Appendix:

Figures:

Figure 1: Box Plot of Attributes

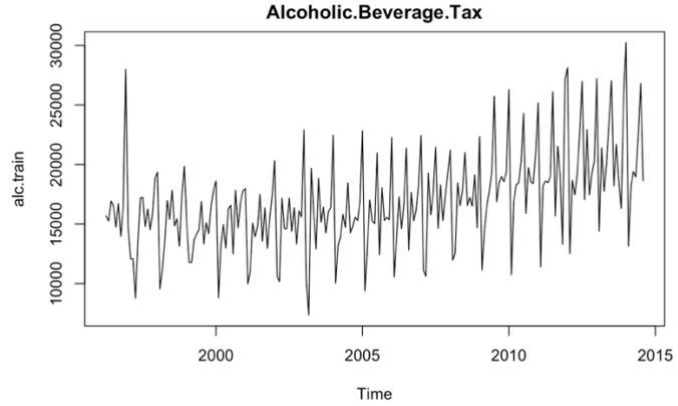

Figure 2: Time Series plot of Monthly Alcoholic Beverage Tax

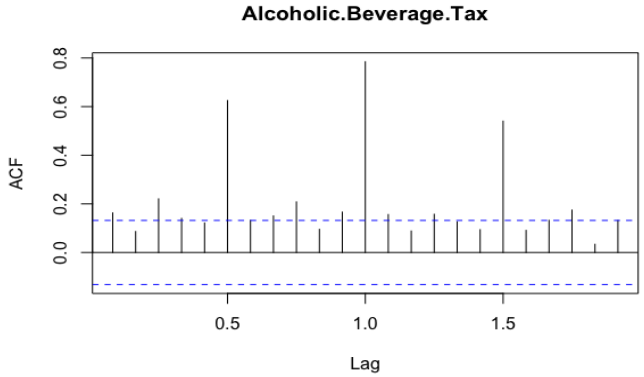

Figure 3: ACF of Monthly Alcoholic Beverage Tax

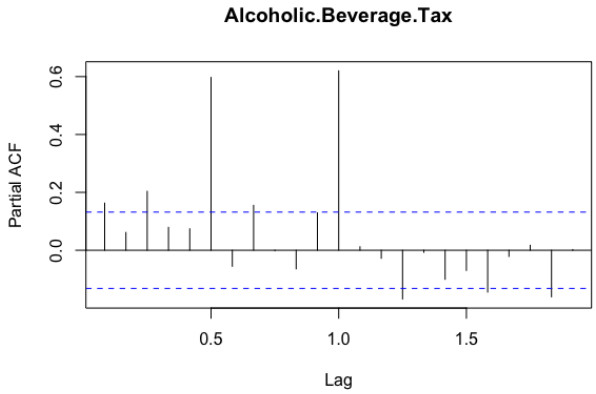

Figure 4: PACF of Monthly Alcoholic Beverage Tax

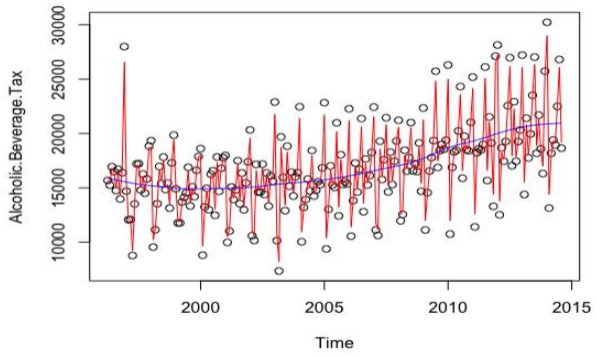

Figure 5: Kernel Smoother fitting plot

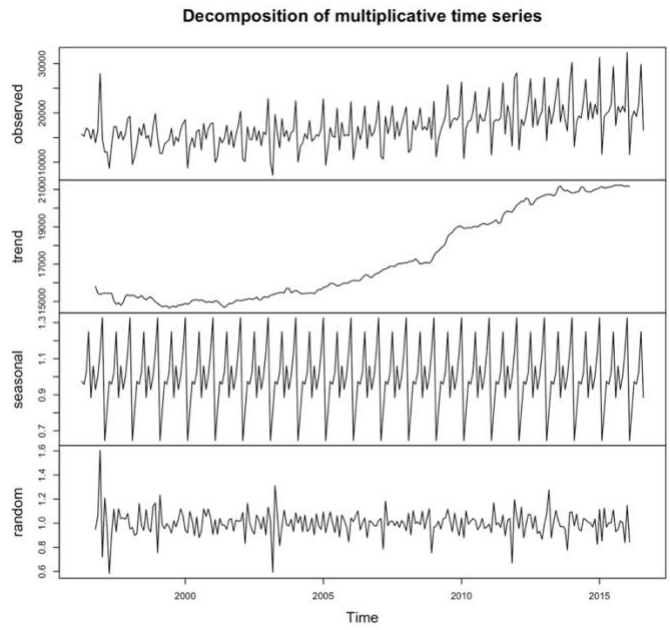

Figure 6: Decomposition of Multiplicative Times Series of Monthly Alcoholic Beverage Tax

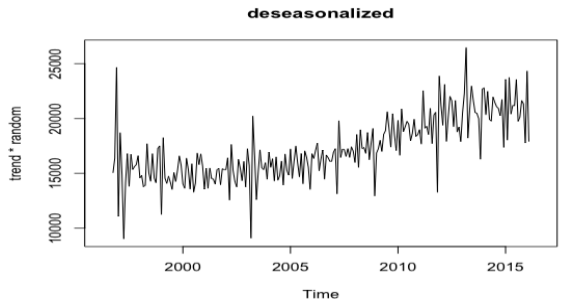

Figure 7: Deseasonlized Times Series of Monthly Alcoholic Beverage Tax

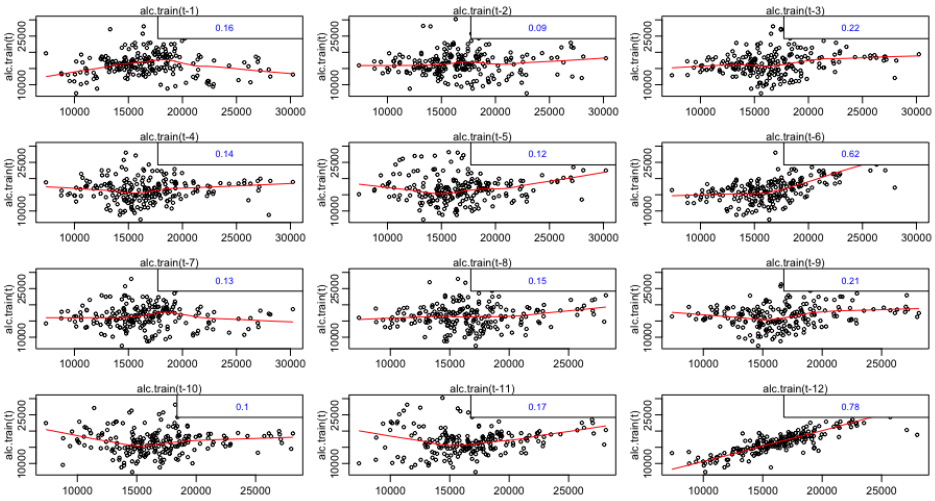

Figure 8: Lagged Scatterplot Matrix

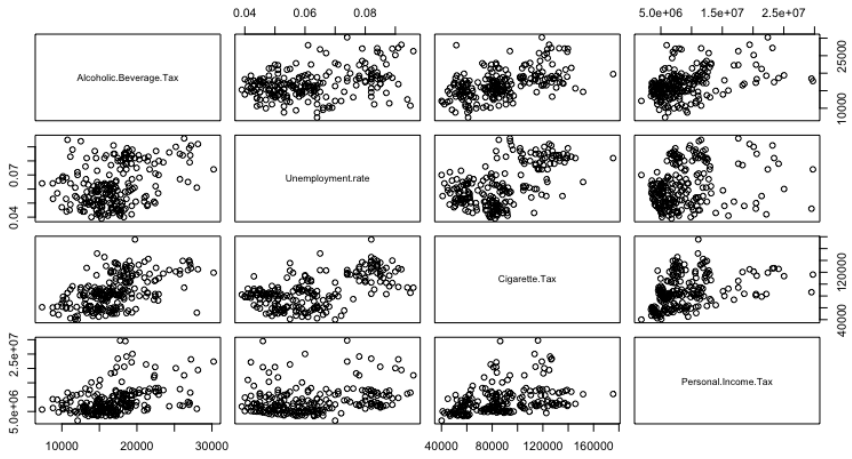

Figure 9: Scatter Matrix Plot

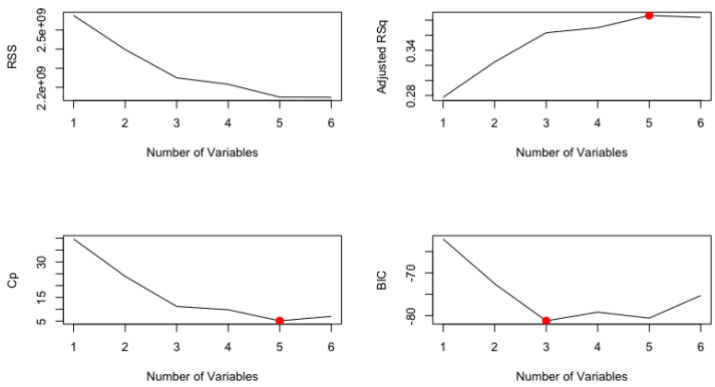

Figure 10: Feature Selection

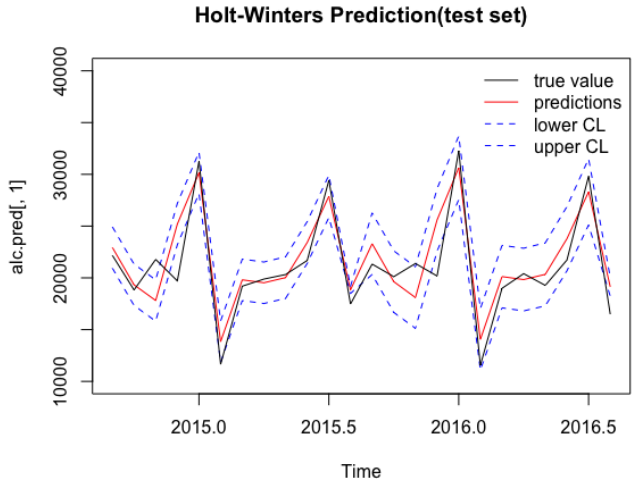

Figure 11: Holt-Winters Prediction for Test Set

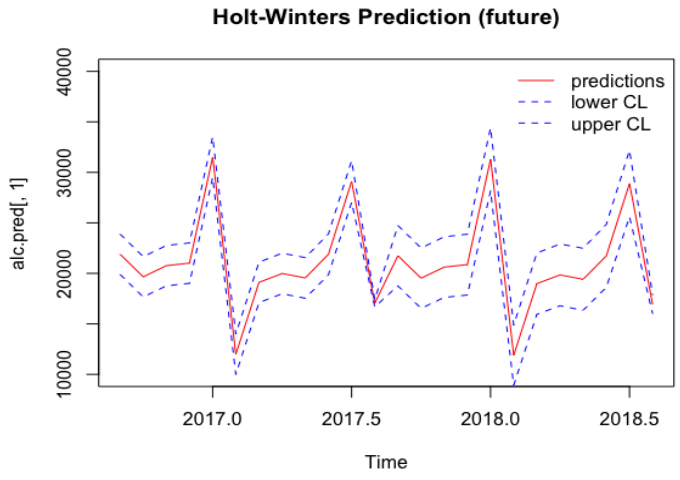

Figure 12: Holt-Winters Prediction for Next Year

```
Call:
arima(x = alc.train, order = c(2, 1, 1), seasonal = list(order = c(1, 1, 0),
    period = 12), method = "ML")

Coefficients:
          ar1      ar2      ma1     sar1
      -0.3691  -0.2038  -0.9355  -0.5378
s.e.   0.0713   0.0706   0.0251   0.0663

sigma^2 estimated as 2961812:  log likelihood = -1848.69,  aic = 3705.39
```

Figure 13: ARIMA$(2,1,1)(1,1,0)_{12}$

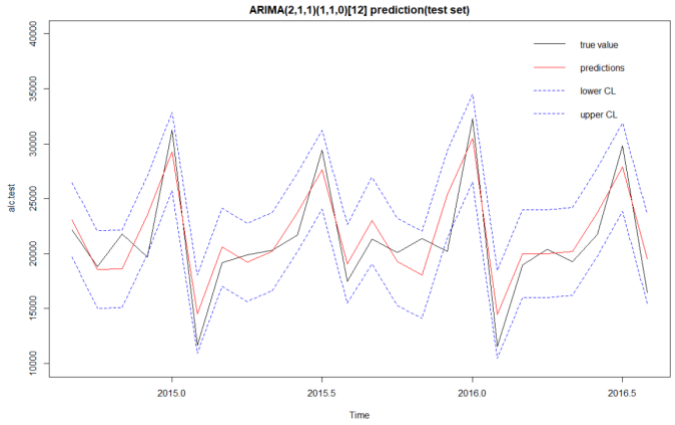

Figure 14: ARIMA Prediction for Test Set

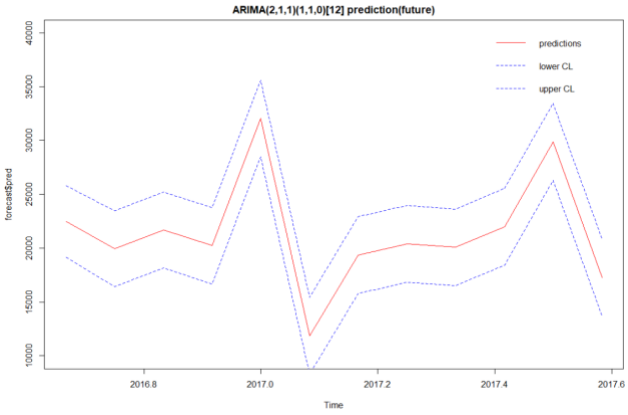

Figure 15: ARIMA Prediction for Next Year

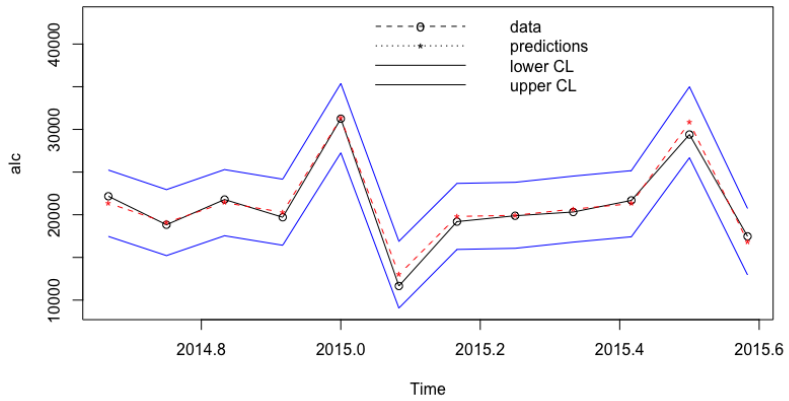

Figure 16: Regression with Lagged Variables for Test Set

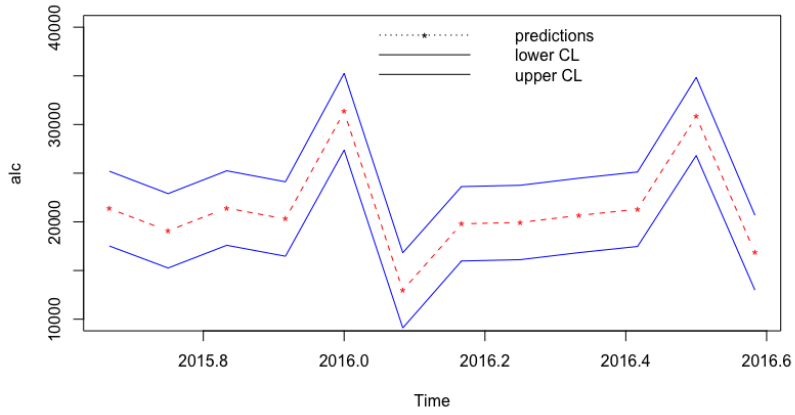

Figure 17: Regression with Lagged Variables Prediction for Next Year

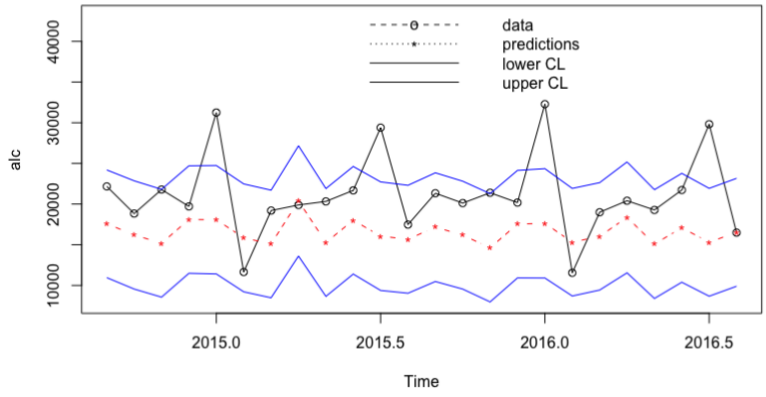

Figure 18: Multiple Linear Regression Prediction for Test Set

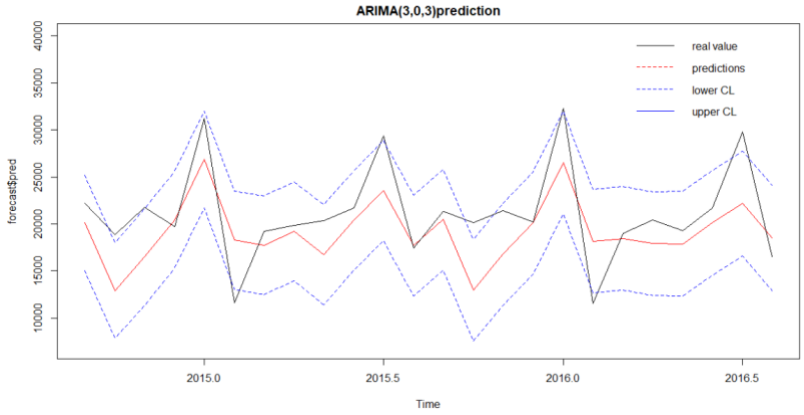

Figure 19: ARIMA (3, 0, 3) Prediction for Test Set

```
Call:
arima(x = alc.train, order = c(2, 1, 1), seasonal = list(order = c(1, 1, 0),
    period = 12), xreg = cbind(cig.train, per.train), method = "ML")

Coefficients:
          ar1      ar2      ma1     sar1  cig.train  per.train
      -0.3614  -0.1978  -0.9366  -0.5392    -0.0008      0e+00
s.e.   0.0734   0.0723   0.0260   0.0666     0.0072      1e-04

sigma^2 estimated as 2957870:  log likelihood = -1848.57,  aic = 3709.14

Training set error measures:
                    ME     RMSE      MAE      MPE     MAPE         MASE       ACF1
Training set 222.3521 1668.506 1243.961 0.422876 3.069339 0.0007787677 0.02713305
```

Figure 20: SARIMA Output

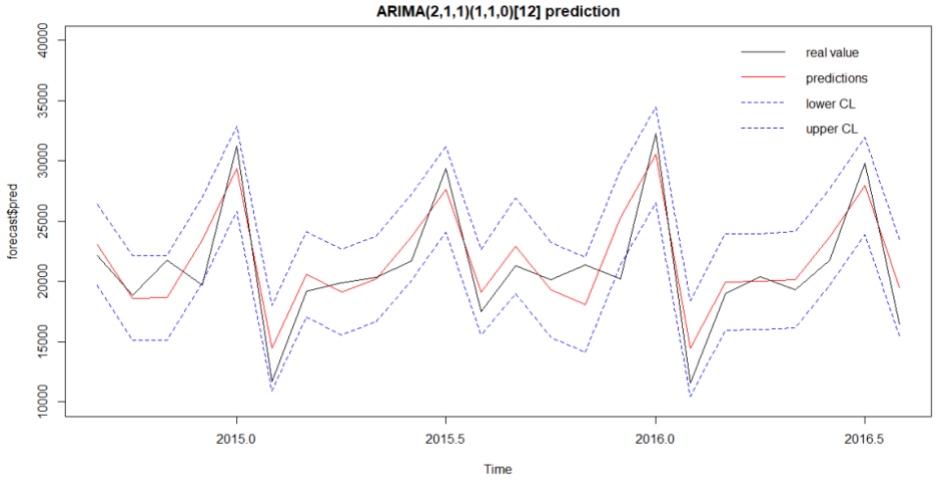

Figure 21: SARIMA Prediction for Test Set

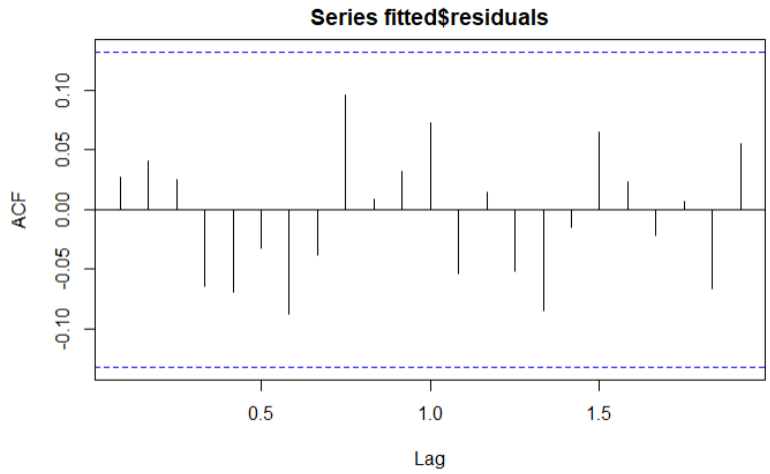

Figure 22: ACF of Residuals OF SARIMA

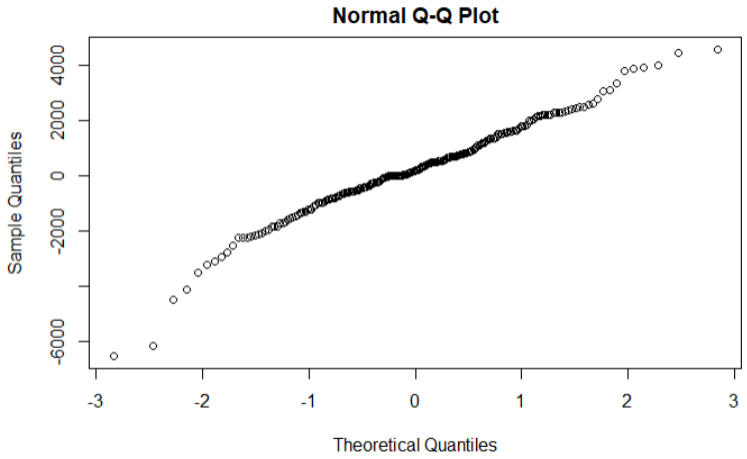

Figure 23: QQ Plot of SARIMA

Tables:

Table 1: Quatitative Summary of Attributes

Method	Proportion
Holt-Winters(Multiplicative)	17/24
Regression with Lagged Variables	12/12
Multiple Linear Regression	20/24
ARIMA(3,0,3)	16/24
SARIMA(2,1,1)(1,1,0)$_{12}$	22/24
Proportion: The proportion of predicted values falling in the prediction intervals with 95% confidence.	

Table 2: Analysis of Variance Table

predictor	df	SSE	MSE	F value	P value
trend	1	7.765×10^8	776527783	73.327	2.25×10^{-15} ***
U_t	1	5.769×10^7	57689376	5.448	0.020532 *
$(C_t - \overline{C_t})$	1	2.038×10^8	203785648	19.243	1.81×10^{-5} ***
$(P_t - \overline{P_t})$	1	1.619×10^8	161921993	15.290	0.000124 ***
$(C_t - \overline{C_t})^2$	1	3.185×10^4	31854	0.003	0.956314
$(P_t - \overline{P_t})^2$	1	3.304×10^8	3303586	0.312	0.577073
$(C_t - \overline{C_t})^3$	1	6.084×10^7	60844438	5.745	0.017399 *
$(P_t - \overline{P_t})^3$	1	7.328×10^7	73282458	6.920	0.009149 **
residuals	212	2.245×10^9	10589983		
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					

Table 3: Method Prediction Result Comparison

Method	Proportion
Holt-Winters(Multiplicative)	17/24
Regression with Lagged Variables	12/12
Multiple Linear Regression	20/24
ARIMA(3,0,3)	16/24
SARIMA(2,1,1)(1,1,0)$_{12}$	22/24
Proportion: The proportion of predicted values falling in the prediction intervals with 95% confidence.	