a guide for comments throughout each file
- ☐ Use `clc` and `clear all` at the beginning of your program.
- ☐ Use descriptive variable names.
- ☐ Use Sample Input/Output as a guide.
- ☐ No extra output, i.e., use semicolons!
- ☐ The input values are vector of random number.
- ☐ Compute horizontal distance(s).
  - It helps to break the large equation into parts and solve for each.
  - The results of some parts will be a vector. Keep this in mind when using multiplication.
    Note: Squaring a variable is multiplication.
  - Combine the parts to compute the distance.
- ☐ The output should include PART labels and column headers.
  - Use `disp()` to print the labels and column headers strings.
  - The algorithm steps/comments can be used as string for the labels.
- ☐ Output:
  - PART 1 and PART 2 should have two decimal places using the format command.
  - PART 3 and PART 4 should have four decimal places using the format command.
  - Use `disp()` to print the numbers as instructed for each PART.

-5 points per file for absence of any of these required comments at the top

New commands:
`rand`
`.*`
`disp` with strings
colon notation

Sample Input/Output: **NOTE: You numbers may be different.**

```
PART 1 -- Compute the distance using the mean of each vectors
         theta       velocity      thrower_ht    distance
         51.16         14.03          5.79         12.76

PART 2 -- Compute a distance for each set of input
         theta       velocity      thrower_ht    distance
         66.24         22.89          6.90         17.73
         68.62          9.00          5.35          4.39
         19.95         20.71          5.96         25.37
         44.18         20.00          5.06         22.32
         40.65          5.72          6.38          5.18
         56.71          4.45          5.14          2.83
         61.75         15.45          5.76         11.42

PART 3 -- Compute a distance for each row in table using colon notation
    theta   velocity  thrower_ht distance
   66.2413   22.8859    6.8994   17.7336
   68.6160    9.0047    5.3510    4.3860
   19.9498   20.7114    5.9632   25.3709
   44.1812   19.9978    5.0595   22.3180
   40.6469    5.7157    6.3782    5.1798
   56.7050    4.4509    5.1377    2.8287
   61.7492   15.4526    5.7649   11.4226

PART 4 -- Display the means of table column using a nested function
   51.1556   14.0313    5.7934   12.7485
```

Submit via Blackboard:

`Lab03.m` MATLAB script file

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SOFTWARE DEVELOPMENT PLAN

Name: J Hundley
Assignment: Lab03
Date: September 1, 2011

PROBLEM SOLVING IN ENGINEERING AND SCIENCE
Always use a systematic problem-solving strategy.

1. STATE THE PROBLEM:
---Describe the problem to be solved for the assignment.
Calculate the distance a water balloon will travel given the balloon launch angle (theta) in degrees, balloon launch velocity (v) in min/sec, and the thrower's height in feet.

2. DESCRIBE THE INPUT AND OUTPUT REQUIREMENTS:
---List and describe the following as needed to solve the problem, as needed.
---***Include units where needed***.

CONSTANTS (known values that don't change):

```
BAL_HEIGHT = 12;     % balcony Height in feet          [a scalar]
G = 32;              % gravitational acceleration      [a scalar]
MIN_THETA = 5;   MAX_THETA = 85;   % degrees
MIN_VEL   = 1;   MAX_VEL   = 30;   % ft/sec
MIN_T_HT  = 4.5; MAX_T_HT  = 7.0;  % feet
```

INPUT (values needed to find the output):

```
balloon launch angle (theta) in degrees   [a vector]
balloon launch velocity (v) in ft/sec     [a vector]
thrower's height in feet                  [a vector]
```

OUTPUT (unknowns):

```
horizontal distance (ft) a water balloon travels  [a scalar or vector]
```

Relevant formulas:
(for complicated equations, it may be helpful to divide it into parts)

$$d = \frac{v\cos\theta}{g}\left(v\sin\theta + \sqrt{(v\sin\theta)^2 + 2gy_0}\right)$$

```
x = (max-min) * r + min     --where r is an array of random numbers
```

3. WORK HAND EXAMPLES
---Solve the problem with a few hand examples.
---Record the input values used and the results

theta degrees	velocity	thrower's height	horizontal distance
5	37.0	5.5	42.44
45	51.0	6.0	96.45
80	42	6.2	21.65

This problem uses random number as input. Care should be taken to know that you equation is still working properly from previous problem.

4. DEVELOP AN ALGORITHM:
---Think about the steps used to solve the problem to solve the problem by
   hand and list them here to create an algorithm.
---The algorithm steps **should be used as comments** in your program as a guide.

*****INPUT*****
 get angle theta, velocity, and thrower's height
   using rand() to create vectors of 7 values each

PART 1 ==
*****COMPUTATION*****
   compute the horizontal distance using mean of each vector
*****OUTPUT*****
   display a vector containing theta, vel, thrower's ht, distance with column
      headers

PART 2 ==
*****COMPUTATION*****
   compute the horizontal distance using input vectors
*****OUTPUT*****
   display a table containing theta, velocity, thrower's ht, distance
      with column headers

PART 3 ==
*****COMPUTATION*****
   compute the values for the 4th column of table (horizontal distance)
      using table columns in the table created in PART3 as input
      use colon notation, not vector names
*****OUTPUT*****
   display a table containing theta, velocity, thrower's ht, distance
      with column headers

PART 4 ==
******OUTPUT******
   display the mean of each column in table created in PART 3

5. SOLVE THE PROBLEM:
---This step represents your writing a computer program to solve the problem.
---NOTE: Do not type your program here. Submit it as a computer program file.
---Use steps in your algorithm as comments in your program
   to guide the development of you program.

6. TEST THE SOLUTION:
---Run your program using the values from #3 to check for correctness.
---If there is an error, correct your program code and run again.