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% CODE CHALLENGE 1 -
%
% The purpose of this challenge is to estimate atmospheric pressure in
% Boulder CO using a pressure model and measurements, and compare the
 two
% through error analysis and statistics.
%
% To complete the challenge, execute the following steps:
% 1) Load the given dataset
% 2) Extract altitude and pressure data
% 3) Determine standard deviation, variance, mean, and
%    standard error of the mean of the pressure data
% 4) Using information given about the instrument, find uncertainty
 associated
%    with altitude measurements
% 5) Use the model to predict pressure measurements at each altitude
 in the
%    data set, along with propagated uncertainty
% 6) Compare results, discuss, and print answers to the command
 window.
% Bonus) Repeat for larger measurement uncertainty in altitude
%
% 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 Challenge1_Sec{section number}_Group{group
 breakout #}.m
% ***Section numbers are 1 or 2***
% EX File Name: Challenge1_Sec1_Group15.m
%
%
% 1)
% 2)
% 3)
% 4)
% 5)
```

```
%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%

% Housekeeping
clear all   % Clear all variables in workspace
close all   % Close all open figure windows
clc           % Clear the command window
```

1) Load data from given file

```
data = readtable('PressureInBoulder.csv');
```

Warning: The DATETIME data was created using format 'MM/dd/uuuu HH:mm' but also matched 'dd/MM/uuuu HH:mm'.
To avoid ambiguity, use a format character vector. e.g. '%{MM/dd/uuuu HH:mm}D'
Warning: Table variable names were modified to make them valid MATLAB identifiers. The original names are saved in the VariableDescriptions property.

2) Extract just the altitude and station pressure data columns to meaningfully named variables

```
AltitudeData = data.Altitude_m_;
PressureData = data.StationPressure_kPa_;
```

3) Determine Statistics and Error

the standard deviation, variance, mean, and standard error of the mean (sem) of the pressure data

```
StdevPressure = std(PressureData);

VarPressure = var(PressureData);

MeanPressure = mean(PressureData);

Sem_Pressure = StdevPressure/sqrt(length(PressureData));
```

4) Uncertainty

```
          The altitude measurements were taken using an instrument that displayed
          altitude to the nearest tenth of a meter.

%    What is the associated absolute uncertainty with these measurements?

AltitudeUncertainty = .05;% [m]
```

5) Pressure Predictions

Using the altitude measurements and uncertainty, predict pressure with t
First, propagate uncertainty BY HAND before calculating uncertainty for
Then check: is it different for each calculation?

```
%               Model
%    P_est =   P_s * e^(-k*h)
%    Assume P_s is 101.7 ± 0.4 kPa and k is 1.2*10^(-4) [1/m]

P_s = 101.7;        % ± 0.4 [kPa]
k = 1.2*10^(-4);    % [1/m]

P_est = P_s*exp(-k*AltitudeData);

P_sig = sqrt(((0.4*exp(-k*AltitudeData)).^2) +
 ((AltitudeUncertainty*(-k*P_est)).^2));
```

6) Print Results

Display the predicted pressure from the model with it's associated uncer
the average pressure with the it's standard error of the mean from the d

```
results  = table(P_est,P_sig);
P_data = [num2str(MeanPressure) '  ±  ' num2str(Sem_Pressure ) '
 kPa'];
disp(results);
disp(P_data);

% Disucss the accuracy of the model and whether or not you think the
% model agrees with the measurements

disp('Model Discussion: The model is accurate and does agree with the
 measurments, despite our readings hovering on the edge of the average
 pressure.')
```

P_est	*P_sig*
83.765	*0.32946*
83.767	*0.32947*
83.766	*0.32946*
83.766	*0.32946*
83.767	*0.32947*
83.767	*0.32947*
83.765	*0.32946*
83.767	*0.32947*
83.767	*0.32947*
83.766	*0.32946*
83.764	*0.32945*
83.767	*0.32947*
83.765	*0.32946*
83.767	*0.32947*

```
    83.767     0.32947
    83.766     0.32946
    83.767     0.32947
    83.767     0.32947
    83.767     0.32947
    83.767     0.32947
    83.767     0.32947
    83.766     0.32946
    83.764     0.32946
    83.765     0.32946
    83.765     0.32946
    83.767     0.32947
```

84.3025 ± 0.00023221 kPa
Model Discussion: The model is accurate and does agree with the measurments, despite our readings hovering on the edge of the average pressure.

Bonus

Repeat steps 4-6, but assume the altitude measurements were taken on a lower precision instrument that only displayed altitude to nearest 10 meters
How does this change the results and comparison ?

```
altitude_uncertainty_new =  5;  % [m]

P_sig_new = sqrt(((0.4*exp(-k*AltitudeData)).^2) +
 ((altitude_uncertainty_new*(-k*P_est)).^2));

disp(table(P_est, P_sig_new));
disp('Lowering the precision of the altitude increases the uncertainty
 of P_est, the estimated pressure.');
```

P_est	P_sig_new
83.765	0.33327
83.767	0.33328
83.766	0.33328
83.766	0.33327
83.767	0.33328
83.767	0.33328
83.765	0.33327
83.767	0.33328
83.767	0.33328
83.766	0.33328
83.764	0.33327
83.767	0.33328
83.765	0.33327
83.767	0.33328
83.767	0.33328
83.766	0.33327
83.767	0.33328

```
83.767     0.33328
83.767     0.33328
83.767     0.33328
83.767     0.33328
83.766     0.33328
83.764     0.33327
83.765     0.33327
83.765     0.33327
83.767     0.33328
```

Lowering the precision of the altitude increases the uncertainty of P_est, the estimated pressure.

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