EE2703 : Applied Programming Lab
Assignment-3

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Question 4

Plot the graphs with the input signal and noise and label them to indicate the noise. Given,

$$f(t) = 1.05J_2 - 0.105t + n(t) \tag{1}$$

Standard Deviation of noise, sigma = logspace(-1,-3,9)

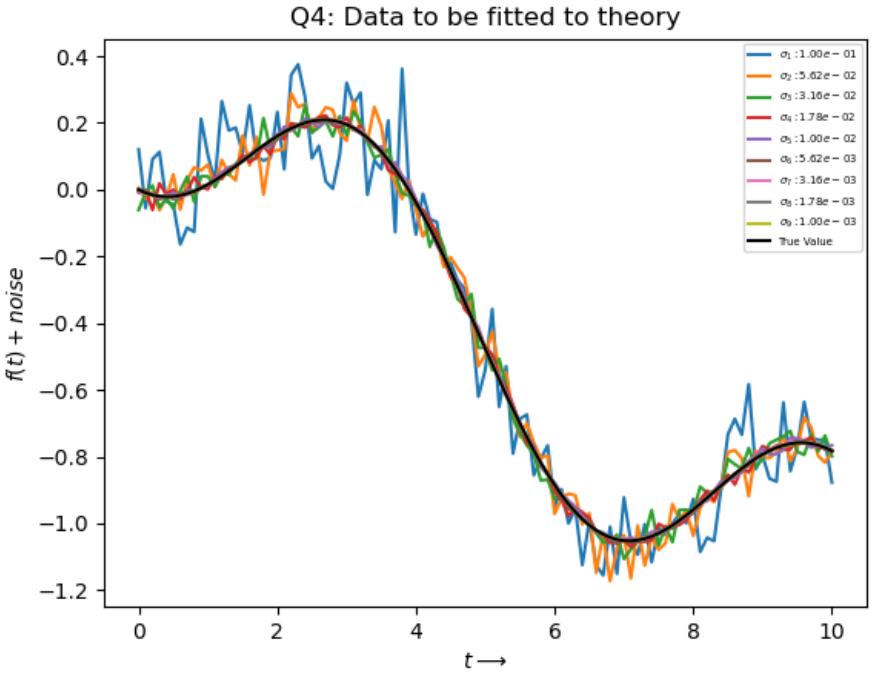

Figure 1: Data to be fitted to theory

The above figure shows the plot of 9 signals with different noise whose standard deviation is given by the numpy array sigma given in the question. The graph in black is the true signal without any noise.

Question 5

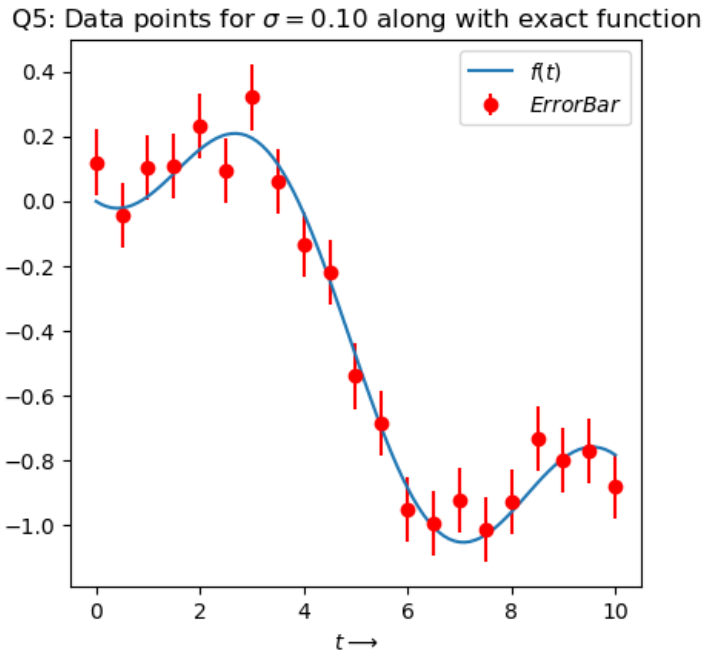

Figure 2: Plot of Data Points of function with $\sigma = 0.10$ and of Actual signal without noise

The above plot shows the points on function with $\sigma = 0.10$ for every fifth data point. The blue graph is the function without noise.

Question 6

Question: How will you confirm that two vectors are equal? We can use *np.allclose* to check whether two vectors are equal or not. If all the elements are equal, then the function returns True else it will return False. This part can be seen in the code file ee2703_asn3_ee19b047.py between lines 74 and 77.

Question 8

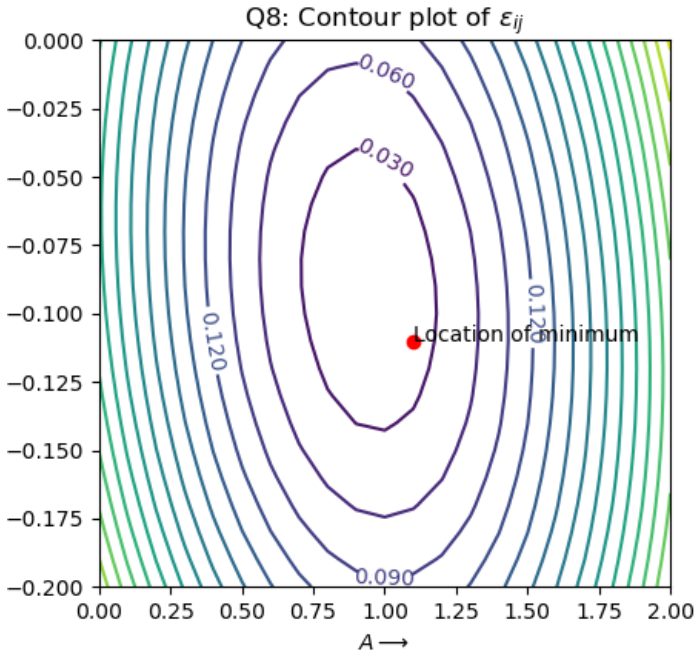

Figure 3: Contour Plot of Mean Squared error of function with A and B varying

The function is given by $f(t) = AJ_2 + Bt$. A and B are varied to find the least mean squared error with a function. The mean squared error is given by:

$$\epsilon_{ij} = \frac{1}{101}\sum_{k=0}^{101}(f_k - g(t_k, A_i, B_j))^2 \tag{2}$$

The values of A vary from 0 to 2 with step of 0.1 and B varies from -0.2 to 0 with step of 0.01. The mesh of A,B is generated to find the error for each point. This is then plotted to get the Contour Plot. After plotting we observe the minimum mean squared error is obtained at the point of red dot. For the given graph, f_k is taken as the first column of the set of data points given.

Question: Does the plot have a minimum? Does it have several?

The plot has a minimum. As we can observe in the graph, the location of minimum is near point (A,B) $\approx$ (1.05,-0.105) which are the A,B values of f_k. There is only one minimum for the contour plot.

Question 10

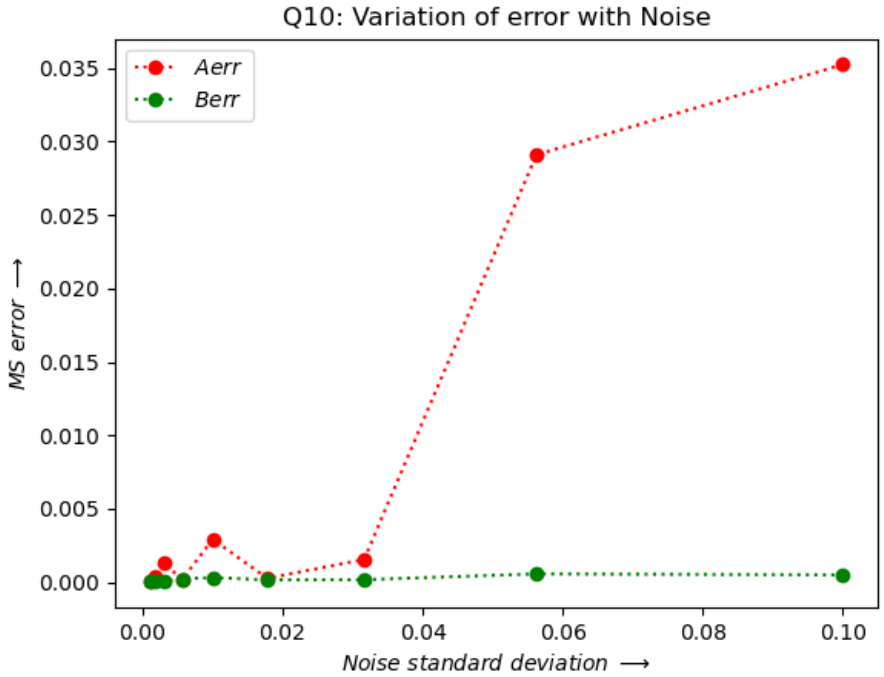

Figure 4: Variation of error in A and B with standard deviation of noise, σ

The above plot shows the error in A and B as the standard deviation of noise changes. The best estimated value of A and B is found out using the lstsq function from scipy.linalg . This estimated value is then subtracted from the original values of A and B i.e., 1.05 and -0.105 and the absolute value is taken.

$$Error\ in\ A, Aerr = \mid A_o - A_{est} \mid \tag{3}$$
$$Error\ in\ B, Berr = \mid B_o - B_{est} \mid \tag{4}$$

Question: Is the error in the estimate growing linearly with

noise? From the graph we can see that the error in A is not growing linearly with noise.

Question 11

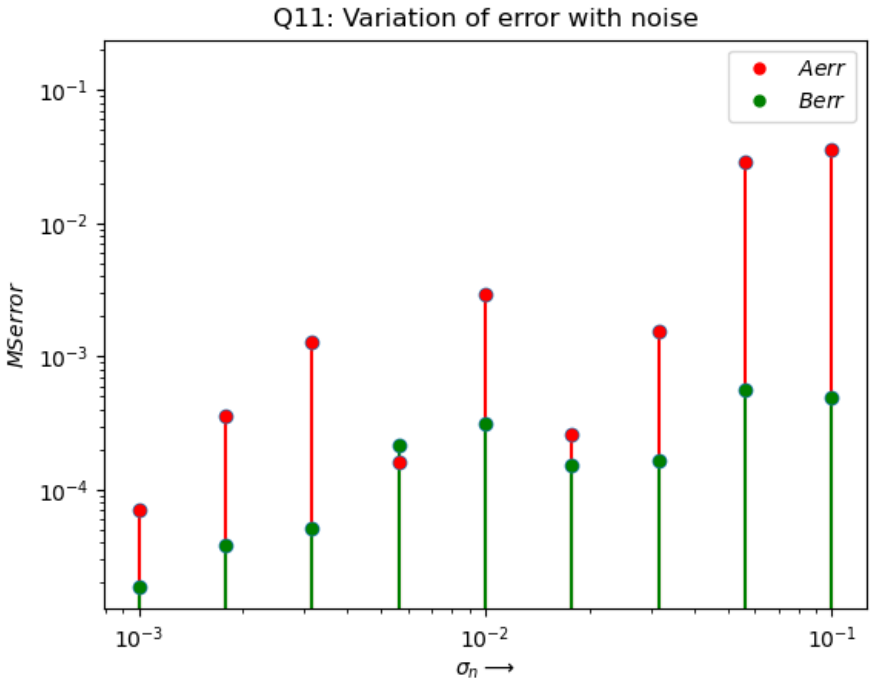

Figure 5: Loglog graph for the error in A and B

Question: Is the error varying linearly? What does this mean? The error here is a better fit to linear function when compared to the error we calculated in Q10.

End