Part 1

# Data

[TOTAL FORESTRY STATISTICS, U.S. GEOLOGICAL SURVEY](https://www.usgs.gov/centers/national-minerals-information-center/historical-statistics-mineral-and-material-commodities#lead). [All values in metric tons], annual from 1900 to 2014



# Estimation



















As autocorrelation was present in all the models, the HAC standard errors need to be considered for inference



Estimating the four given models and evaluating their performance led us to conclude that the quadratic trend is significant in both specifications. Graphs of the residuals as well as the goodness of fit and information criteria noticeably improved by its addition.

Since the dependent variable is different among the two transformations, we cannot directly compare the level and log quadratic models. It is therefore not clear which one is better. Visualizing the production series and its log transformation, the latter exhibits distribution closer to the Gaussian, therefore we favor the log model.

# Forecast

When comparing the RMSEs on the last 10 forecasts, we can see that the quadratic models performed better as expected by their in-sample superiority. However, our preferred log model did not do as well in the out of sample forecast as the linear one. It is worth noting that the graph of our series shows that there was a drop in forestry production during the last 10 recorded years. Perhaps the log model would otherwise do better.





The 2050 forecasts are presented for both quadratic trend model. Productionf4, productionf5 represents the log and the level model, respectively. both forecasts are for the forestry series in levels. It is visible that the production is forecasted to be higher by the log specification.





Part 2

# Data

U.S. Bureau of Economic Analysis, Gross Domestic Product [NA000334Q], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/NA000334Q>, March 4, 2023.

For the purpose of this exercise, we wanted to us quarterly seasonally unadjusted data. This requirement led to use the GDP (Millions of Dollars) instead of real GDP (Billions of Chained 2012 Dollars) in order to achieve sufficient number of observations as the [not seasonally adjusted series](https://fred.stlouisfed.org/series/ND000334Q) latter series starts from the year 2002 while the former from 1947.



For comparison, let us estimate both the level and log models first.

# Seasonality

The null hypothesis of joint insignificance of the seasonal deterministic dummies was rejected in the level model as the p-value for both the F-statistic and the chi-square test were less than 0.05, indicating strong evidence against the null. In the log model, the null hypothesis is the same, but the p-values for both the F-statistic and chi-square test are greater than 0.05, indicating that there is not enough evidence to reject the null hypothesis at the 95% confidence level.

# Autocorrelation

From now, we will consider only the level model.



The LM and BP tests reject the null of no autocorrelation, we therefore add the HAC standard errors to our equation.



# Correction

Using ARDL EViews method with Schwarz criterion model selection, we arrived at the following specification



The autocorrelation tests show that even after including 12 lags, the model still exhibits some autocorrelation. To tackle this issue, we return to the log specification.



Applying the same method led us to include 9 lags of the log(GDP). The LM and BP test results now indicate that the model residuals are not autocorrelated.



# Misspecification tests

The null hypotheses of homoskedasticity and normality were both rejected. HAC standard errors are thus justified. Further, the squared fitted values significantly contribute to the model’s explanatory power.





# Forecast

Finally, we estimate the model without the last 12 observations and provide a forecast to test its out of sample performance. The resulting RMSE is 463 356.6 $

