EE2703 Assignment3

Vighnesh N, EE17B119

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1 Introduction - Fitting Data To Models

The assignment involves
- Reading files from data and parsing them
- Analysing the data to extract information
- Study the effect of noise on the fitting process
- Plotting Graphs

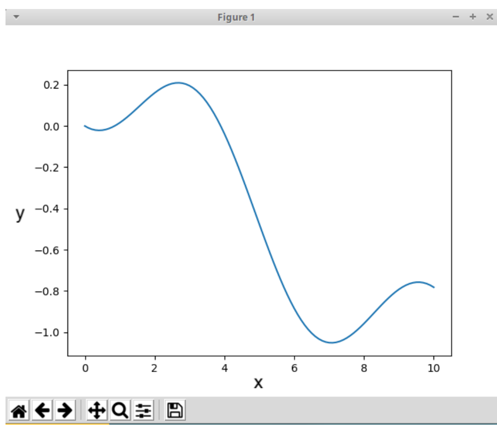

Figure 1: g(t) = $1.05J_2(t) - 0.105t$

Figure 1 is the model we are fitting to

2 Loading Data with different Sigmas

The data generated by generate_data.py is loaded using loadtxt and plotted, with a legend indicating the different standard deviations for each of the curves with noise

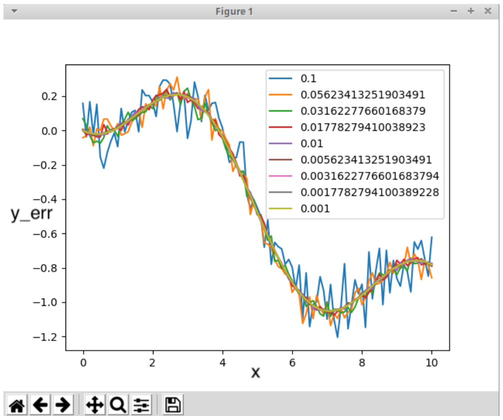

Figure 2: Different plots to fit

3 Plotting Error bars

The reading of the first column is taken and plotted along with the standard deviation and the ideal curve, to give us an initial sense of understanding of the data, and how to expect the fit.

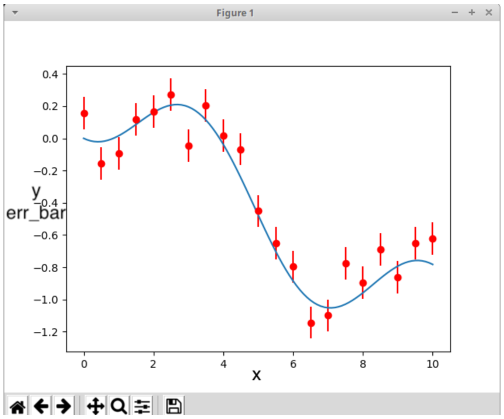

Figure 3: Error bar of y[0]

4 Creating the matrix

$$g(t, A, B) = M \cdot p = \begin{bmatrix} J_2(t_1) & t_1 \\ \dots & \dots \\ J_2(t_m) & t_m \end{bmatrix} \begin{bmatrix} A \\ B \end{bmatrix}$$

We need to construct matrix M, by taking the t column extracted from fitting.dat and concatenaing that vector with the second order bessel function of that vector.
g(t,A,B) is the required column of data to which we wish to fit A and B.

5 Error matrix and Contour plot

An error matrix is created by calculating the mean square error for different values of A and B. A ranges from 0 to 2 in steps of 0.1 while B ranges from -0.2 to 0 in steps of 0.01

$$\epsilon_{ij} = \frac{\sum_{k=0}^{101}(f_k - g(t_k, A_i, B_j))^2}{101}$$

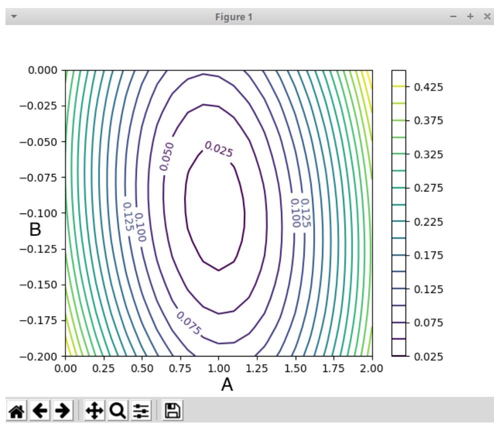

Figure 4: Contour plot of the error matrix

6 Least Squares Fitting

The python function *lstsq* from the module *scipy.linalg* is used to obtain the best estimate of A,B. It solves for the vector **p** defined while creating the matrix.

A graph is plotted highlighting the errors in A and B for data with different standard deviations

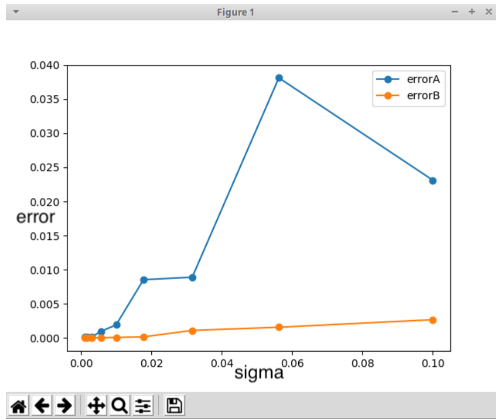

Figure 5: Error in A and B

The error estimate above does not grow linearly with noise, there is more fluctuation. Another plot is plotted on the loglog scale, showing a variation that seems to be more linear. But what we really can expect to be linear is the loglog plot of the absolute error.

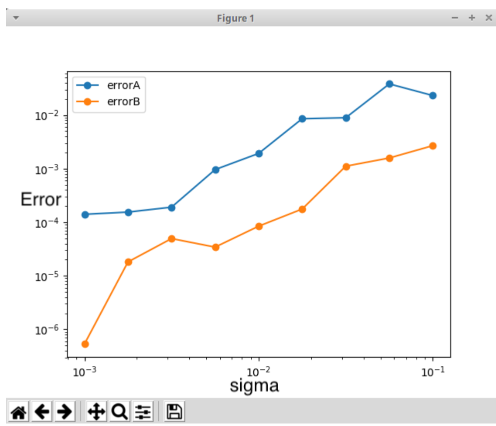

Figure 6: Log-Log plot of error in A and B