

Monthly Armed Robberies in Boston (1966-1975)

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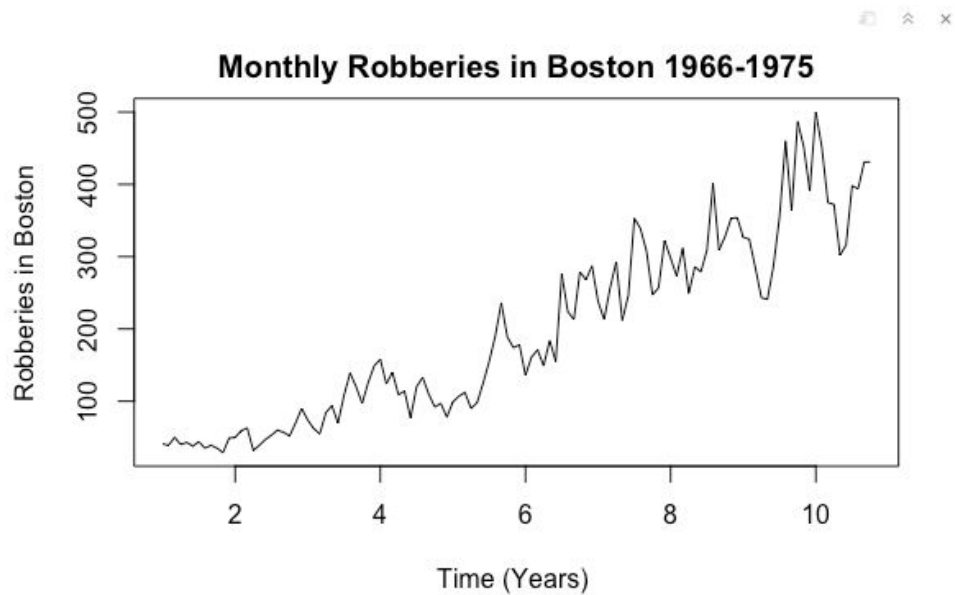
Anton Sunico

William Berman





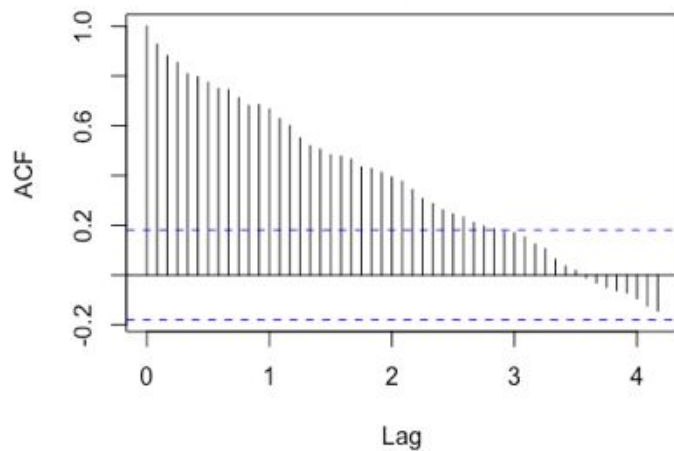
Initial Dataset



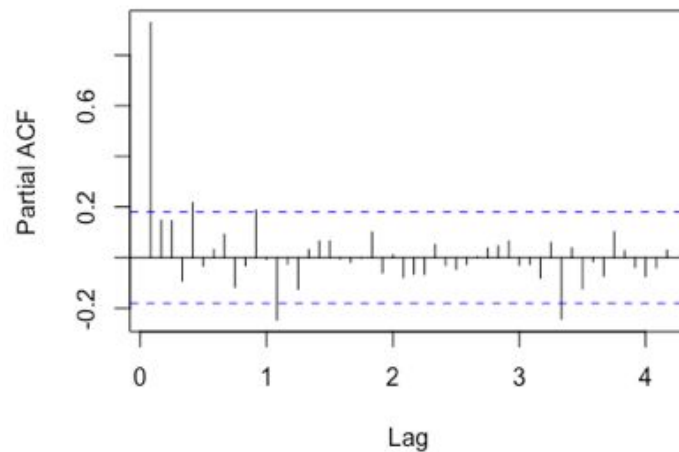


Autocorrelation Analyses

ACF of Original Data

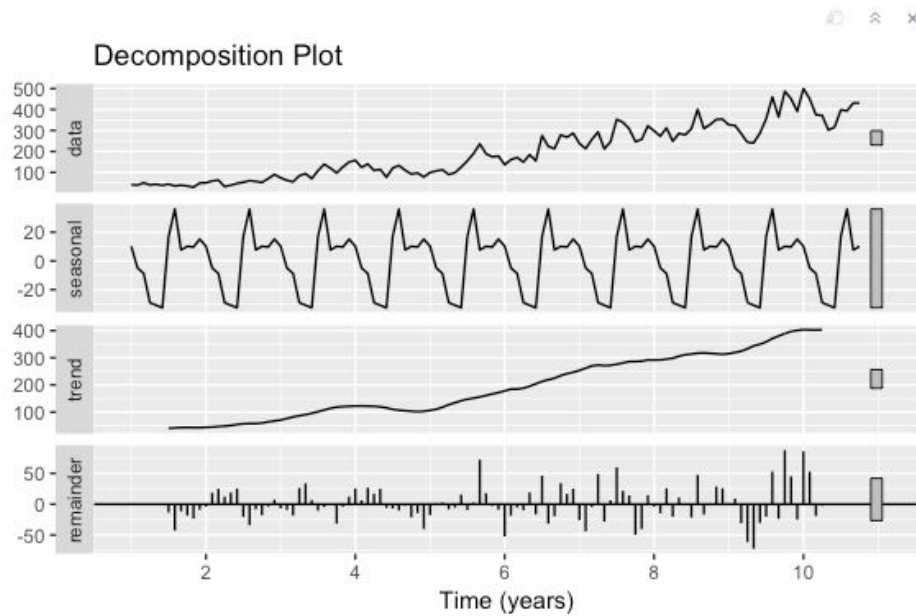


PACF of Original Data





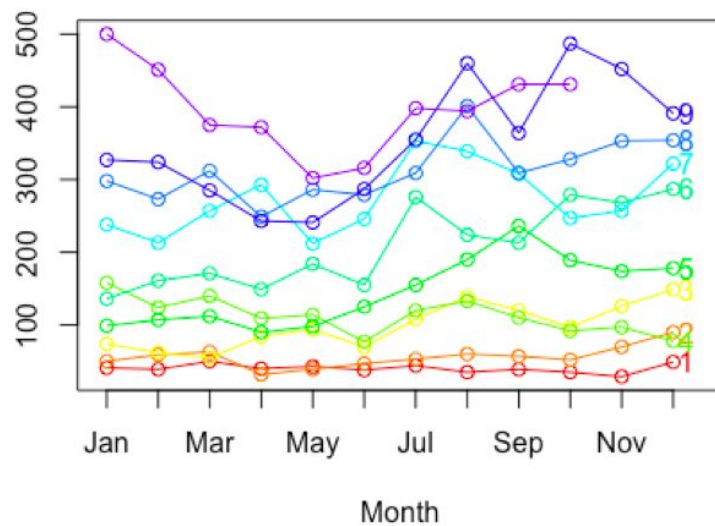
Decomposition





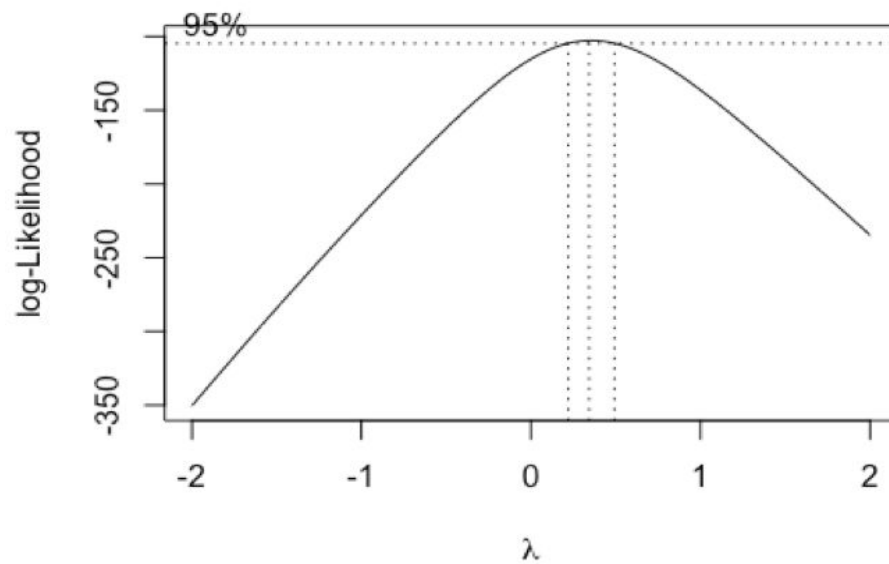
Seasonality

Seasonal Plot



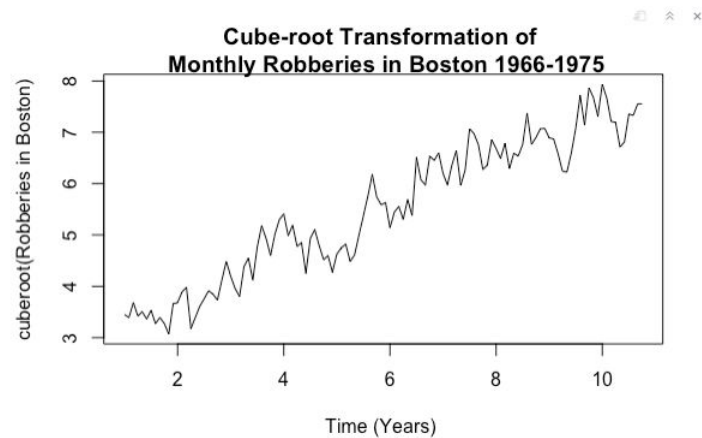
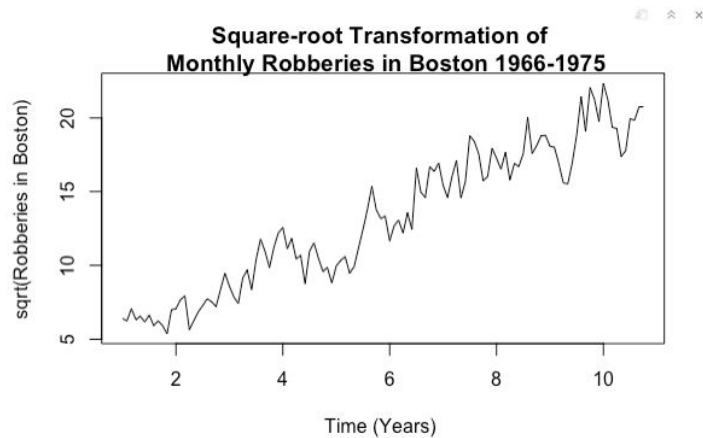


Box Cox



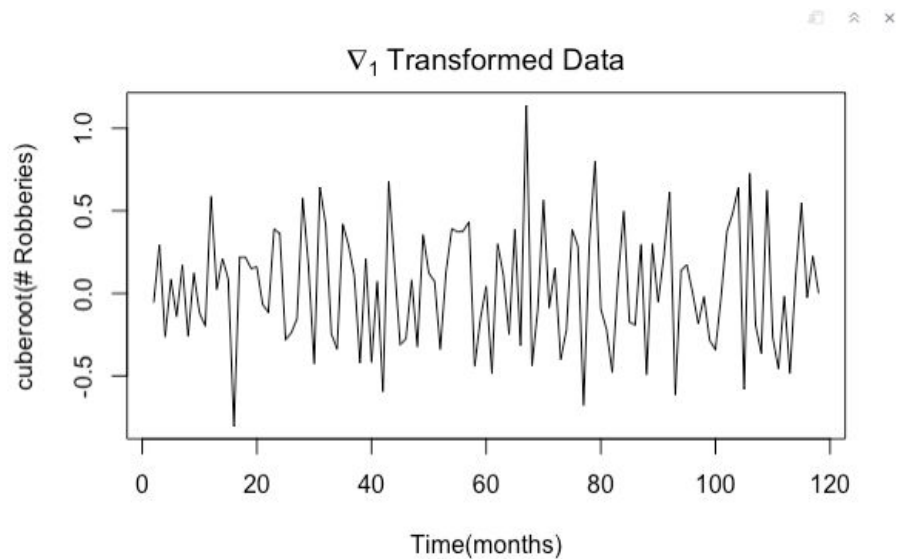


Transformations

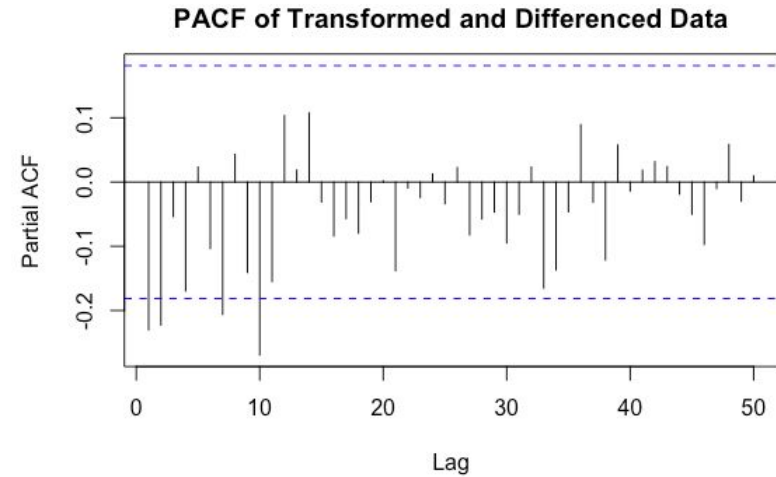
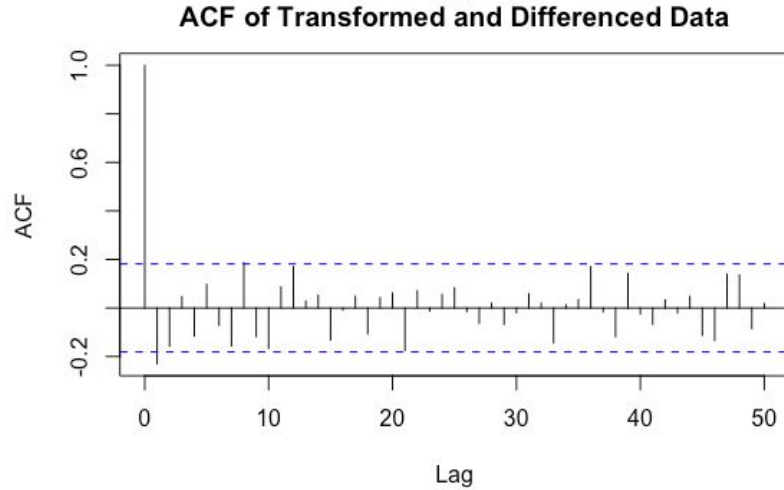




Difference of Transformed Data



Autocorrelation Analyses of $\nabla_1(Y^{1/3})$





Model Selection

ARIMA(1,1,2)

p	d	q	<u>AIC</u>	<u>BIC</u>
1	1	2	88.56592	99.58028

ARIMA(2,1,2)

p	d	q	<u>AIC</u>	<u>BIC</u>
2	1	2	90.33802	104.10597



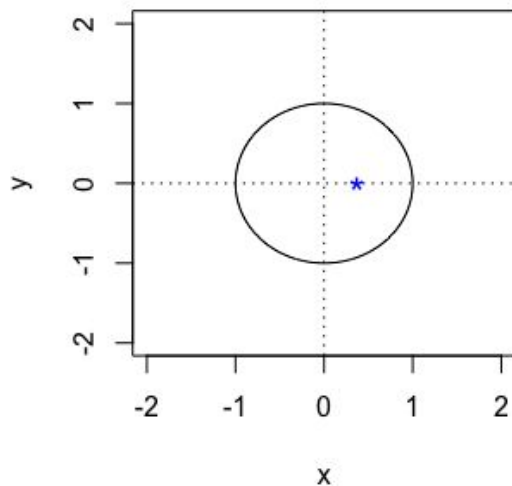
Coefficient Estimation

	Model 1: ARIMA(1,1,2)	Model 2: ARIMA(2,1,2)
AR(1)	-0.3718	-0.2991
AR(2)	-	0.1702
MA(1)	0.0913	0.0266
MA(2)	-0.302	-0.4532

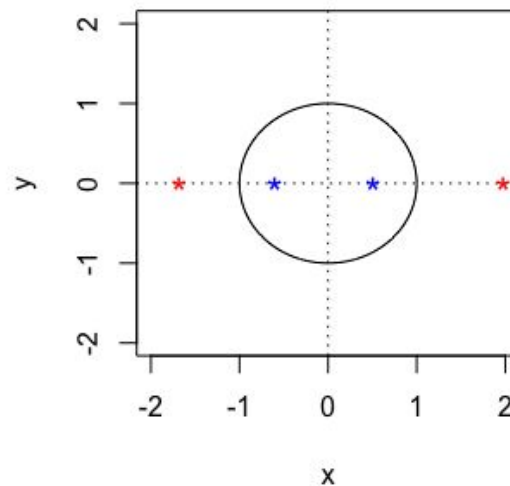


ARIMA(1,1,2) Roots

Roots for AR Part - ARIMA(1,1,2)



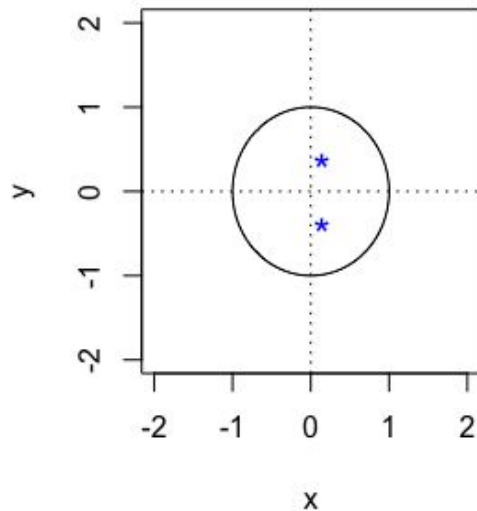
Roots for MA Part - ARIMA(1,1,2)



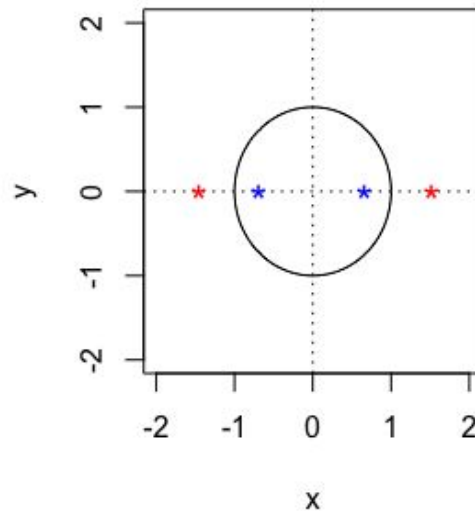


ARIMA(2,1,2) Roots

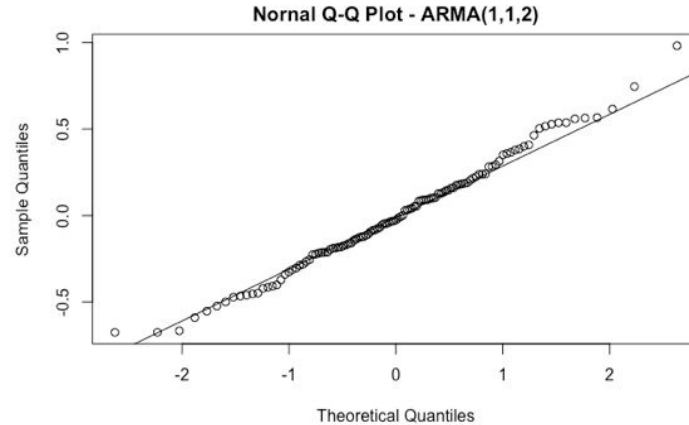
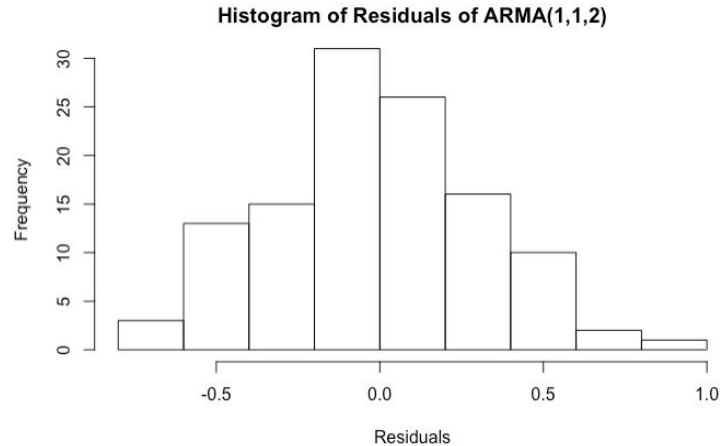
Roots for AR - ARIMA(2,1,2)



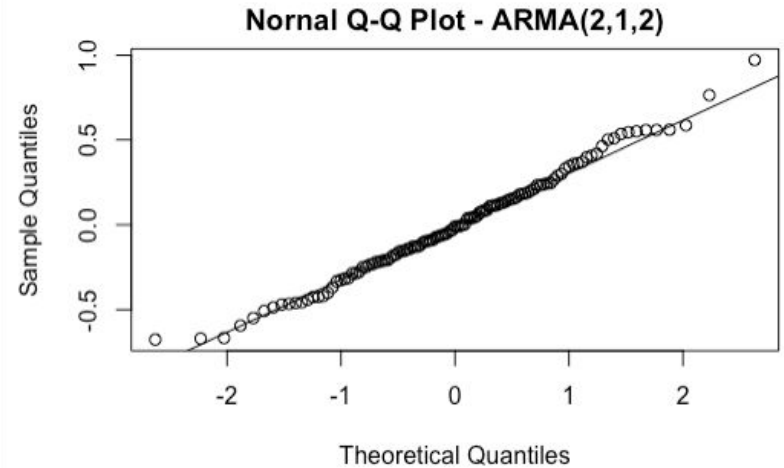
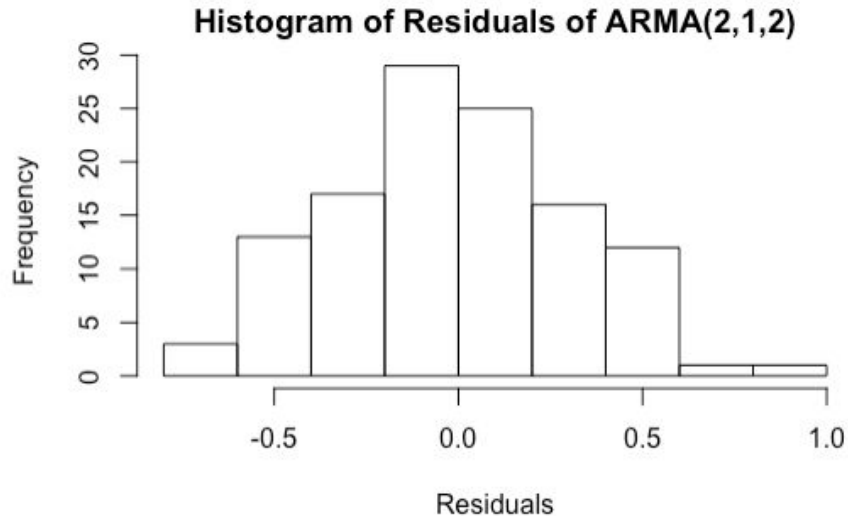
Roots for MA - ARIMA(2,1,2)



ARIMA(1,1,2) Normality of Residuals



ARIMA(2,1,2) Normality of Residuals





Error Normality

Shapiro-Wilk Test with $\alpha = 0.05$

H_0 = residuals are normally distributed vs. H_1 = residuals are not normally distributed

	Model 1: ARIMA(1,1,2)	Model 2: ARIMA(2,1,2)
W-Statistic	0.99125	0.9909143
P-Value	0.6673572	0.6362329



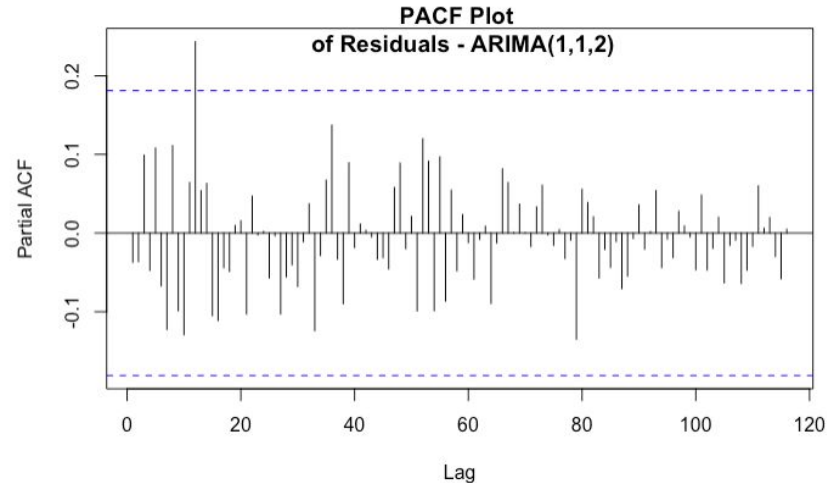
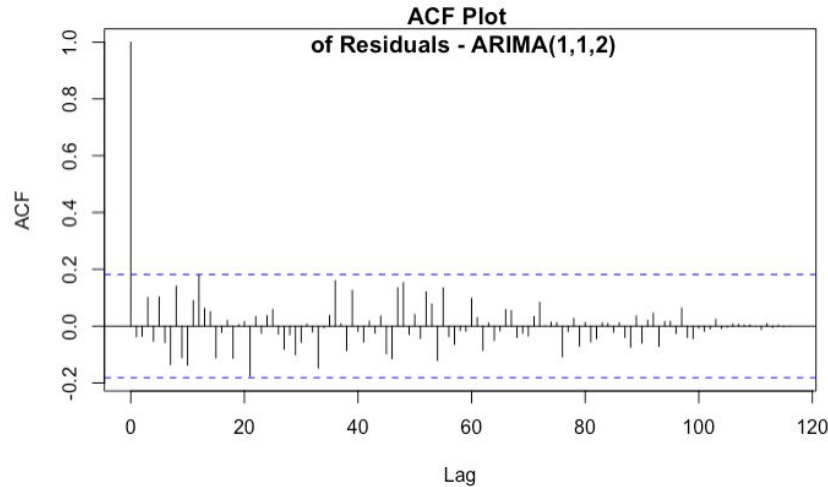
Serial Correlation

Box-Pierce and Ljung-Box with $\alpha = 0.05$

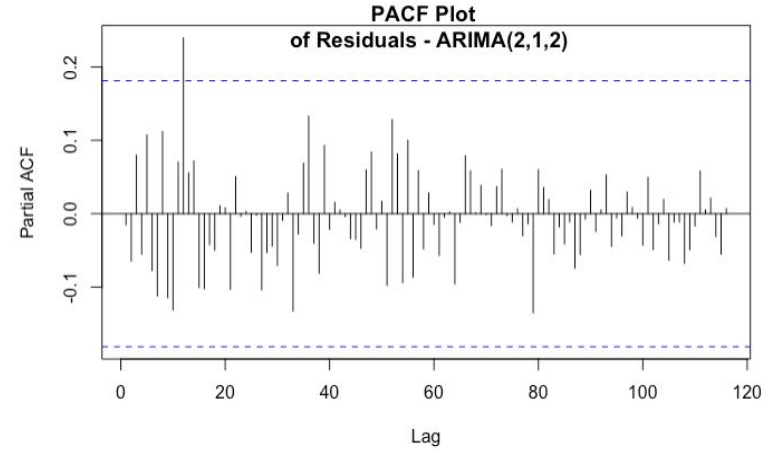
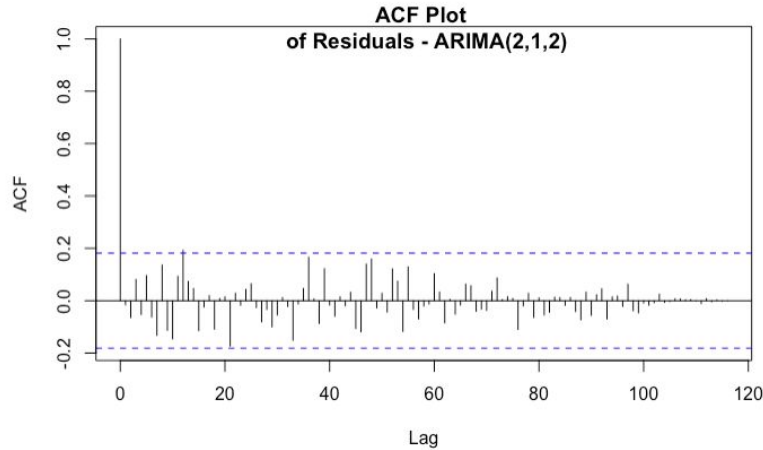
H_0 = residuals are serially uncorrelated (independent) vs. H_1 = residuals are serially correlated (dependent)

	Model 1: ARIMA(1,1,2)	Model 2: ARIMA(2,1,2)
Box-Pierce P-Value	0.1857596	0.1931732
Ljung-Box P-Value	0.1373411	0.1427492

Autocorrelation Analyses of Errors for ARIMA(1,1,2)



Autocorrelation Analyses of Errors for ARIMA(2,1,2)





Final Model: ARIMA(1,1,2)

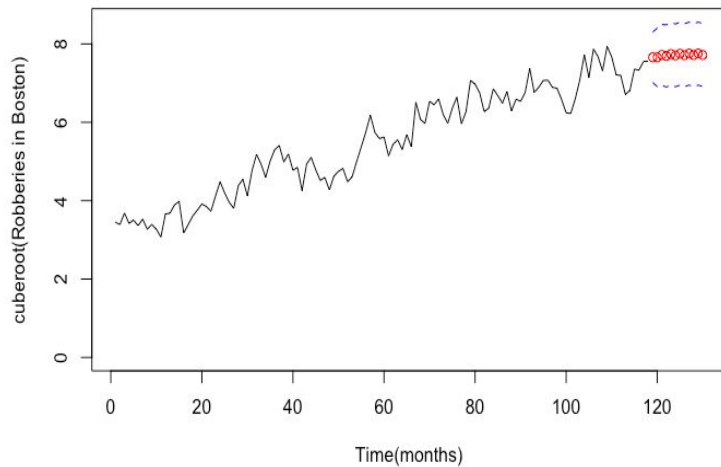
$$(1+0.37B) X_t = (1+0.09B - 0.30B^2)Z_t$$

$$Z_t \sim N(0,0.1064543)$$



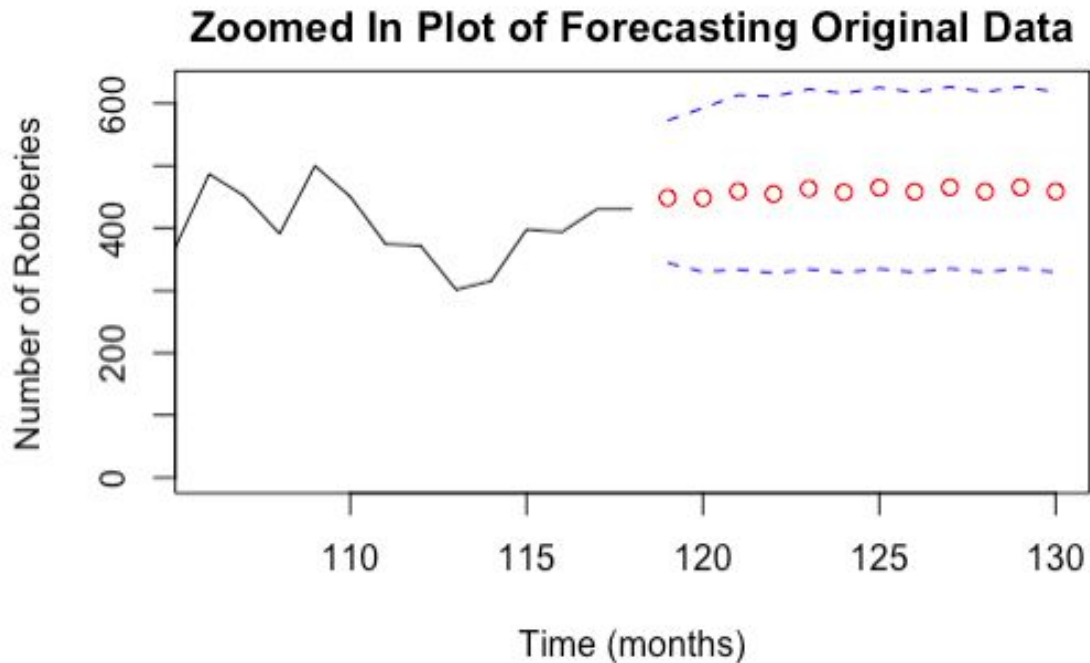
Forecasting

Forecasting Based on Transformed Data





Forecasting





References

1. *Data Market*,
<https://datamarket.com/data/set/22ob/monthly-boston-armed-robberies-jan1966-oct1975-deutsch-and-alt-1977#!ds=22ob&display=line>
2. *Massachusetts Crime Rates 1960 - 2016 - Public Records*,
<http://www.disastercenter.com/crime/maccrime.htm>



questions...?