Econometric Methods III - Problem Set 2

Álvaro Corrales Cano and Emilio Esguerra

Question 1. Forecasting with ARMA processes

See handwritten solutions

Question 2. Out-of-Sample Forecasting US GDP

Part A: Preliminaries

1. - 2. *See Matlab code*

3. Figure 1 shows GDP growth and the difference between the US 10 year government yield and the US 3 month treasury bill over the period 1960Q1 - 2017Q4. We can see that, while there is a certain degree of co-movement, this depends substantially on the period (the correlation seems to be stronger in the first half of the sample).

Part B: Forecasting with AR(1) and ARDL Models

4. - 11. *For the construction of the loop, forecast estimation and computation of forecast errors for the three models see Matlab code.*

Part C: Forecast Evaluation

12. Figure 2 plots the actual data against the three forecasts - Model 1 using an AR(1) process, Model 2 using an ARDL process and the combined forecast - over the forecasted sample period of 1985Q1 to 2017Q4. We can see that all three forecasts follow the movements of the actual data quite well albeit they are naturally smoother and show less extreme deviations than the actual series. Furthermore, we can see that

on first sight the three forecasts seem to be quite similar in their predictive power. Note that by construction the combined forecast always lies in between Model 1 and Model 2 forecasts.
Figure 3 then shows the plot for the two loss differentials - l2 comparing Models 1 and 2 and lc comparing Models 1 and the combined forecast. Here it can be seen that the loss differential is smaller between Model 1 and the combined forecast as between Models 1 and 2. Moreover, again by construction of the combined forecast, loss differential lc is exactly half of loss differential l2.

$$l_2 = \hat{\varepsilon}_1 - \hat{\varepsilon}_2$$
$$l_c = \hat{\varepsilon}_1 - \frac{1}{2}(\hat{\varepsilon}_1 + \hat{\varepsilon}_2) = \frac{1}{2}(\hat{\varepsilon}_1 - \hat{\varepsilon}_2) = \frac{1}{2}l_2$$

13. Figure 4 compares for each of the three models the timeseries of the actual data versus the forecasted timeseries. Again, this highlights that the forecasts are very similar in their development and seem to follow well the actual data. However, a close look reveals that there seems to be more movement and noise in model 2 compared to model 1.

14. Table 1 shows the calculated mean squared errors associated with the three forecast models. The MSE is a widely used loss function and indicates a directly comparable value on the forecast errors. From the table we can see that Model 1 has the lowest MSE and is hence more accurate than both Model 2 as well as the combined forecast.

Table 1: Mean Squared Errors

	MSE

Model 1	0.2972
Model 2	0.33095
Combined	0.30692

15. Using the Diebold-Mariano Test to compare the difference in the MSE between Models 1 and 2 we find a test statistic of -2.3958. As the DM is asymptotically standard normal distributed, we compare this to a critical value of 1.96 and can hence reject the null hypothesis that there is no significant difference between the MSE of both models. As a result, this test tells us that Model 1 is a more accurate predictor of the sample data than Model 2. In contrast, when comparing Model 1 to the combined forecast, we find a test statistic of -1.3952. Here, however, we cannot reject the null hypothesis of equally good predictive power of the two models.

Table 2: ME, MAE and RMSE

	ME	MAE	RMSE
	-------	-------	-------
Model 1	-0.12204	0.40037	0.54516
Model 2	-0.19655	0.42828	0.57529
Combined	-0.1593	0.40665	0.554

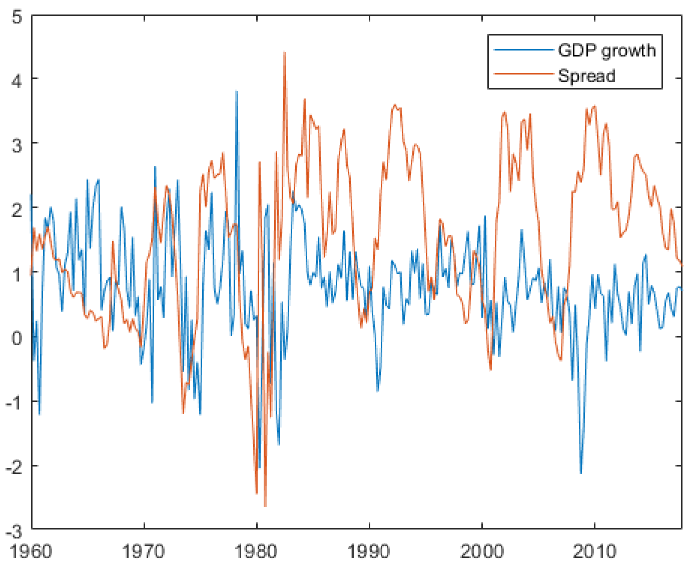

Figure 1: GDP growth and Spread

16. Table 2 shows the calculated values of the mean error (ME), the mean absolute error (MAE) and the root mean squared error (RMSE) for each of the three models. Again, as already highlighted by the graphical evidence and test results, these figures also indicate that Model 1 is the most accurate predictor.

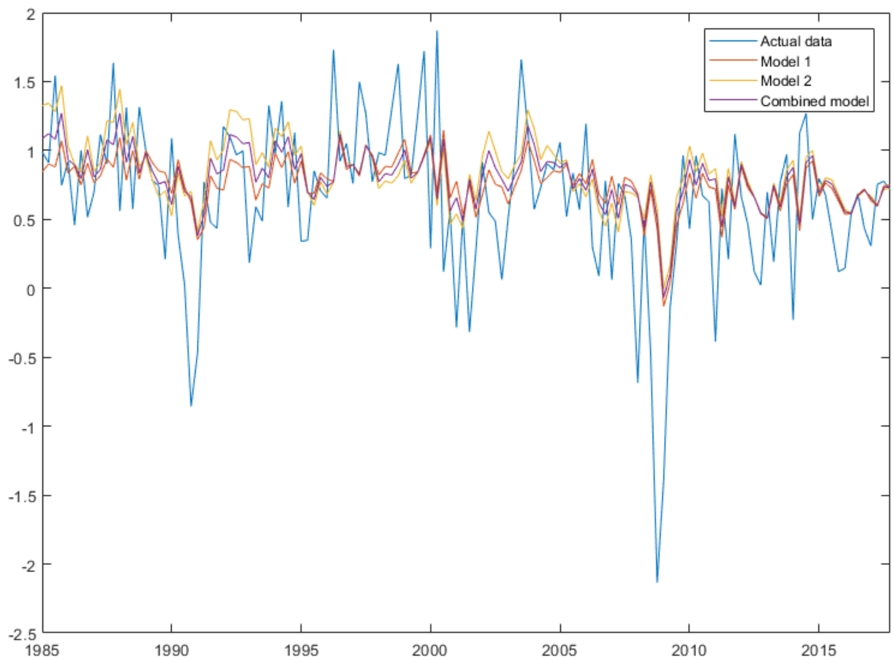

Figure 2: Actual Data and Forecasts

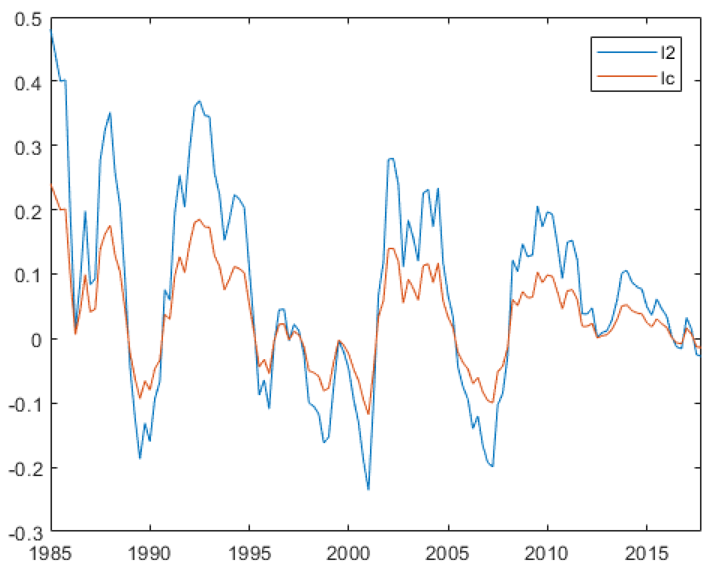

Figure 3: Loss Differentials

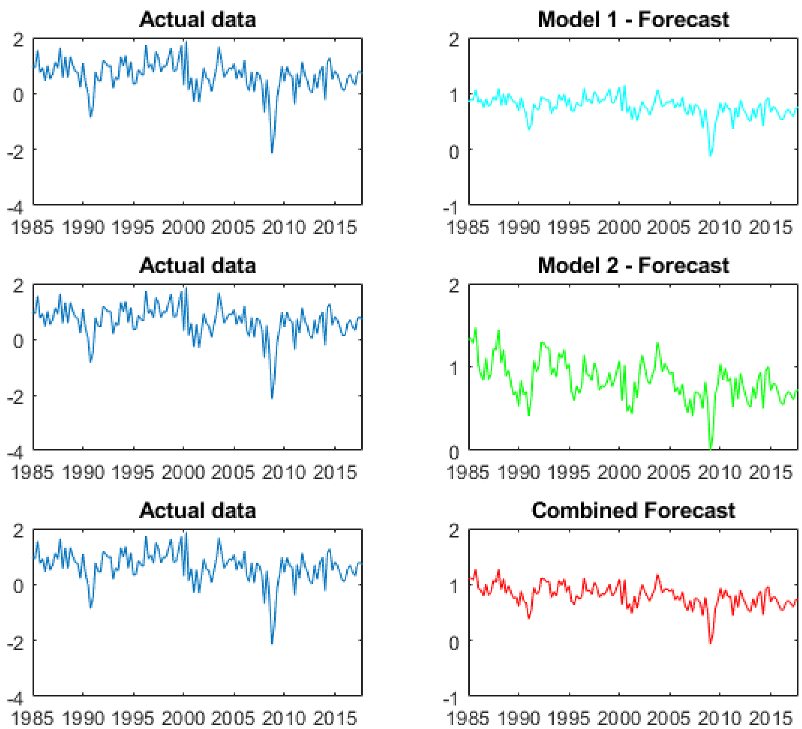

Figure 4: Actual values vs. forecasts