Last class period, we learned about the technique of regression, which can be used to fit a function (either linear, exponential, or power) to a data set. Here is a quick summary:

**Fitting a Linear Model** \( y = mx + b \):

For a linear model, we simply use Excel, as described in Excel Lab 3, to compute the slope \( m \) and intercept \( b \) of the regression line (i.e. the “best-fit” line).

**Fitting a Power Function Model** \( y = Ax^p \):

Through the mass-pulse data example in class, we learned the following procedure:

1. Compute the natural log of both columns of data. (Known as a log-log transformation.)
2. Fit a linear model to the transformed data, to get a slope \( m \) and intercept \( b \).
3. Translate into a power function for the original data with the relations \( p = m \) and \( A = e^b \).

**Fitting an Exponential Function Model** \( y = Be^{rx} \):

The procedure here is similar to the one for power function models:

1. Compute the natural log of only the dependent variable data column. (Known as a semi-log transformation.)
2. Fit a linear model to the data set (consisting of the original independent variable column and the transformed dependent variable column) to get a slope \( m \) and intercept \( b \).
3. Translate into an exponential function for the original data with the relations \( r = m \) and \( B = e^b \).
Deciding which type of model to try:

To decide which type (linear, power, exponential, or none-of-the-above) of model to fit to a data set, we have two tools: AROC and scatter plots.

AROC: We already learned that AROC can tell us when a linear model is a good idea: *If the AROC values are all close to each other in value, throughout the entire table, then a linear model is a good thing to try.* Here is a strategy that is simple to use in Excel. In this description, we call the independent variable \( x \) and the dependent variable \( y \).

1. Compute the log-log transformation of the data set.
2. Compute AROC for the original data set. (Call this column “AROC-L”.)
3. Compute AROC for the semi-log data set, i.e. for the data columns \( x \) and \( \ln(y) \). (Call this column “AROC-E”.)
4. Compute AROC for the log-log data set, i.e. for the data columns \( \ln(x) \) and \( \ln(y) \). (Call this column “AROC-P”.)
5. Assess the AROC values:
   a. If the AROC-L values are all close to one another in value, try a linear function model.
   b. If the AROC-E values are all close to one another in value, try an exponential function model.
   c. If the AROC-P values are all close to one another in value, try a power function model.
   d. If none of the AROC columns satisfy a.-c. above, then probably none of these three types of models is appropriate.

Scatter Plot: As a second tool for deciding which type of model to use, we can look at some scatter plots.

1. Compute the log-log transformation of the data set. (This should be already done from your AROC calculations.)
2. Produce a scatter plot of the original data set. (Call this plot “PLOT-L”.)
3. Produce a scatter plot of the semi-log data set, i.e. for the data columns \( x \) and \( \ln(y) \). (Call this column “PLOT -E”.)
4. Produce a scatter plot of the log-log data set, i.e. for the data columns \( \ln(x) \) and \( \ln(y) \). (Call this column “PLOT -P”.)
5. Assess the scatter plots:
   a. If PLOT-L looks basically linear, try a linear function model.
   b. If PLOT-E looks basically linear, try an exponential function model.
   c. If PLOT-P looks basically linear, try a power function model.
   d. If none of these three scatter plots look basically linear, then probably none of these three types of models is appropriate.

NOTE: When trying to decide which type of model to use on a particular data set, you should do the AROC calculations and the scatter plots.