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% CODE CHALLENGE 2 - Monte Carlo Analysis
%
% The purpose of this challenge is to perform a Monte-Carlo analysis
 on the
% lift generated by an aircraft.  The aircraft has the following
 characteristics:
%   Wing surface area, S = 80 m^2
%   Lift coefficient, C_L = 0.90 +- 0.03
%
% And is flying under the following conditions
%   Air density, rho = 0.653 kg/m^3
%   Airspeed, V = 100 +- 10 m/s
%
%
 -------------------------------------------------------------------------
%
% To complete the challenge, execute the following steps:
% 1) Sample S, C_L, rho, and V 10,000 times.
% 2) Calculate lift in kilonewtons for each of the 10,000 samplings/
simulations.
% 3) Calculate the best estimate and error for lift and report it to
 the
% command window using appropriate significant figures.
% 4) Plot a histogram of L.
% Bonus 1) Calculate drag in kilonewtons for each of the 10,000
% samplings/simulations.
% Bonus 2) Make a scatterplot of Lift vs Drag.
%
% NOTE: DO NOT change any variable names already present in the code.
%
% Upload your team's script to Canvas to complete the challenge.
%
% NAME YOUR FILE AS Challenge2_Sec{section number}_Group{group
 breakout #}.m
% ***Section numbers are 1 or 2***
% EX File Name: Challenge2_Sec1_Group15.m
%
%
```

```
% 1) Lila Monprode
% 2) Jordi Brownlow
% 3) Andrew Logue
% 4) Julian Claxton
% 5) Joshua Quarderer
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%
```

Housekeeping

(Please don't "clear all" or "clearvars", it makes grading difficult)

```
close all    % Close all open figure windows
clc          % Clear the command window
```

1) Sample S, C_L, rho, and V 10,000 times

(i.e. the S variable should contain 10000 samples of the wing surface area)

```
N = 1e04;
S = 80*ones(N,1); % [m^2]
C_L = .9+(.06*(rand(N,1)))-.03;
rho = 0.653*ones(N,1); % [kg/m^3]
V = 100+(20*(rand(N,1)))-10; % [m/s]
```

2) Calculate lift in kilonewtons for each of the 10,000 samplings/simulations.

Given that the equation for lift is: L = 0.5 * rho * V^2 * C_L * S (Newtons)

```
L = (0.5 .* rho .* V.^2 .* C_L .* S)/1000; % [kN]
```

3) Calculate the best estimate and error for lift

Report it to the command window using appropriate significant figures.

```
L_best = mean(L);
L_err  = std(L);

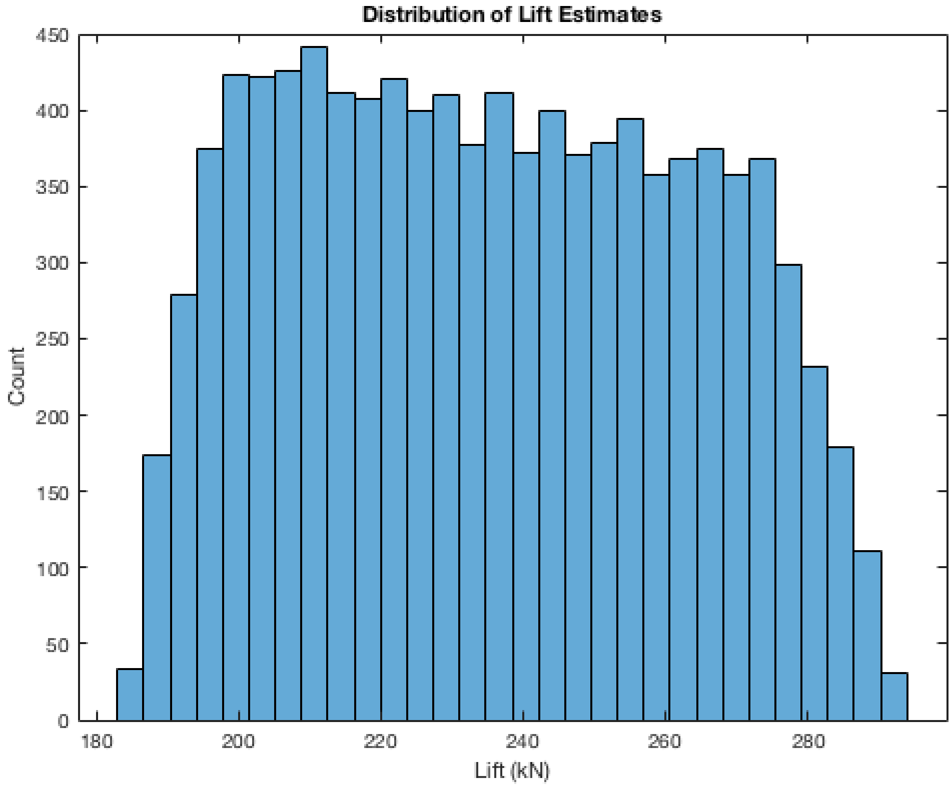
fprintf("Best Estimate of Lift: %f kN\n",L_best);
fprintf("Error for Lift Estimate: %f\n", L_err);
```

```
Best Estimate of Lift: 235.727177 kN
Error for Lift Estimate: 27.509089
```

4) Plot a histogram (use the "histogram" command) of L with 30 bins.

Add annotations and labels for style points!

```
figure();
histogram(L,30)
title("Distribution of Lift Estimates")
xlabel("Lift (kN)")
ylabel("Count")
```



Bonus 1) Calculate drag in kilonewtons

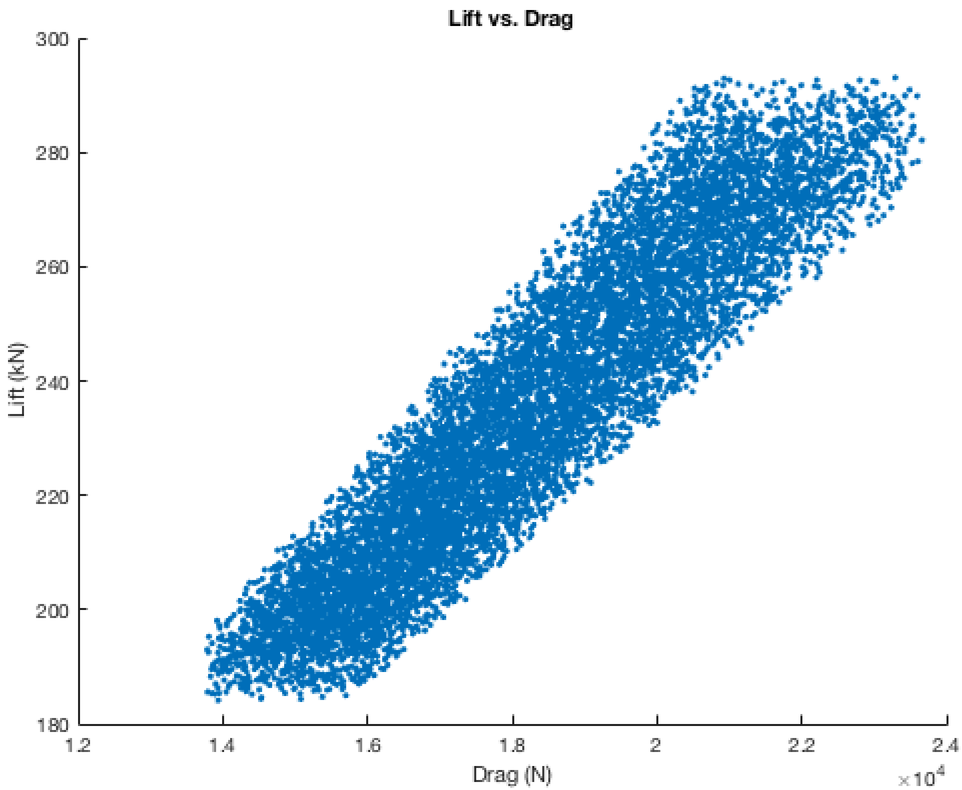
For each of the 10,000 samplings/simulations, given that the equation for drag is: D = 0.5 * rho * V^2 * C_D * S (Newtons) and that C_D = 0.070 +- 0.005

```
C_D = .070+(.01*(rand(N,1)))-.005;
D = 0.5 * rho .* V.^2 .* C_D .* S;
```

Bonus 2) Make a scatterplot of Lift vs Drag.

Think about the following (no work to do): - Why do you think the points are spread into an ellipse and not a circle? - What is the significance of the general trend/slope of the data? - How could this sort of analysis be useful when dealing with more complicated systems and equations?

```
figure();
scatter(D,L,1,'.')
title("Lift vs. Drag")
xlabel("Drag (N)")
ylabel("Lift (kN)")
```



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