

Read all instructions
before beginning your work.

COMP1200-MATLAB – assign06
Due 4:45pm – Friday – March 6, 2020
Submit assign06.m via Canvas

NOTE:
Your submitted file(s) **MUST** be
spelled and cased as instructed.

Before you start writing your program:

Read the complete instructions including the **algorithm**. An **algorithm** contains the steps needed to guide you through solving a problem. Use the **algorithm** as comments to a guide you when writing the MATLAB program file solution for the following problem.

Problem:

Drag Force and Drag Coefficients

The **drag equation** is a practical formula used to calculate the force of drag experienced by an object moving through a fluid. The force on a moving object due to a fluid due to Lord Rayleigh is

$$F_d = \frac{1}{2} \rho v^2 C_d A$$

where

F_d is the force of the drag, air resistance

ρ is the density of the fluid, air density

V is the velocity of the object relative to the fluid, i.e. the air

A is the reference area, frontal area of vehical

C_d is the drag coefficient (a dimensionless constant).

NOTE: use descriptive variables

The reference area A is the area of the projection of the object on a plane perpendicular to the direction of motion (i.e. cross-sectional area). Sometimes different reference areas are given for the same object in which case a drag coefficient corresponding to each of these different areas must be given. Note: v^2 dependence on velocity, meaning that fluid drag increases with the square of velocity.

The drag coefficient of a car at the design conditions of 1 atm at 25°C ($\rho = 1.225 \text{ kg/m}^3$) and velocity ($v = 90 \text{ km/h} / 3.6 \text{ km/h OR } 25 \text{ m/s}$) is to be determined experimentally in a large wind tunnel in a full-scale test. The horizontal force (F_d) acting on the car is measured to be 350 N.

For example, typical examples of drag coefficients for automobiles.

Year	Model	C_d
2015	BMW-7	0.24
2016	Toyota-Tacoma	0.39
2017	Tesla-3	0.23
2018	Audi-A6	0.26
2018	Jeep-Wrangler	0.45
2019	Toyota-Corolla	0.28

Program: assign06.m

Read the data file, dragCoef06.txt, into a matrix. The first column will contain the year and the second column contains the drag coefficient for vehicles. Write a MATLAB script file that uses the velocity, horizontal force, and air density given above and the drag coefficient read from the data file to compute the frontal area for all the vehicles. Display and print title and column headers over the numbers of a three column matrix with the year, drag coefficient and frontal area of each vehicle. Note: you will need to add the frontal area as the third column of the original input data matrix. Sort the output table by the year column for output.

Use `fscanf()` to read the data file. Read the first number (the number of cars in this file) then use it to control the **for** loop to build a matrix **ONE row at time in the for loop** saving one number at a time into the first and second columns of each car row.

Use `fprintf()` title and column headers over the numbers of a three column table of the information in the matrix. Print the table **ONE row at a time in a for loop**. At the end of each line, mark each frontal area greater than the average frontal area with an asterisk *. Print a legion after the table.

NOTE: Reading the number of cars from the data file is VERY IMPORTANT. **The grading data file will have more or less cars.** The first number in the grading data will reflect the number of cars in that file.

**Submit BEFORE
leaving for Spring
Break**

NO error checking.
**Do not use commands and statements beyond
what has been taught on class.**
**Do not use commands and statements in assign01
until they have been discussed in class.**

New commands:
`fopen()`, `fscanf()`, `fclose()`
Only continue if file is available otherwise
ONLY print the message from `fopen()`.
for loops
Continue:
Use functions from previous assignments as needed.
`if...else` to check for file
Use descriptive variables.

Problem CONSTANTS: (with units)

filename = 'dragCoef06.txt'
velocity, horizontal_force, air_density
number of columns in data file = 2

Problem Inputs: (with units)

drag coefficient

Problem Outputs: (with units)

frontal area

Other variables: (with units)

number of cars

average frontal area

Equation:

See above.

Algorithm:

Using the following section comments and previous assignment files as a guide create an algorithm for the current requirements. Use the algorithm as comments in your assign06.m

```
% ***** CONSTANT *****  
% ***** INPUT *****  
% ***** COMPUTE *****  
% ***** OUTPUT *****
```

Data file:

10
2015 0.24
2016 0.27
2016 0.36
2016 0.39
2017 0.22
2017 0.23
2018 0.26
2018 0.33
2018 0.45
2019 0.28

Output:

All Cars		
Year	Drag Coef	Frontal Area(m^2)
2015	0.24	3.8095 *
2016	0.27	3.3862 *
2016	0.36	2.5397
2016	0.39	2.3443
2017	0.22	4.1558 *
2017	0.23	3.9752 *
2018	0.26	3.5165 *
2018	0.33	2.7706
2018	0.45	2.0317
2019	0.28	3.2653 *
* Frontal area above area		

Instructions for all assignment scripts:

- ☐ See Standards for Documentation of MATLAB Programs on the Canvas Resources page.
- ☐ Insert comments at the top and throughout each file.
 - o Include the follow comments at the beginning of this (and ALL) files.
 - % submitter's name, **GROUP # or "none"**
 - % other group members' names or **"none"**
 - % **program file name**, ex. assign02a.m
 - % due date of the assignment
 - % **statement about collaboration REQUIRED.**
 - % a short narrative about what the file does
 - o Use the algorithm given as comments throughout your program.
- ☐ Observe the instructor's rule for naming variables.
 - o Use ALL CAPS for constants variable names.
 - o Start other variables with lower case.
 - o Use descriptive variable names.
- ☐ Use Sample Input/Output as a guide.
- ☐ Code clarity:
 - o Indent blocks as needed. **Use Smart Indent.**
 - o Divide your solution program code into sections as noted in the algorithm. Use blank lines as needed to group statements.
 - o Use section comments as well as the algorithm step comments.
 - o Remove statements from previous assignments that do not apply to the current requirements.
- ☐ Use comments to show units.
- ☐ **Use the CONSTANT and variable names, not numbers.**
Exceptions are incrementers (or counters) and numbers without identity.
- ☐ No extra output, i.e. use semicolons

GRADE OF ZERO for a file if submitter name not part of Canvas group.

(-3pts) No **CURRENT** GROUP# or **"none"**.

(-3pts) For your own protection, type **"none"** for other group members if submitting alone.

(-5pts) Five point penalty for not joining your Canvas group.

(-5pts) Starting with assign06, penalty applied for omitting the name of any group member from a script comment list or an incomplete name of a group member in a script comment list. This penalty will be applied to the group grade if at least one file has incomplete or incorrect name information.

(-5pts) Zero points for comments if no collaboration statement.

Submit via Canvas:

assign06.m MATLAB script file

NOTE: Your submitted file(s) **MUST** be spelled and cased as instructed.
One submission per group. Canvas links members to files and rubric.
A script cannot run from Canvas. It must be downloaded, saved, and "run".