PHYS 361: Lab 5

Warm-Up: Write the following equations in linear form. An example is given.

Nonlinear Equation	**Linear Form**
$\boldsymbol{y = bx^m}$	$\mathbf{ln}(\boldsymbol{y}) = \boldsymbol{mln}(\boldsymbol{x}) + \mathbf{ln}\ (\boldsymbol{b})$
$\boldsymbol{y = be^{mx}}$	
$\boldsymbol{y = b10^{mx}}$	
$\boldsymbol{y = \dfrac{1}{mx+b}}$	
$\boldsymbol{y = \dfrac{mx}{b+x}}$	

Warm-Up: The linear regression algorithm is:

To fit data with a line: $y = ax + b$

1. Calculate sums of N data points:

$$S_x = \sum_{i=1}^{N} x_i \qquad S_y = \sum_{i=1}^{N} y_i \qquad S_{xy} = \sum_{i=1}^{N} x_i y_i \qquad S_{xx} = \sum_{i=1}^{N} x_i^2$$

2. Solve for constants:

$$a = \frac{nS_{xy} - S_x S_y}{nS_{xx-}(S_x)^2} \qquad \text{b=} \frac{S_{xx}S_y - S_{xy}S_x}{nS_{xx-}(S_x)^2}$$

Write pseudo code for a user defined function called LinearReg that takes arrays of data points (x,y) as input and outputs the slope and y-intercept of the linear regression fit (i.e., a and b in y=ax+b).

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Problem 1:
This problem involves hot wire anemometers used to measure wind velocity using a heated wire. The wire's resistance changes as air flows across it, cooling the wire. The change in resistance correlates with the wind speed, which is then measured as voltage across the wire. The voltage is converted to wind speed using the formula:

$$\text{Wind speed} = A\, e^{B*voltage}$$

Steps:

1. Determine the linear form of the equation above.
2. Download and load " anemometer.mat" from Canvas.
3. Transform the data into a linear form. Plot the linear form of voltage and wind speed to confirm it appear linear.
4. Implement the Linear Regression user-defined function you wrote to find coefficients the slope and y-intercept of the linear form of the data.
5. Calculate the A and B in the wind speed equation from the y-intercept and slope you found in the last step.
6. Plot the data in its original form and demonstrate that you can fit it with the exponential form of the equation about with the values of A and B.
7. Make sure your MATLAB script has the appropriate format and comments.
8. Upload the m-file and the plot make in step 6 to Canvas.