EE2703 : Applied Programming Lab
A3 Assignment

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EE20B102

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Extracting and visualising the data

The given data was obtained by running the generate data.py script. The data contained 10 columns : the first column was time, and the other 9 columns were each riddled with different amounts of noise, with standard deviation uniformly sampled from a logarithmic scale. On plotting all the 9 columns, the following graph was observed : **figure 1.**

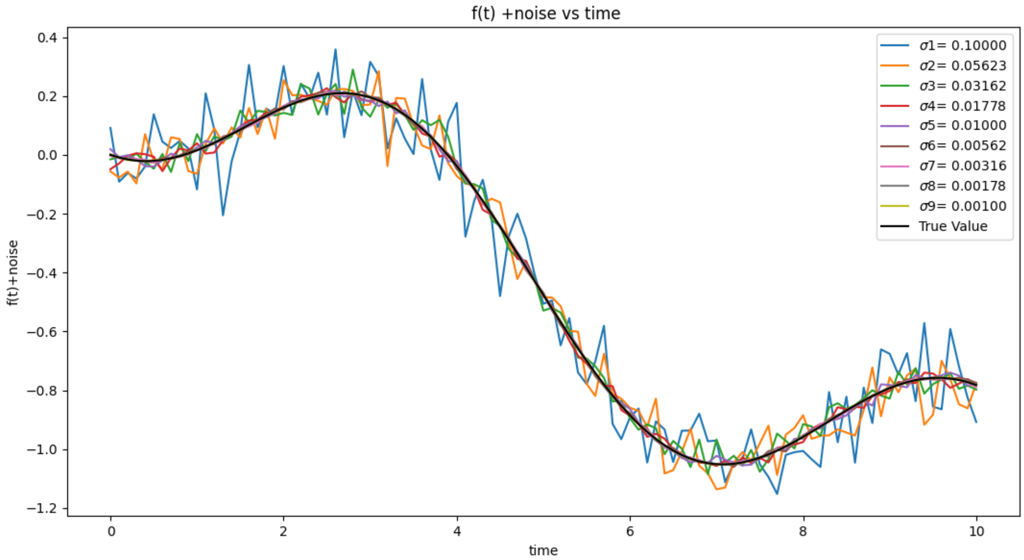

Figure 1:

The function

Since we are aware of the actual function to be extracted from the data columns, the general shape of the function to fit the given data is known. A simple implementation does the required computation :

```
def g(t,A,B):
    return (A*sc.jn(2,t)+B*t)
```

Visualising noise- the erorr bar plot

An errorbar is a convenient way of visualising the uncertainty in the reported measurement. The errorbars for the first data column are plotted using the errorbar() function. The graph obtained by plotting every 5th data point with errorbars and the original data is as follows:

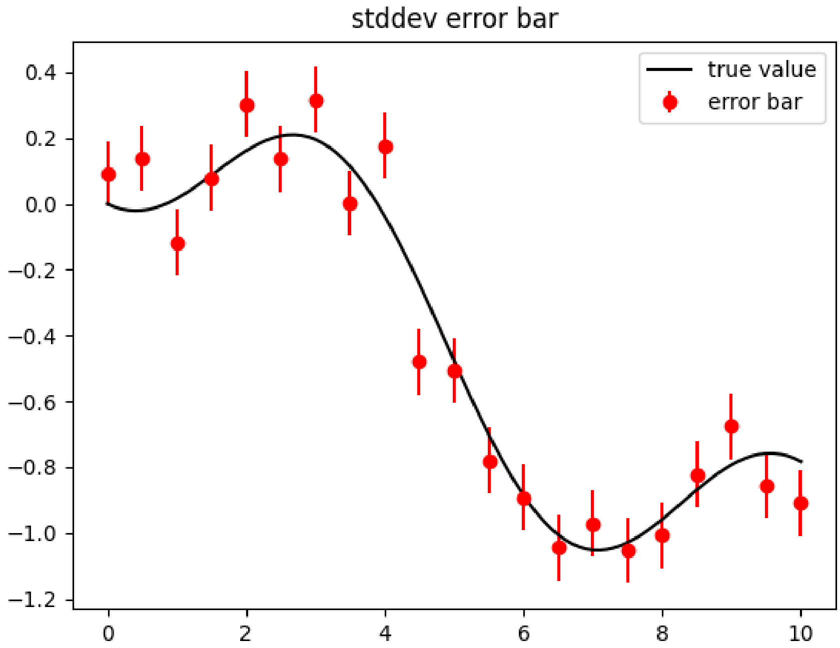

Figure 2: stddev error bar

Each point in the data column can be seen to be varying mostly within a width of the true value, except in a few cases. These are the points that most affect the prediction of the function parameters A and B

The Matrix Equation

We can compare the results obtained using matrix multiplication and the user-defined function using the np.array equal() function. If this returns a T rue value, then they are equivalent.

Error Computation

The following code snippet is used to compute the error e in each data column:

```
E = np.zeros([21,21])
for j in range(len(A1)):
    for k in range(len(B1)):
        for l in range(len(rows)):
            E[j][k] += (x[l][1]- g(x[l][0], A1[j], B1[k]))**2/101 #finding the \
```

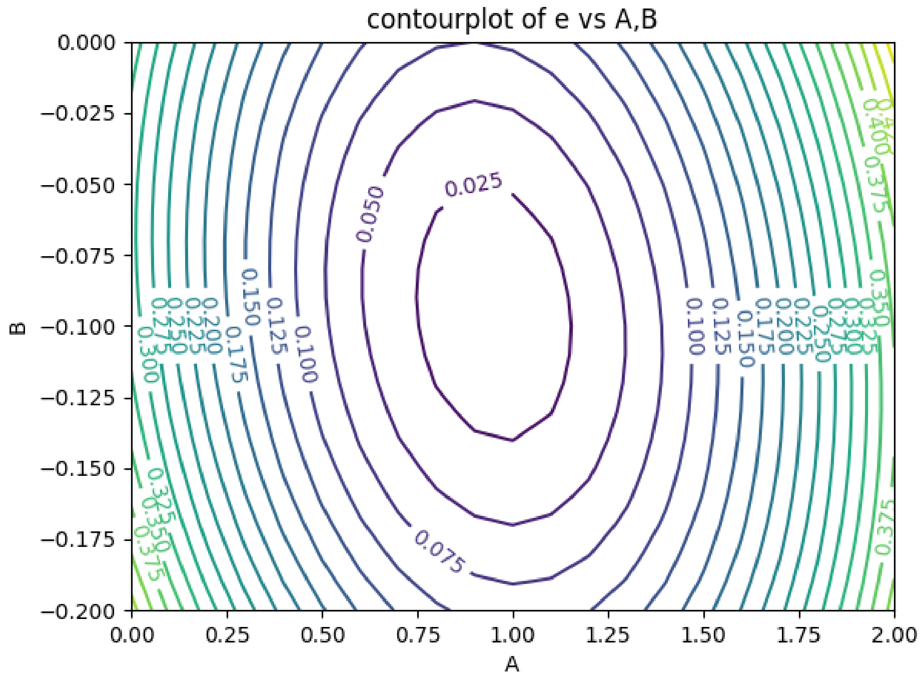

Figure 3: contour plot

The contour pplot has only one minima, which occurs approximately at A = 1.05 and B = -0.105.

Parameter estimation

The plot of the error in the estimation of A and B parameters with respect to standard deviation () of the noise is given in Figure 4

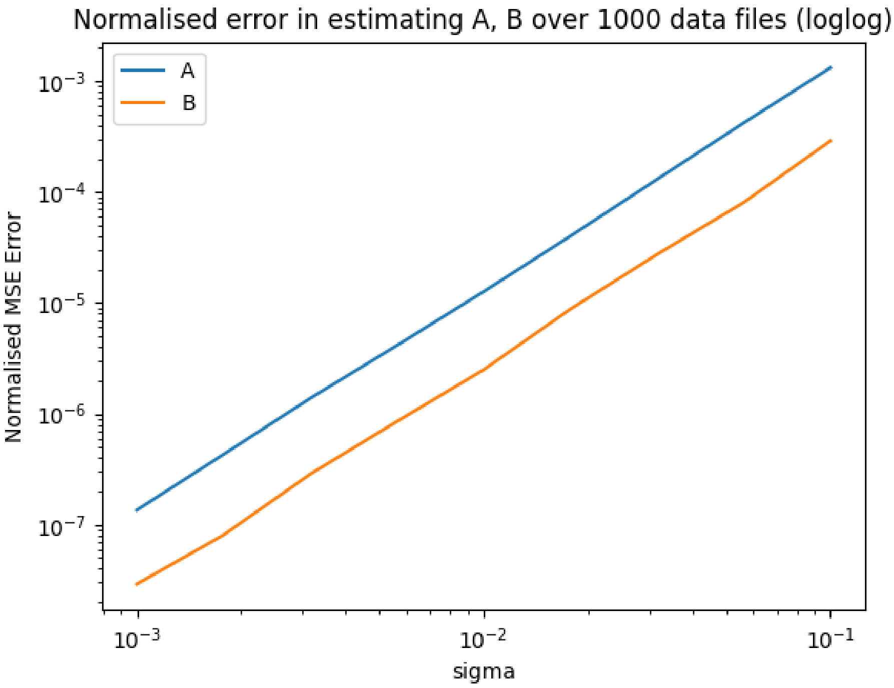
Normalised error in estimating A, B over 1000 data files (loglog)
A
B
Normalised MSE Error
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-3}
10^{-2}
10^{-1}
sigma

Figure 4:

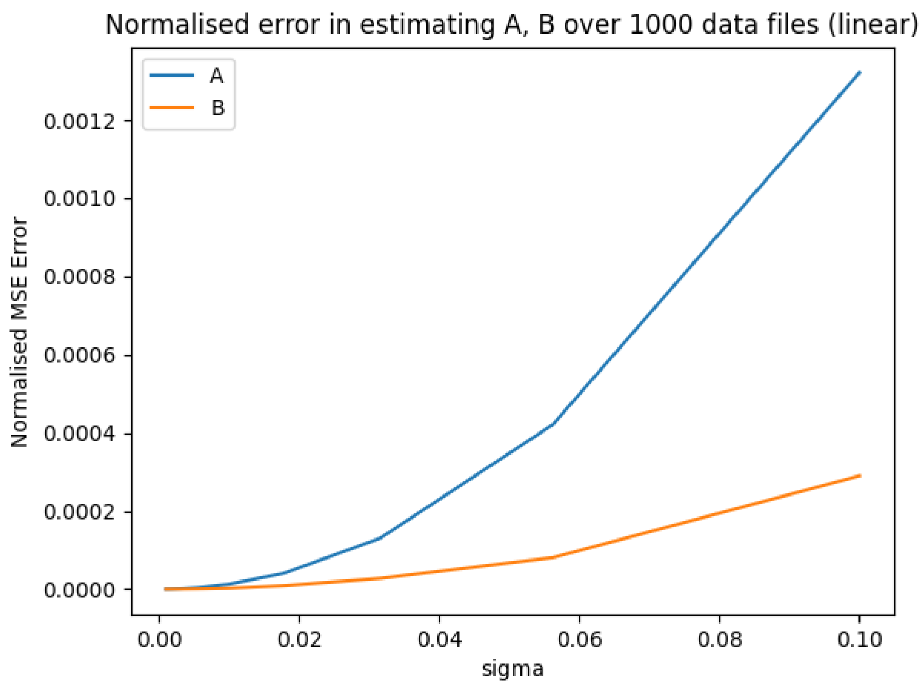

Figure 5:

We can see that the error graph when plotted on a linear scale is not linear, but on a loglog scale is linear. This tells us the the error increases exponentially with the sigma of the noise distribution

Conclusion

The given noisy data was extracted and the best possible estimate for the underlying model parameters were found by minimizing the mean squared error. It was observed that the error was approximately linear in n in the log scale.