

We have two models here. One is Benchmark model and another one is our portfolio. The benchmark model is the average return of one of the market indices. Then we tried to find the error of the benchmark model by deducting the return of each month from the average return.

When we are done with finding the market error, we tried to find error in our model. To find error, we tried to predict the return for each predictors that we were given in the questions from February 2019 onwards, and we have the actual observed returns in our hands too, so we deducted the actual observed returns from the predicted returns. That's how we found the error in our model.

Initially, we were not concerned about the direction of the error, so we are taking the squares of the both errors. As we have the both errors now, we can find the difference by deducting the square root of the mean-squared error of the portfolio from the square root of the mean-squared error of the benchmark model. We are taking the square root, because we took the square in the beginning.

We can apply the following formula to get the difference:

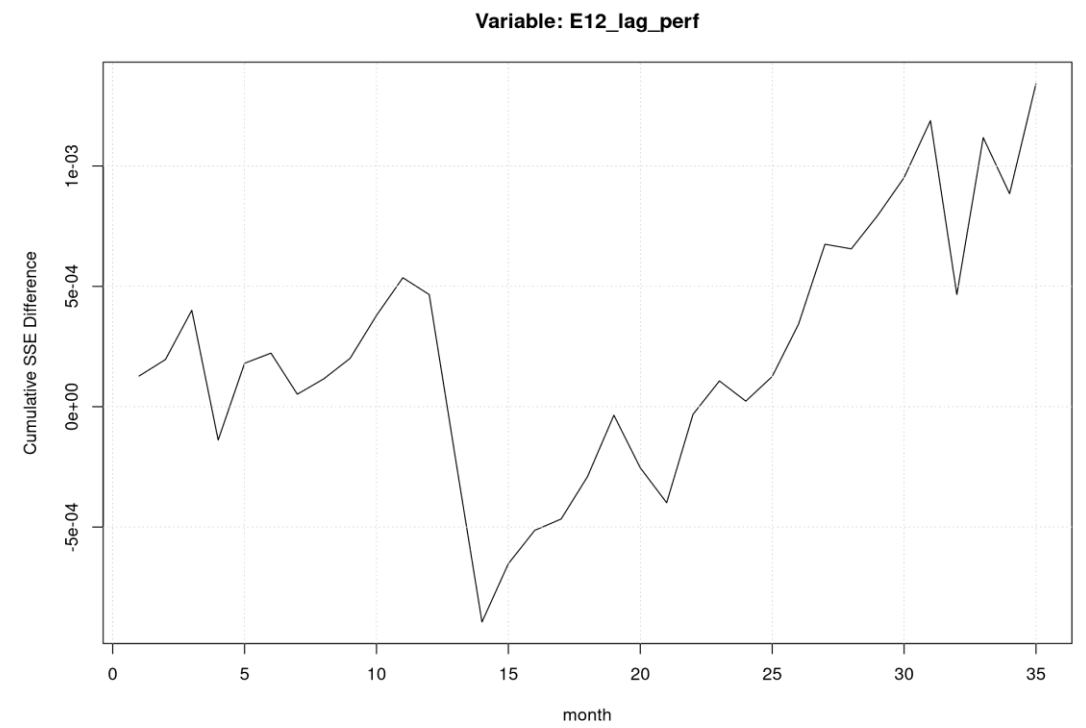
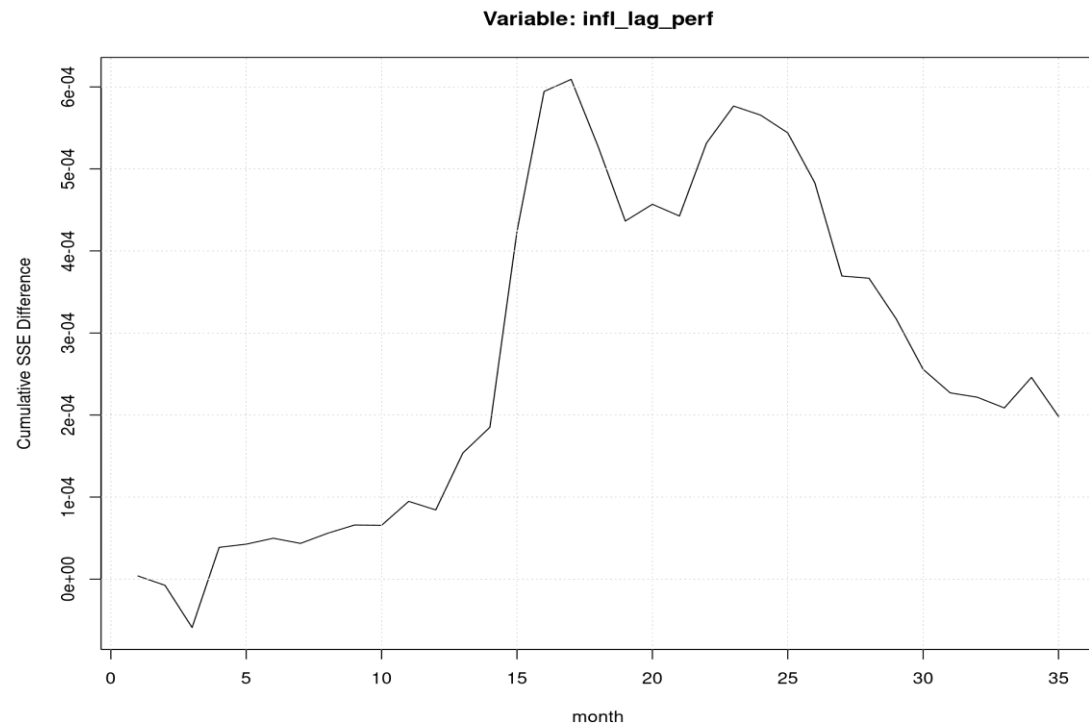
Compute the difference between the (square roots of) these mean-squared errors:

$$\Delta RMSE = \sqrt{SSE(M)/T} - \sqrt{SSE(R)/T}$$



We have found “ntis” as our best model as it has the highest positive cumulative SSE difference. Even though it has the highest SSE difference, it doesn’t mean that it has always done better than the benchmark model. There were some volatilities in the beginning and then it declined sharply from around 11 to 14<sup>th</sup> months. After the sharp decline, from 14<sup>th</sup> month onwards it rose sharply till 26<sup>th</sup> which means our model did extremely good against the benchmark model for about a year and then it became flat. Flat line indicates that our model is just as good as the benchmark model. For last 9 months, the model hasn’t been able to outperform the benchmark model and moreover, it is little bit in the declining trend.

Even after doing good in the recent past, our best model failed to beat the benchmark model; however, we expect that our model will continue to beat the market as the macro economy stabilizes slowly. There have been some macro economic instability throughout the forecasting period we used in this model.



After “ntis”, “infl” and “E12” are the next two best predictors respectively. Even though “infl” has the second highest cumulative difference, it have performed poorly for the last year of the sample period. On the other hand, “E12” is probably best if we consider the recent data only. It has done extremely well from 14<sup>th</sup> onwards and it has very consistent despite some spikes in the graph. Considering the recent performance, thus, we can easily conclude that “E12” has done exceptionally well even though it hasn’t done very well previously.

# Conclusion

As we have the square root of the mean-squared error of the benchmark model first in the equation and the square root of the mean-squared error of the portfolio second, the direction of the difference matters. We want the error of the benchmark model to be higher than the error of the portfolio. It is, hence, better to have higher cumulative SSE difference and if we have the higher cumulative SSE difference, then graphically, it should be upward sloping. We got the cumulative difference for each predictor and for each month. So, we are taking the average of the cumulative SSE difference and find the maximum value to find the best model.

Finally, it is very subjective what we choose as our best model as it depends on the time horizon we are considering. For different time horizon, we will have different best model. Nevertheless, we believe our “ntis” is the best model as it has done really good from 14<sup>th</sup> month onwards even though the line is pretty much flat for about last eight months. It is, however, worth noting that our economy has gone through many changes specially in terms of policies, so we are seeing this trend in our model, but in the long run, I believe our model will outperform the market as it did before the changes in macro economic variables.