US Unemployment Trends

Initial Model Selection

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STAT 626: Time Series Analysis

Outline

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Description of data

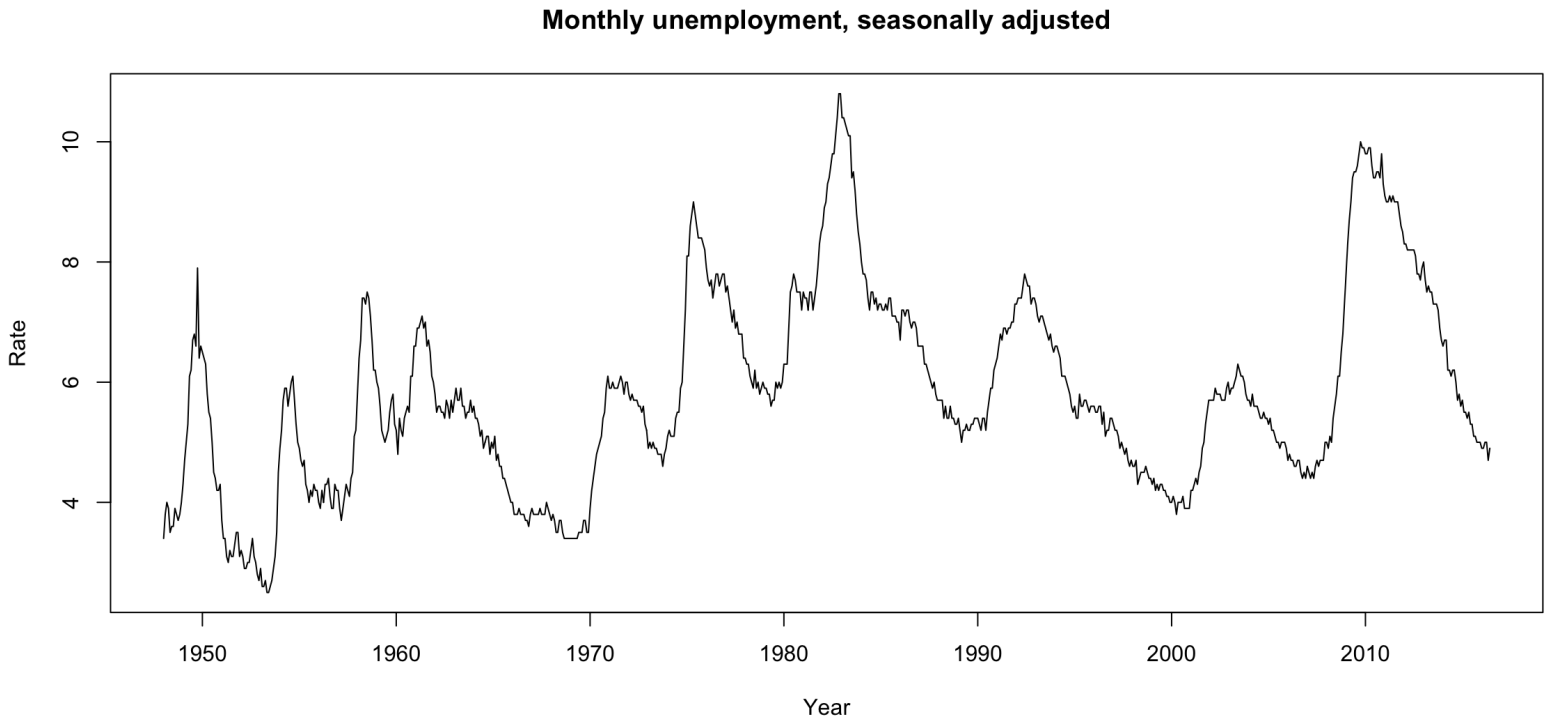
Models Considered

Forecast comparisons

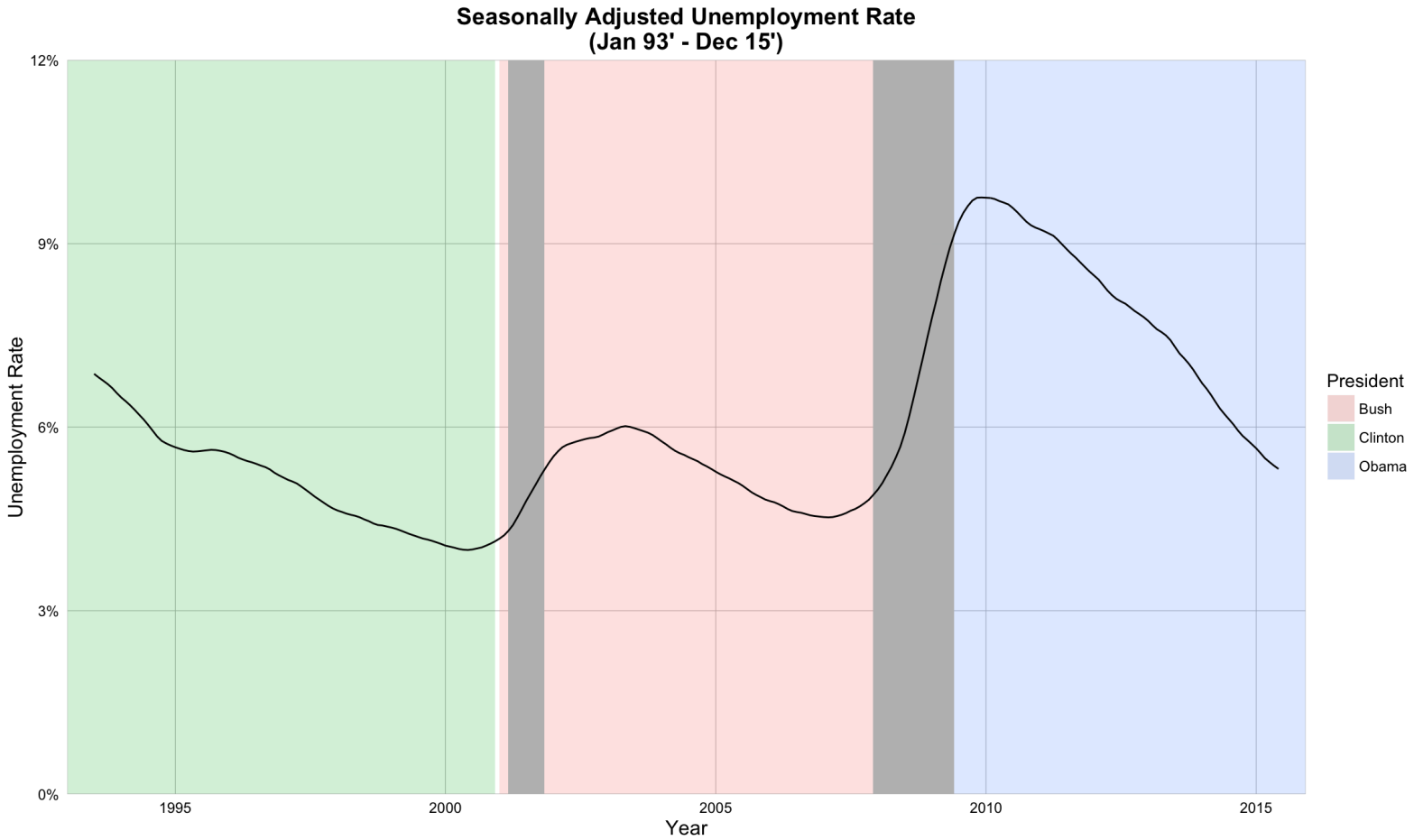
Final model decision, forecast analysis

1. Description of data
2. Models Considered
3. Forecast comparisons
4. Final model decision, forecast analysis

Timplot of National Unemployment



Smoothed unemployment for the study time period



Scatterplot matrix of unemployment and potential predictors

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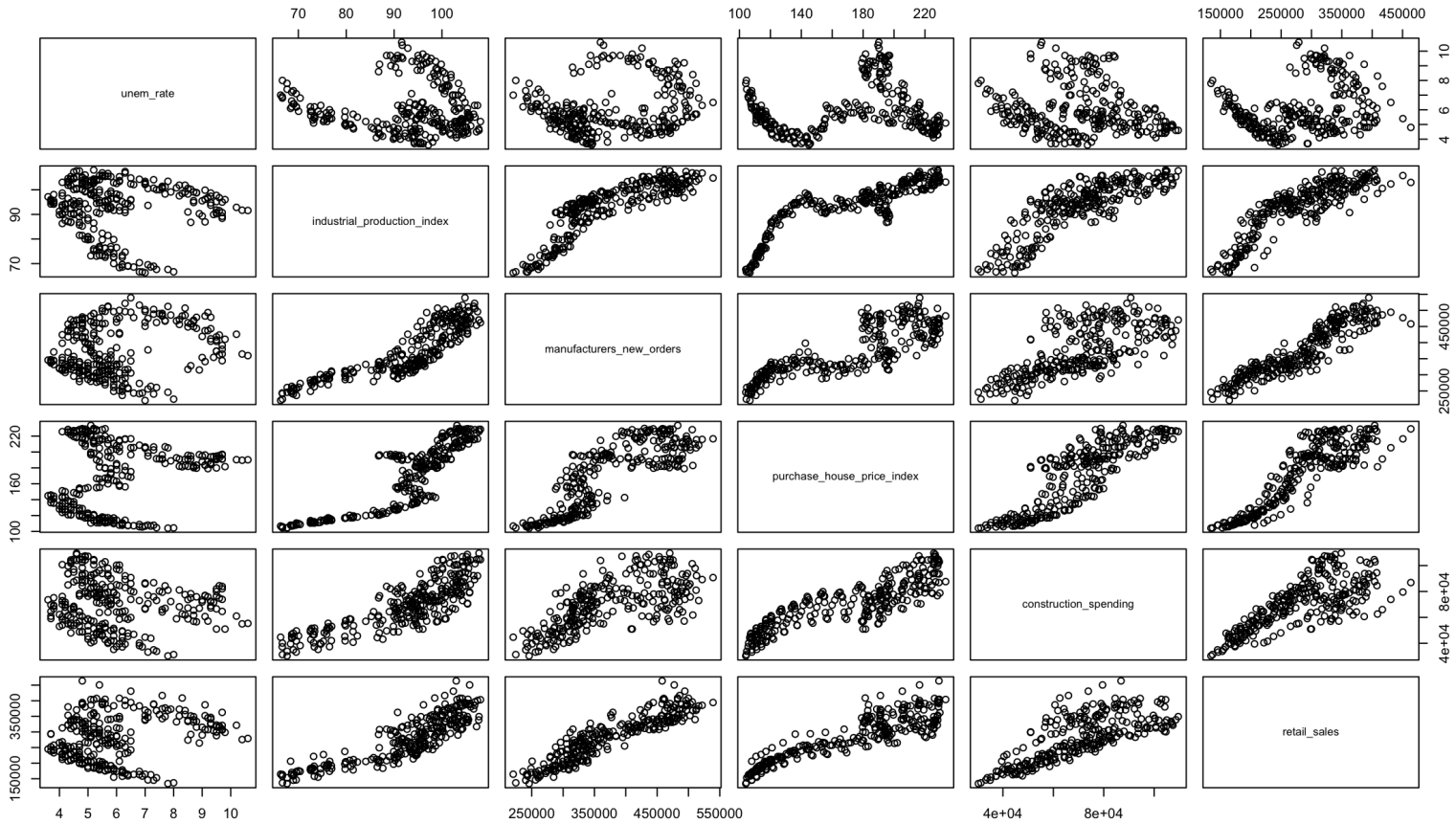

Decomposition of Data


```
-------------------------------------------------------------------------------
decom.unem = decompose(ts(data = econ$unem_rate,
             start = c(1993,1), frequency = 12), type = "additive")
decom.ind = decompose(ts(data = econ$industrial_production_index,
                         start = c(1993,1), frequency = 12), type = "additive")
decom.mno = decompose(ts(data = econ$manufacturers_new_orders,
                         start = c(1993,1), frequency = 12), type = "additive")
decom.hpi = decompose(ts(data = econ$purchase_house_price_index,
                         start = c(1993,1), frequency = 12), type = "additive")
decom.con = decompose(ts(data = econ$construction_spending,
                         start = c(1993,1), frequency = 12), type = "additive")
decom.rts = decompose(ts(data = econ$retail_sales,
                         start = c(1993,1), frequency = 12), type = "additive")
-------------------------------------------------------------------------------
## Seasonally Adjust 2016 unemployment
unem.16 = unem.16 - decom.unem$seasonal[1:5]
-------------------------------------------------------------------------------
## Add seasonally adjusted rate
econ.sa = data.frame(
  row.names = row.names(econ),
  unem_rate_sa = econ$unem_rate - decom.unem$sea,
  industrial_production_sa = econ$industrial_production_index - decom.ind$sea,
  manufacturers_new_orders_sa = econ$manufacturers_new_orders - decom.mno$sea,
  house_price_sa = econ$purchase_house_price_index - decom.hpi$sea,
  construction_spend_sa = econ$construction_spending - decom.con$sea,
  retail_sales_sa = econ$retail_sales - decom.rts$sea,
  recession_ind = econ$recession_ind
)
-------------------------------------------------------------------------------
```

Autocorrelation of unemployment data

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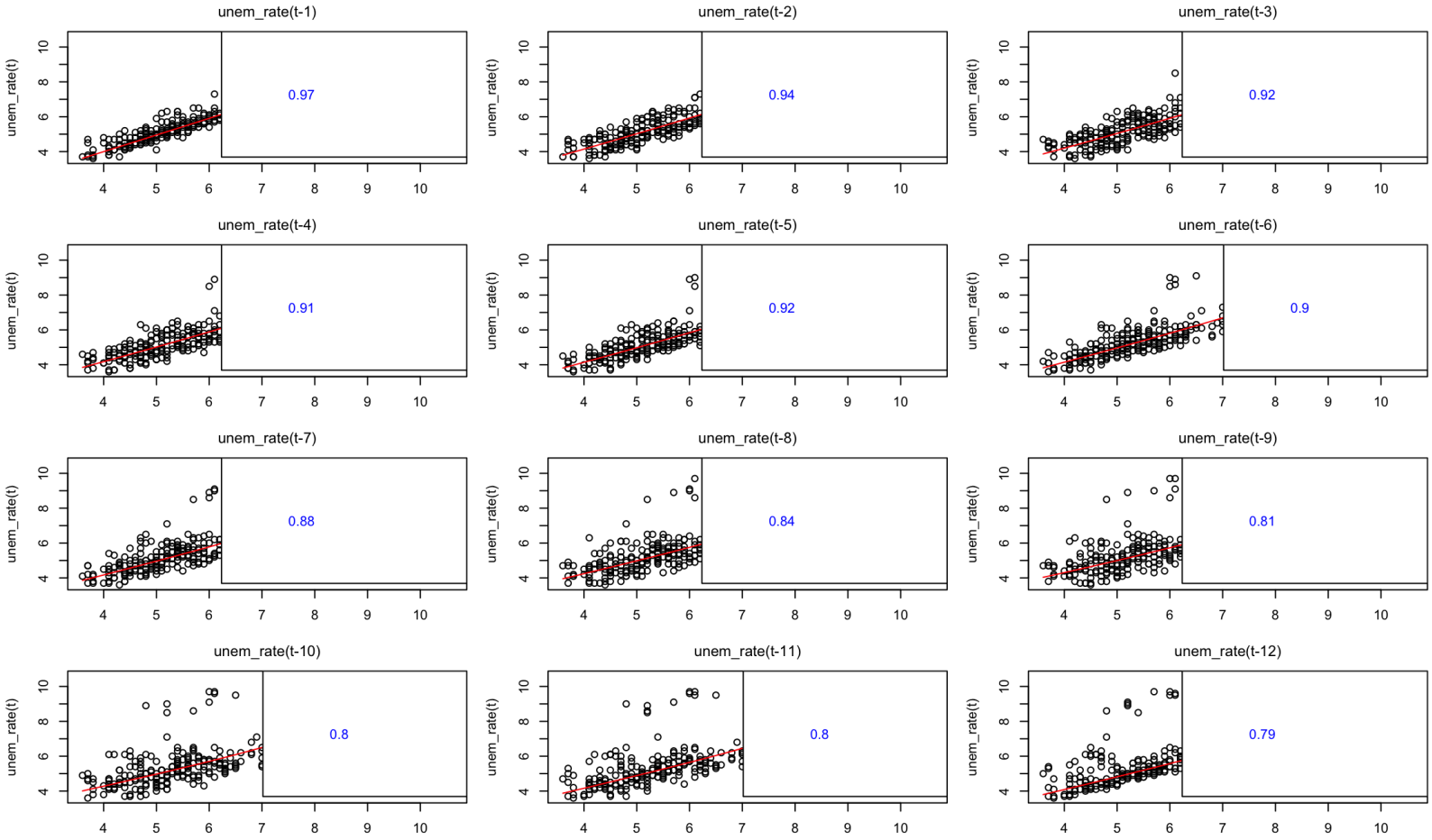

Timeplots with and without differencing

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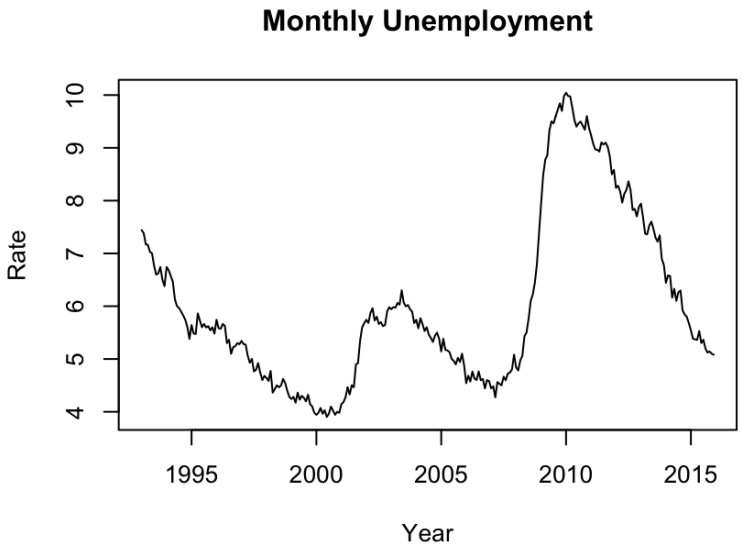
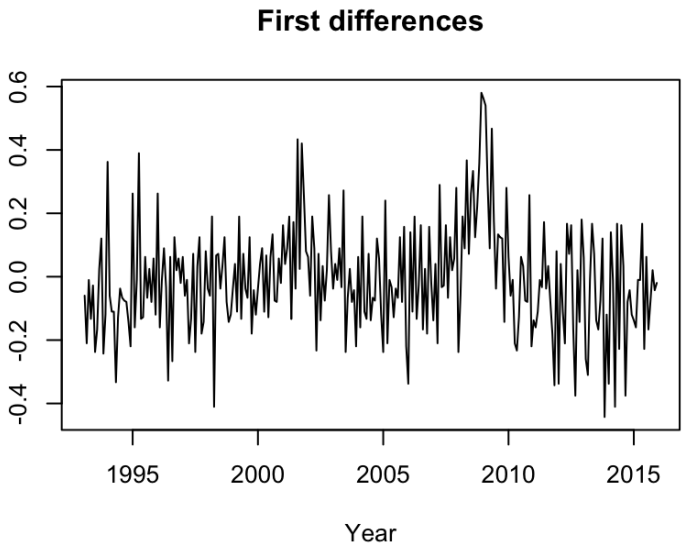
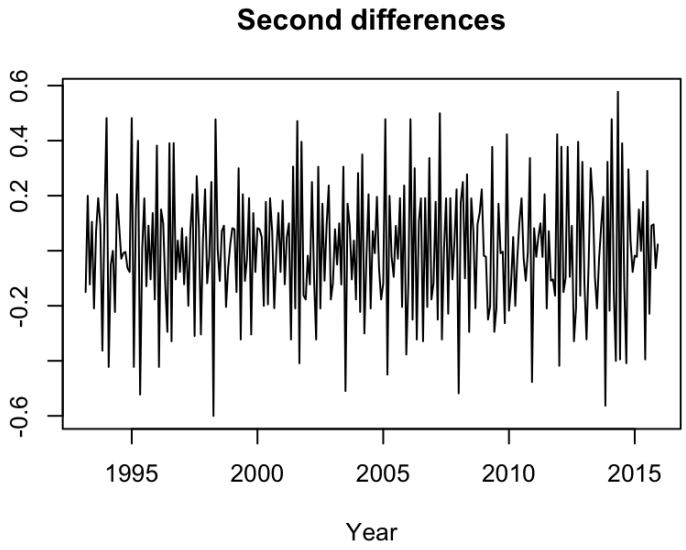
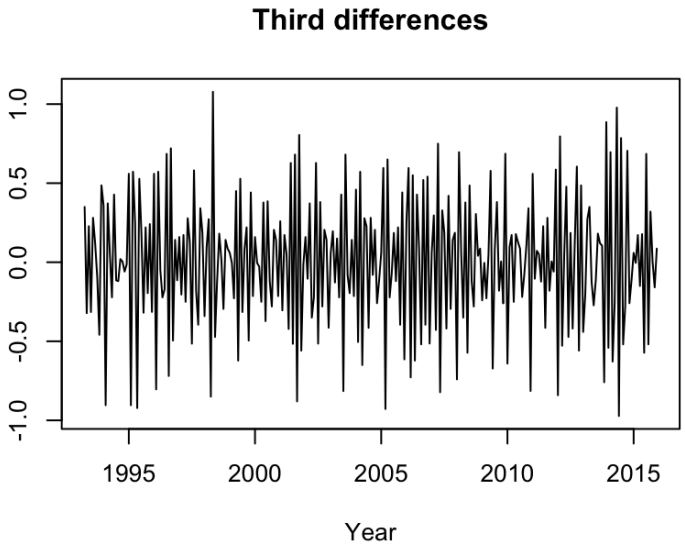




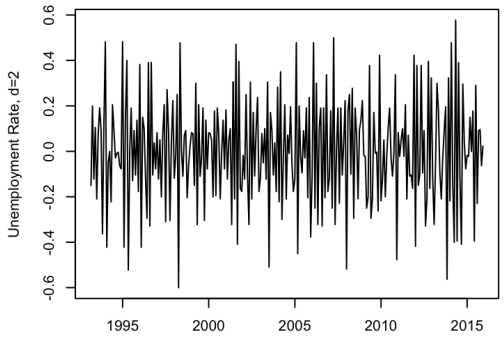


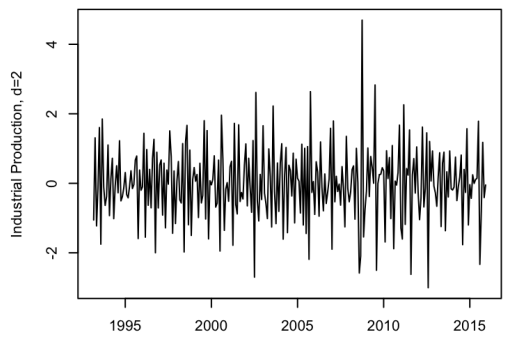


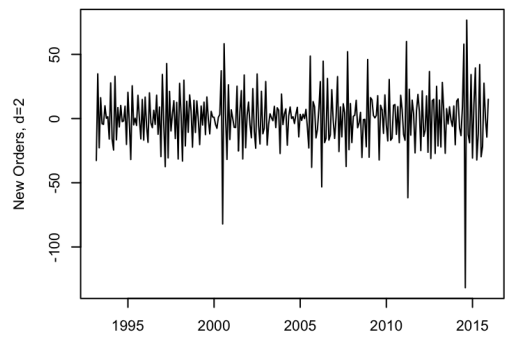
ADF Test Results for unemployment

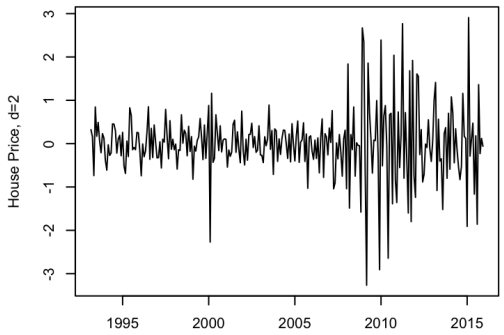
Model	Statistic	Lag order	p-value
1^{st} difference	-9.3595	6	< 0.01
2^{nd} difference	-9.3595	6	< 0.01
3^{rd} difference	-13.02	6	< 0.01

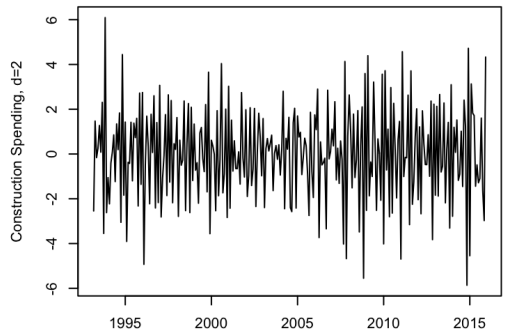
Timeplots of differenced predictors

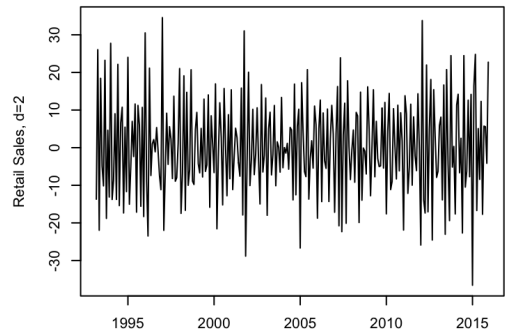








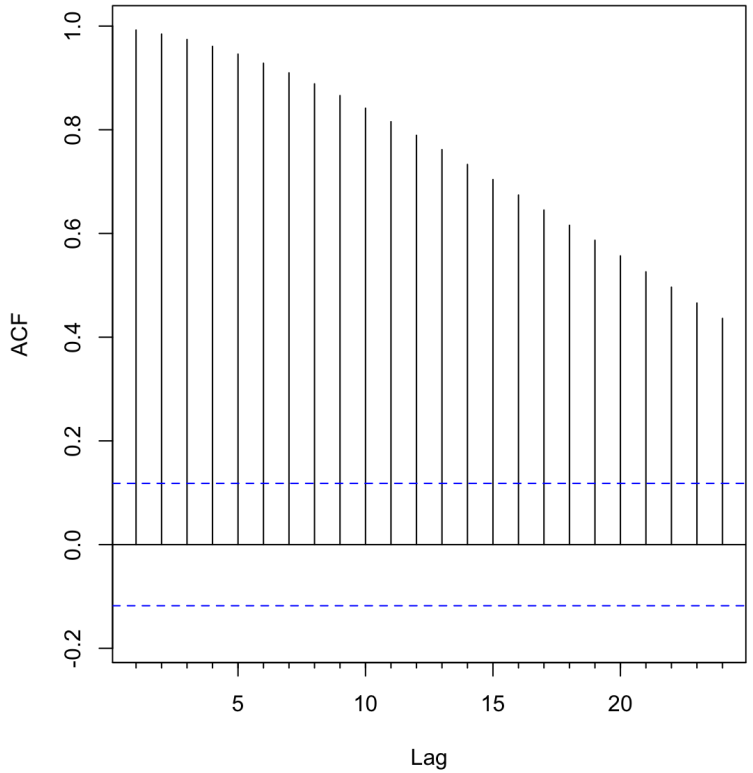


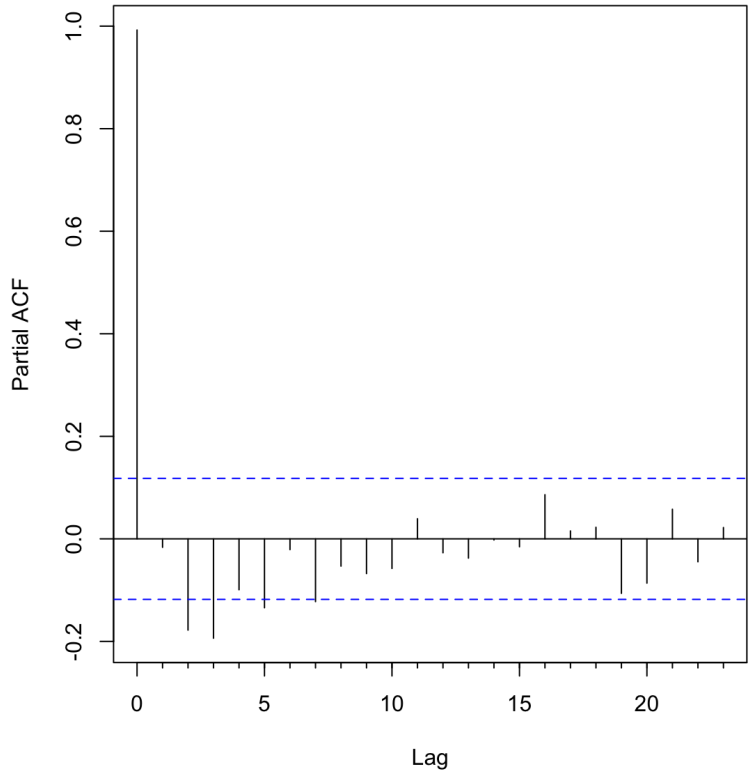


ADF Test Results for Predictors, $d = 2$

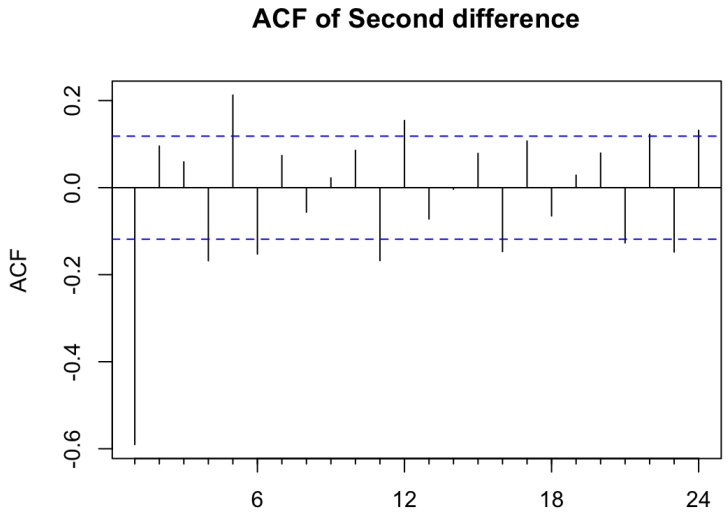
Variable	Statistic	p-value
Industrial Production	-9.2333	< 0.01
New Orders	-8.391	< 0.01
House Prices	-9.104	< 0.01
Construction Spending	-10.447	< 0.01
Retail Sales	-10.72	< 0.01

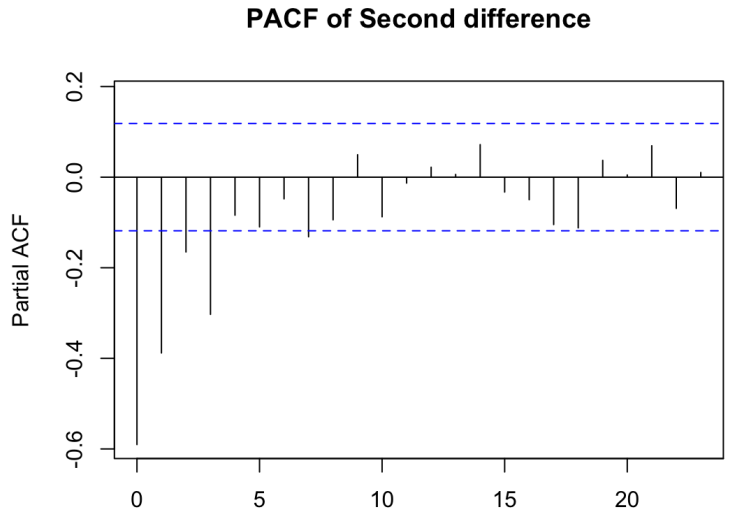
ACF & PACF Plots





ACF & PACF Plots of Second Differences





ARIMA Models Considered

Model	Order	Reg	AIC	BIC	Best
1	1,2,1	NA	-212.30	-201.46	BIC
2	2,2,2	NA	-211.81	-193.74	
3	3,2,3	NA	-215.48	-190.19	
4	1,2,1	X	-211.56	-182.65	
5	2,2,2	X	-209.83	-177.32	
6	3,2,3	X	-215.10	-171.74	
7	1,2,1	LagX	-222.45	-193.69	AIC
8	2,2,2	LagX	-220.70	-188.35	
9	3,2,3	LagX	-217.89	-174.76	

VAR Models Considered

Model	P	Type	AIC	BIC	Best
1	1	NA	-223.67	-201.97	
2	2	NA	-217.83	-185.31	
3	1	Ind	-256.77	-231.45	BIC/AIC
4	1	LagX	-216.65	-195.06	
5	2	LagX	-212.53	-180.17	
6	1	Both	-245.72	-220.53	

Comparison of best ARIMA and VAR models

Model	Type	AIC	BIC
ARIMA #1	Univariate ARIMA(1,2,1)	-212.29	-201.45
ARIMA #7	Multivariate ARIMA(1,2,1)	-222.45	-193.69
VAR #3	VAR(1)	-256.76	-231.45

Multivariate ARIMA(1,2,1)

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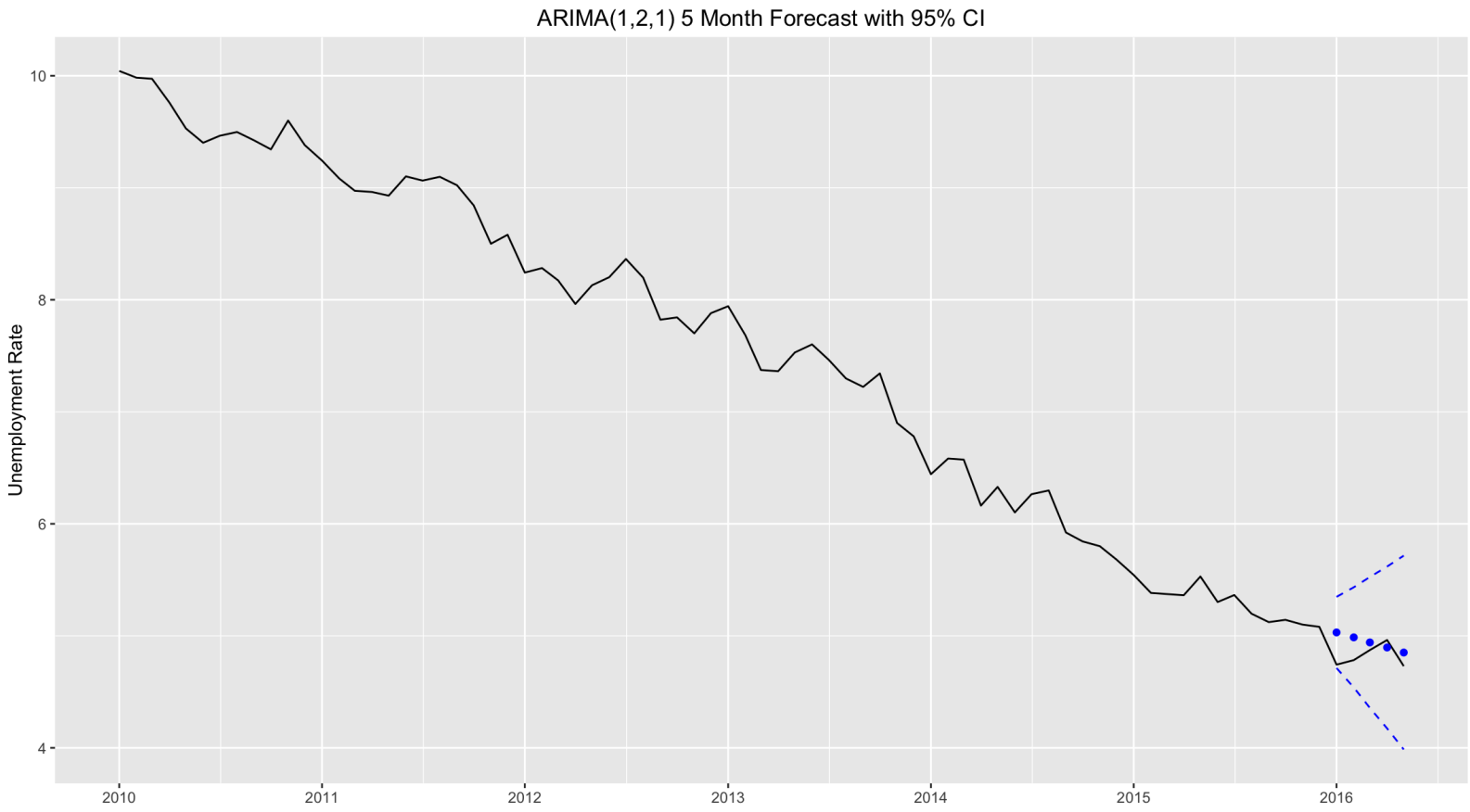

VAR(1)

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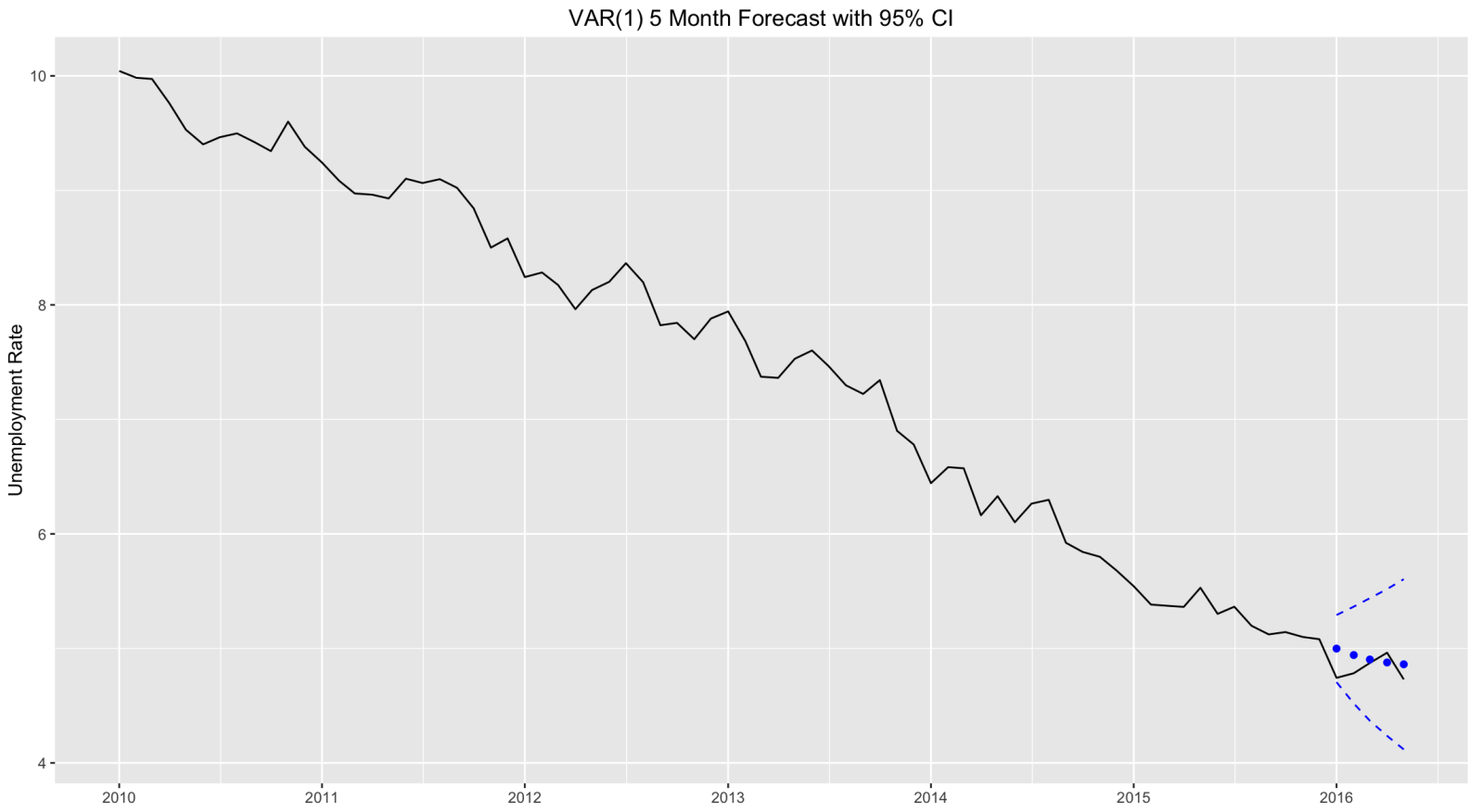

Comparison of ARIMA(1,2,1) and VAR(1)

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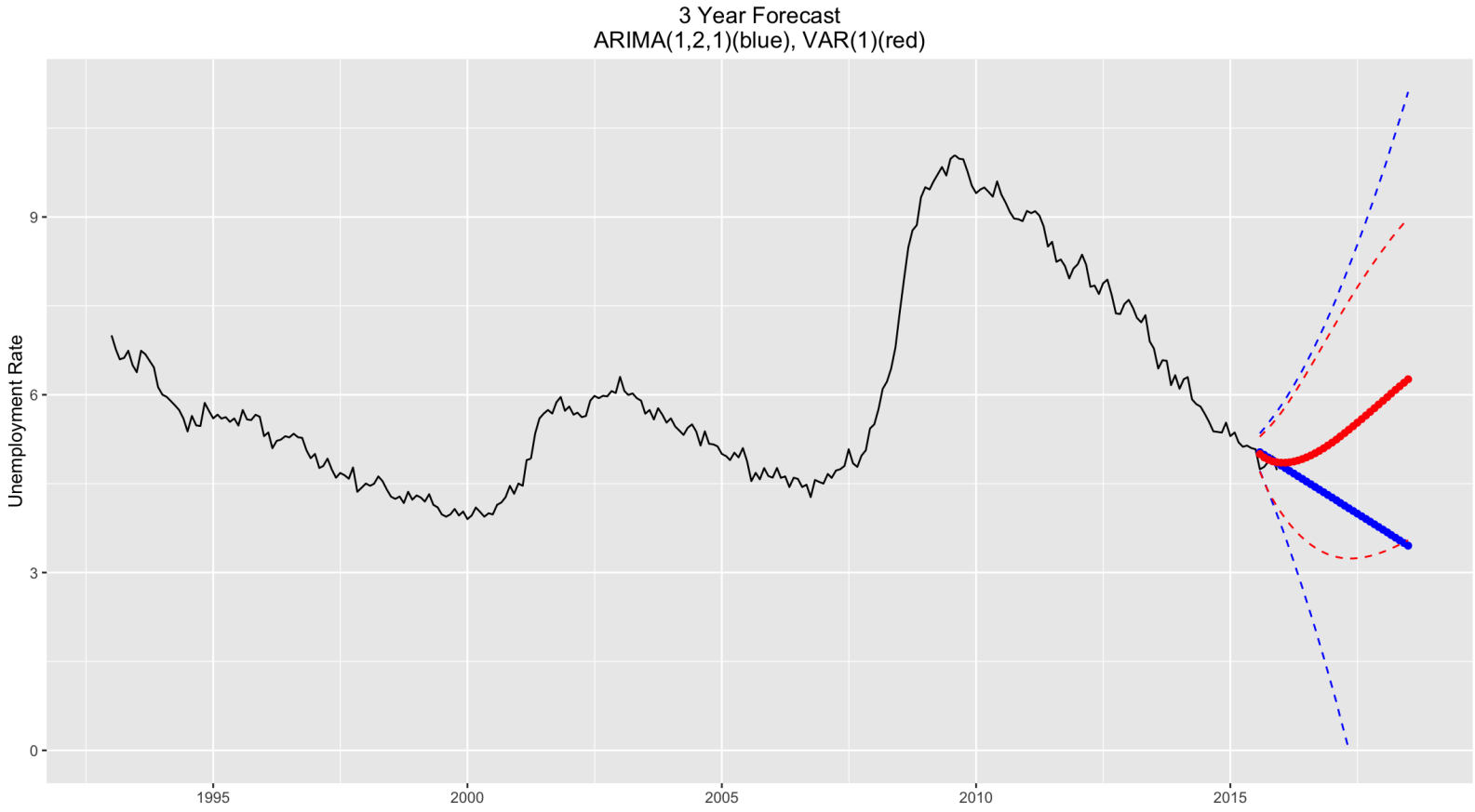

Final Model: VAR(1)

The final model chose was the VAR(1) with construction spending, retail sales, and the recession indicator as predictors:

$$\begin{aligned} \textit{Unemployment} = .935 &+ .0041(t) + .975\text{Unemployment}_{t-1} \\ &+ .004\text{ConstructionSpend}_{t-1} - .005\textit{RetailSales}_{t-1} \\ &+ .19\text{RecessionIndicator}_{t-1} + w_t \end{aligned}$$

Final Model: VAR(1): Predictions

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