Description of the Plots

AR Plots:

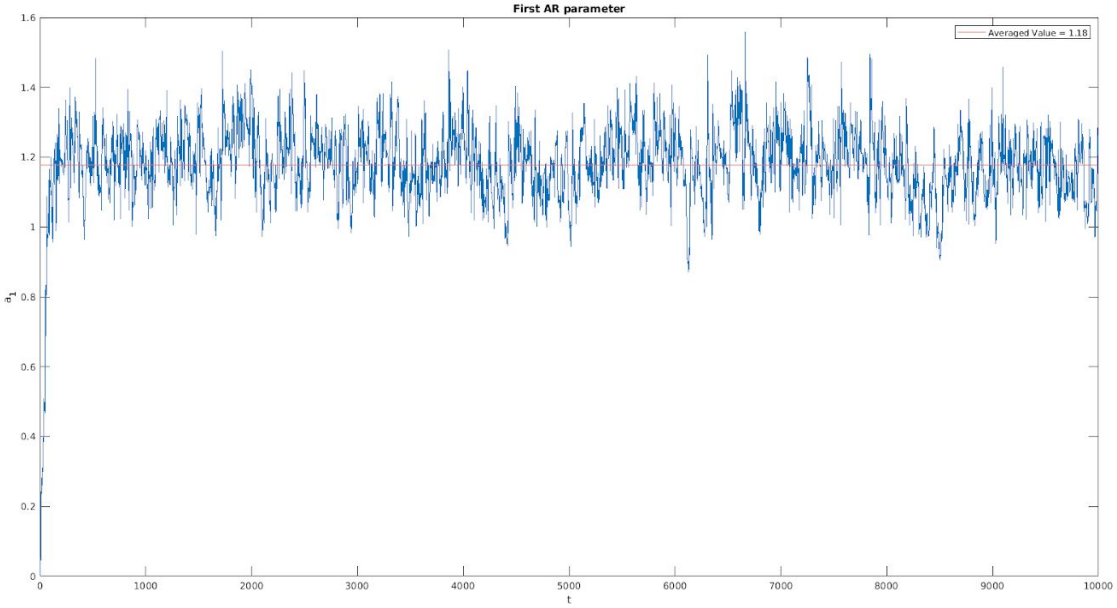
The two plots ("*a1_plotted_against_number_of_samples.png*", "*a2_plotted_against_number_of_samples.png*") plots the AR parameters (a1_hat, a2_hat) against the number of samples. The LMS algorithm computes the AR parameters as a function of the sample number. Averaging the values of these parameters across the samples leads to the following values:

1) a1_hat = **1.18**
2) a2_hat = **- 0.77**

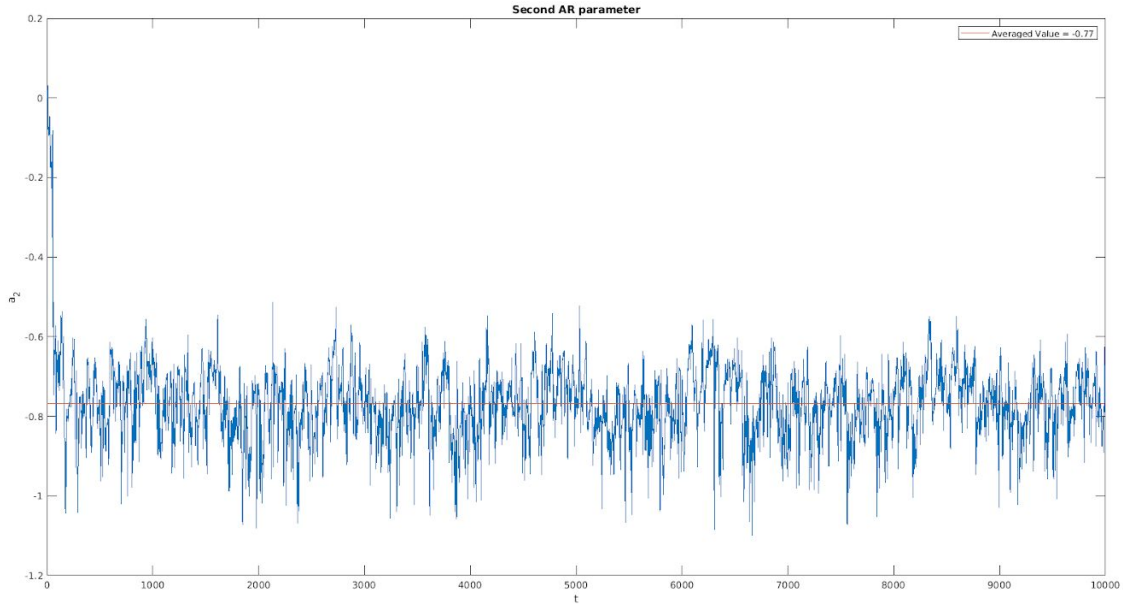
where a1_hat and a2_hat are the predicted values for the actual AR parameters a1 **= 1.2** and a2 = **-0.8** which parametrized the autoregressive process as described by the question.

Calculating the error percentages for each of the AR parameters as calculated by the LMS algorithm gives the following values:

1) error% for a1 = **1.66%**
2) error% for a2 = **3.75%**

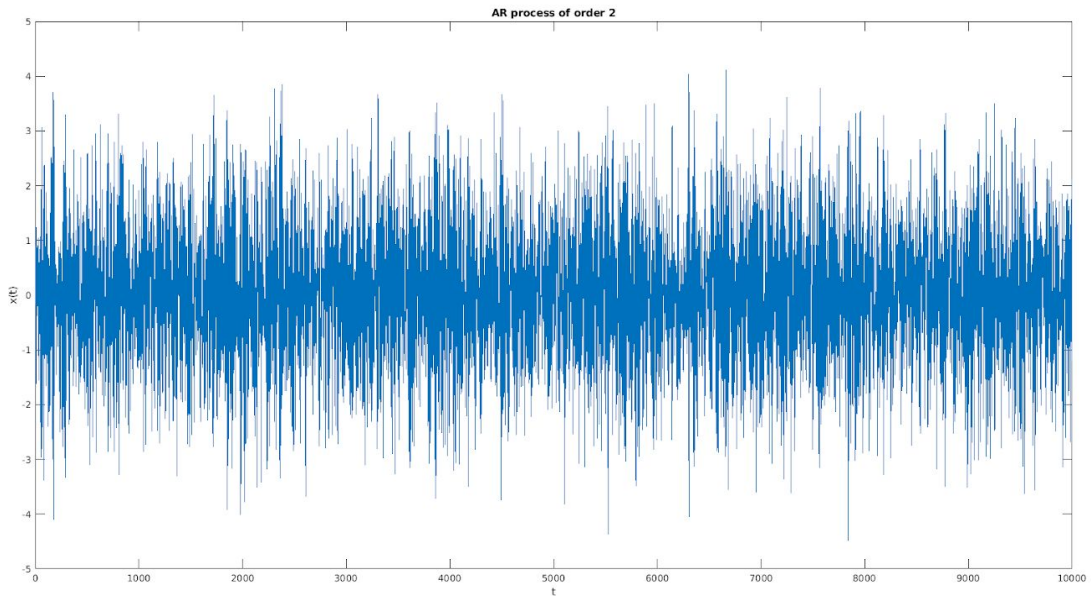


a1_plotted_against_number_of_samples



a2_plotted_against_number_of_samples

Finally, the plot ("*AR_process_of_order_2.png*") gives a pictorial representation of the AR process of order 2 for some specific noise sequence.



AR_process_of_order_2

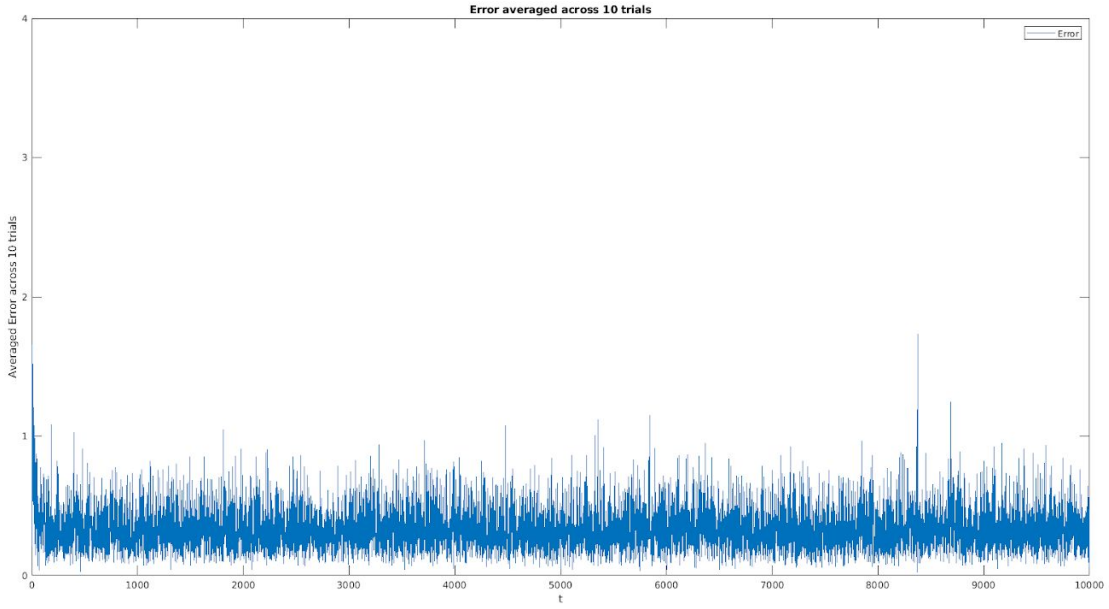
Error Plots:

The plot ("*learning_curve_10trials.png*") describes the values of squared error averaged across 10 trials with different noise sequences having the same value for their variance (as asked in the question). The learning curve demonstrates that the values of the averaged squared error **starts tapering off** as the LMS algorithm encounters more samples generated by the AR process. However, the plot shows spikes in the error values which could be either due to two reasons:

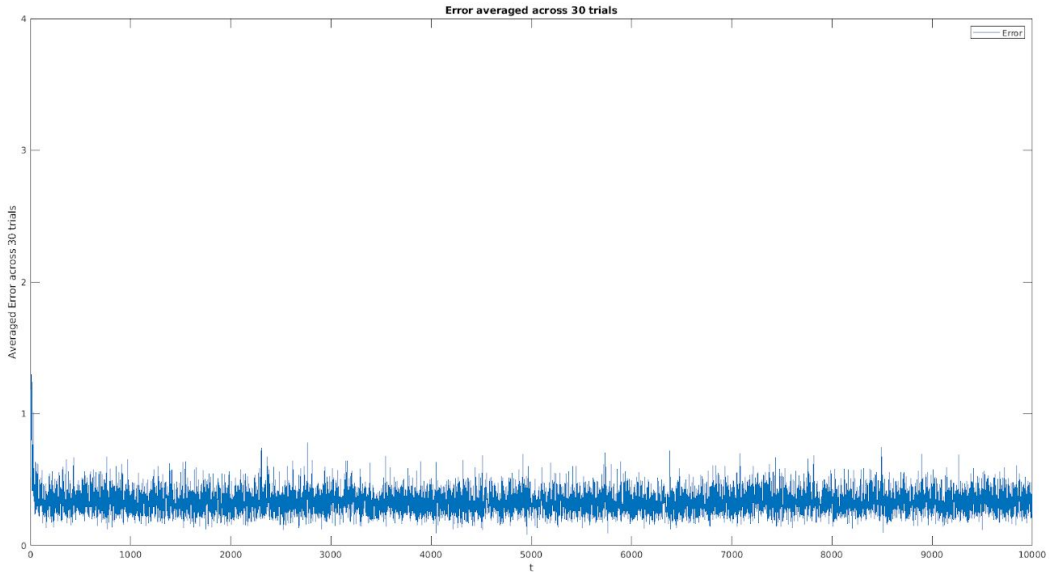
1) The values of the error have only been averaged over 10 trials. The number of trials is slightly on the lower side could be one of the primary reasons behind the noise in the learning curve.
2) The sample generation process that is characterized by an AR process of order 2 could have generated some outliers

To ascertain which one of the reasons is more likely, 2 sets of experiments are carried out. IF the second reason were to be true, then the probability of the AR process generating outliers consistently is quite low. So if the generation process were run multiple times, then the learning curve should get a lot smoother if this case were to be true. However, from experimental

verification, running the script multiple times for 10 trials leads to the generation of similar learning curves with some noise as observed before. On the contrary, the plot ("*learning_curve_30_trials*") attached along with this assignment details the learning curve generated by running 30 trials. Increasing the number of trials is leading to the generation of smoother learning curves with much lesser noise. From this set of experiments, the conclusion that the noise in the plot ("*learning_curve_10trials.png*") is due to the lesser number of trials over which the error values have been averaged over, can be derived.

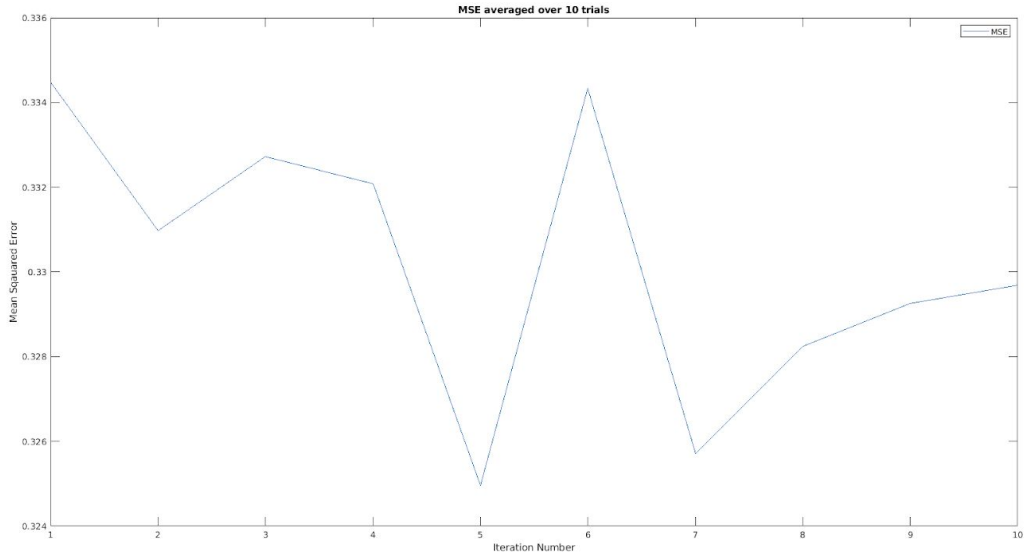


Learning_curve_10_trials



learning_curve_30_trials

The plot (*MSE_values_for_10iterations.png*“) does not offer any specific insight into the process and has been generated to check the cumulative error values at the end of each trial. The randomness of this curve ascertains that the noise sequences used in each of the 10 trials are quite distinct from each other.



MSE_values_for_10iterations