

Physics 503: Scientific Computing

Homework #8

Topic: Regression

Due: Monday April 16 by midnight.

Assignment

1. Write a function to generate some noisy data which follows the general trend

$$f(t) = A \left(1 - e^{-\frac{t}{\tau}} \right) + f_0 \text{ where } A, \tau, f_0 \text{ are parameters you will need to choose values for.}$$

You should also have as an argument to your data generating function a “noise level” variable which defines the amplitude of the scatter relative to $A - f_0$. Use this function to generate some synthetic noisy data with perhaps 20 data points.

2. Perform a non-linear fit to the data using the above non-linear model. Use the `curve_fit()` function in `scipy.optimize` to fit this model to the data and report the values of these parameters (make sure to include units!). Of particular interest is the time constant. Plot the fitted model and data together on a plot with appropriate labels and a legend.
3. Write your own correlation coefficient (r^2) function to compute the quality of the fit as well as approximate confidence on the fitted parameters. You may use components of code we’ve discussed in class.
4. To get a feel for how the fits depend on the level of scatter in the data, repeat the above fits for a range of scatter levels. Plot the error in τ and correlation coefficient versus the noise level (express errors and noise levels as percentages). Include a sampling of plots of generated data with their fits as well.