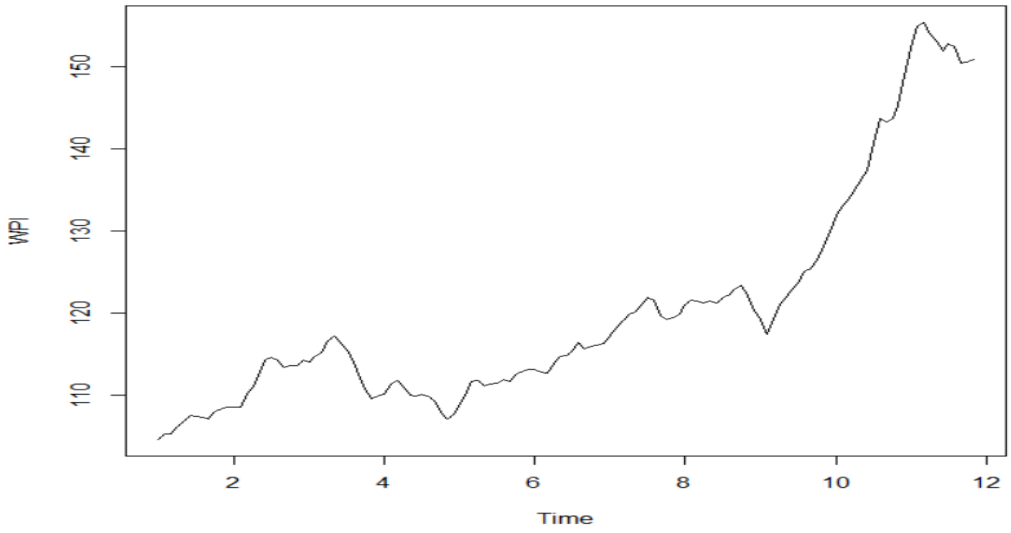
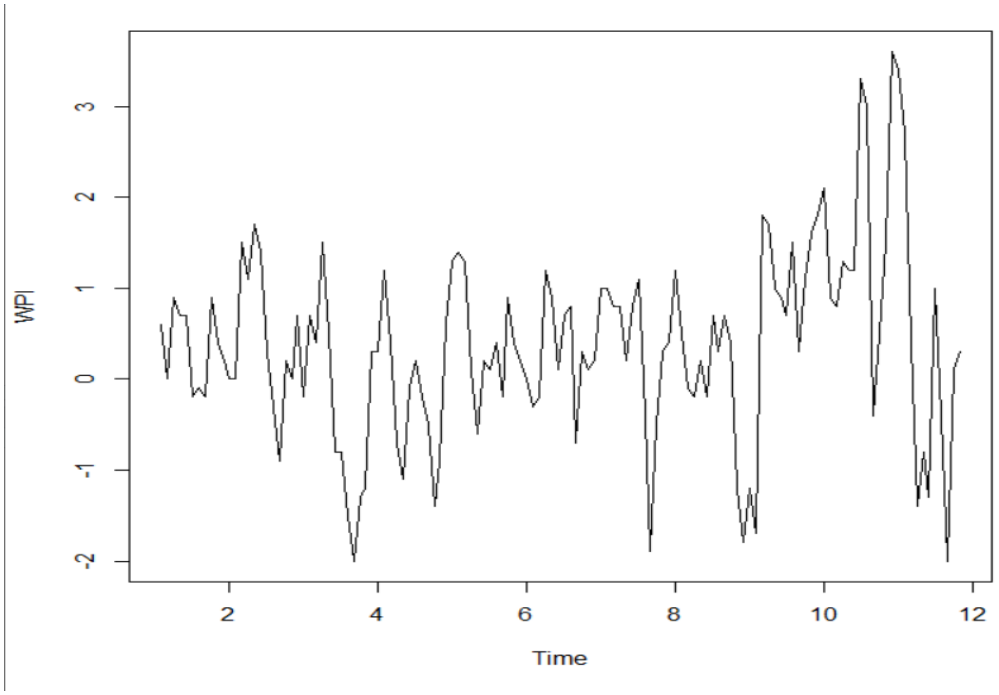
Applied Econometrics Assignment on Time Series Data Analysis

Name - Shubham Agrawal
ID - 2020B3A70505H
Instructor-in-charge - Dr. Rishi Kumar sir

1. Time series data plot
   Command -
   wpitimeseries <- ts(wpi,frequency=12)
   plot.ts(wpitimeseries)



2. Taking the first difference
   Command -
   wpitimeseriesdiff1 <- diff(wpitimeseries, differences=1)
   plot.ts(wpitimeseriesdiff1)



3. Testing for stationarity
   Command -
   adf.test((wpitimeseries), alternative="stationary", k=0)

```
        Augmented Dickey-Fuller Test

data:  (wpitimeseries)
Dickey-Fuller = -0.11924, Lag order = 0, p-value = 0.99
alternative hypothesis: stationary
```

   adf.test((wpitimeseriesdiff1), alternative="stationary", k=0)

```
        Augmented Dickey-Fuller Test

data:  (wpitimeseriesdiff1)
Dickey-Fuller = -5.8677, Lag order = 0, p-value = 0.01
alternative hypothesis: stationary
```

4. Commands-
   stationary.test(wpitimeseries)

```
Augmented Dickey-Fuller Test
alternative: stationary

Type 1: no drift no trend
     lag  ADF p.value
[1,]   0 4.05   0.990
[2,]   1 1.83   0.982
[3,]   2 2.20   0.990
[4,]   3 2.23   0.990
[5,]   4 2.11   0.990
Type 2: with drift no trend
     lag   ADF p.value
[1,]   0 1.792   0.990
[2,]   1 0.267   0.975
[3,]   2 0.573   0.988
[4,]   3 0.890   0.990
[5,]   4 0.841   0.990
Type 3: with drift and trend
     lag    ADF p.value
[1,]   0 -0.119   0.990
[2,]   1 -1.317   0.860
[3,]   2 -0.942   0.944
[4,]   3 -0.796   0.960
[5,]   4 -0.820   0.957
----
Note: in fact, p.value = 0.01 means p.value <= 0.01
```

   stationary.test(wpitimeseries, method = "pp")

```
Phillips-Perron Unit Root Test
alternative: stationary

Type 1: no drift no trend
 lag Z_rho p.value
   4 0.393   0.777
-----
 Type 2: with drift no trend
 lag Z_rho p.value
   4  1.18    0.99
-----
 Type 3: with drift and trend
 lag Z_rho p.value
   4 -1.82   0.973
---------------
Note: p-value = 0.01 means p.value <= 0.01
```

stationary.test(wpitimeseries, method = "kpss")

```
KPSS Unit Root Test
alternative: nonstationary

Type 1: no drift no trend
 lag  stat p.value
   2 0.364     0.1
-----
 Type 2: with drift no trend
 lag  stat p.value
   2 0.127     0.1
-----
 Type 1: with drift and trend
 lag  stat p.value
   2 0.108     0.1
-----------
Note: p.value = 0.01 means p.value <= 0.01
    : p.value = 0.10 means p.value >= 0.10
```

5. Along with the difference
   Commands used -
   (a) stationary.test(wpitimeseriesdiff1)

```
Augmented Dickey-Fuller Test
alternative: stationary

Type 1: no drift no trend
     lag   ADF p.value
[1,]   0 -5.40    0.01
[2,]   1 -5.51    0.01
[3,]   2 -5.04    0.01
[4,]   3 -4.28    0.01
[5,]   4 -3.23    0.01
Type 2: with drift no trend
     lag   ADF p.value
[1,]   0 -5.74    0.01
[2,]   1 -5.99    0.01
[3,]   2 -5.54    0.01
[4,]   3 -4.78    0.01
[5,]   4 -3.62    0.01
Type 3: with drift and trend
     lag   ADF p.value
[1,]   0 -5.87  0.0100
[2,]   1 -6.14  0.0100
[3,]   2 -5.81  0.0100
[4,]   3 -5.07  0.0100
[5,]   4 -3.89  0.0172
----
Note: in fact, p.value = 0.01 means p.value <= 0.01
```

(b) stationary.test(wpitimeseriesdiff1, method = "pp")

```
Phillips-Perron Unit Root Test
alternative: stationary

Type 1: no drift no trend
 lag Z_rho p.value
   4 -44.4    0.01
-----
 Type 2: with drift no trend
 lag Z_rho p.value
   4 -49.4    0.01
-----
 Type 3: with drift and trend
 lag Z_rho p.value
   4   -51    0.01
---------------
Note: p-value = 0.01 means p.value <= 0.01
```

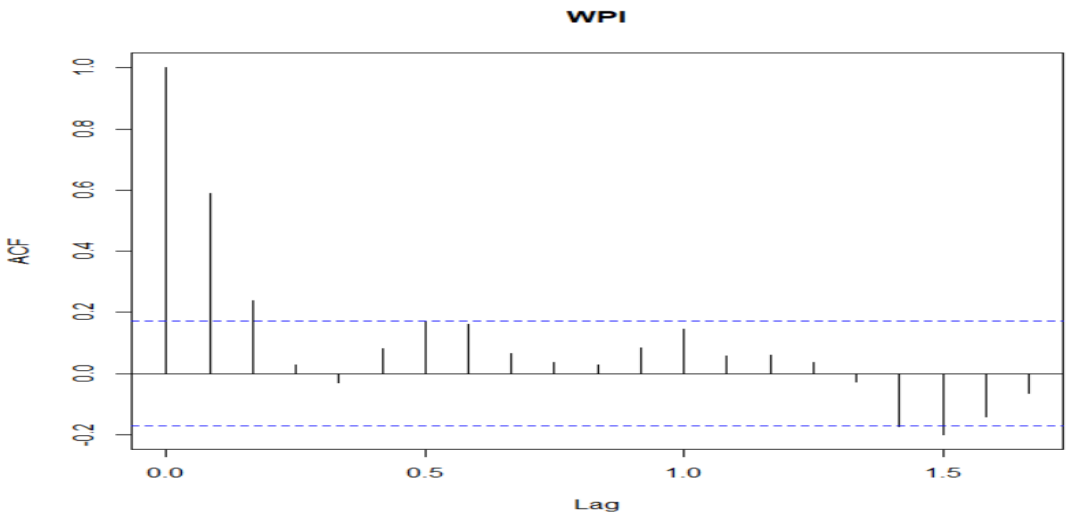
(c) stationary.test(wpitimeseriesdiff1, method = "kpss")

```
KPSS Unit Root Test
alternative: nonstationary

Type 1: no drift no trend
 lag  stat p.value
   2 0.547     0.1
-----
 Type 2: with drift no trend
 lag  stat p.value
   2 0.197     0.1
-----
 Type 1: with drift and trend
 lag   stat p.value
   2 0.0504     0.1
-----------
Note: p.value = 0.01 means p.value <= 0.01
    : p.value = 0.10 means p.value >= 0.10
```

6. ACF and PACF plots to find information about the model:

   Commands -

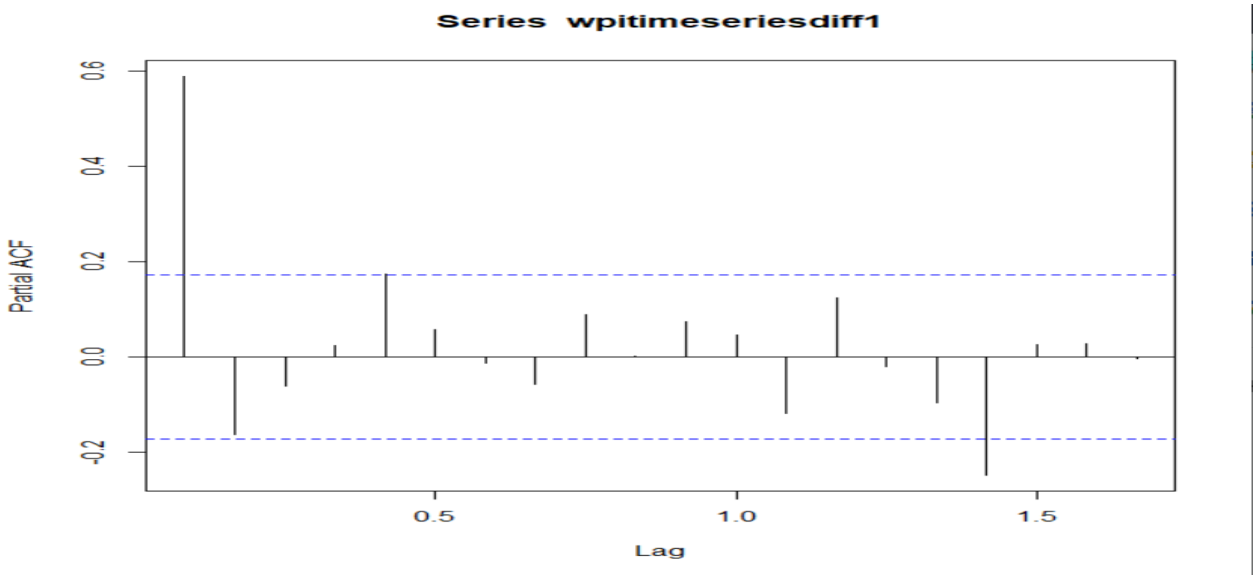
   acf(wpitimeseriesdiff1, lag.max=20)



acf(wpitimeseriesdiff1, lag.max=20, plot=FALSE)

```
Autocorrelations of series 'wpitimeseriesdiff1', by lag

0.0000 0.0833 0.1667 0.2500 0.3333 0.4167 0.5000 0.5833 0.6667 0.7500 0.8333 0.9167 1.0000 1.0833 1.1667 1.2500 1.3333
 1.000  0.588  0.239  0.029 -0.031  0.081  0.171  0.162  0.066  0.037  0.027  0.085  0.145  0.058  0.060  0.036 -0.028
1.4167 1.5000 1.5833 1.6667
-0.173 -0.199 -0.143 -0.064
```

pacf(wpitimeseriesdiff1, lag.max=20)



pacf(wpitimeseriesdiff1, lag.max=20, plot=FALSE)

```
Partial autocorrelations of series 'wpitimeseriesdiff1', by lag

0.0833 0.1667 0.2500 0.3333 0.4167 0.5000 0.5833 0.6667 0.7500 0.8333 0.9167 1.0000 1.0833 1.1667 1.2500 1.3333 1.4167
 0.588 -0.163 -0.061  0.023  0.173  0.058 -0.013 -0.057  0.088  0.001  0.074  0.046 -0.119  0.124 -0.020 -0.096 -0.248
1.5000 1.5833 1.6667
 0.025  0.027 -0.004
```

7. Commands -

auto.arima(wpi)

```
Series: wpi
ARIMA(2,1,0) with drift

Coefficients:
          ar1      ar2   drift
      0.6802  -0.1622  0.3585
s.e.  0.0862   0.0860  0.1510

sigma^2 = 0.7134:  log likelihood = -161.22
AIC=330.43   AICc=330.75   BIC=341.9
```

auto.arima(wpitimeseries)

```
Series: wpitimeseries
ARIMA(2,1,0)(0,0,1)[12] with drift

Coefficients:
         ar1      ar2    sma1  drift
      0.6927  -0.1822  0.2956  0.352
s.e.  0.0861   0.0861  0.1032  0.183

sigma^2 = 0.6743:  log likelihood = -157.6
AIC=325.19   AICc=325.67   BIC=339.53
```

auto.arima(wpitimeseriesdiff1)

```
Series: wpitimeseriesdiff1
ARIMA(2,0,0)(0,0,1)[12] with non-zero mean

Coefficients:
         ar1      ar2    sma1    mean
      0.6927  -0.1822  0.2956  0.3521
s.e.  0.0861   0.0861  0.1032  0.1830

sigma^2 = 0.6742:  log likelihood = -157.6
AIC=325.19   AICc=325.67   BIC=339.53
```

8. Command -

wpitimeseriesarima <- arima(wpitimeseries, order=c(2,1,0))
wpitimeseriesarima

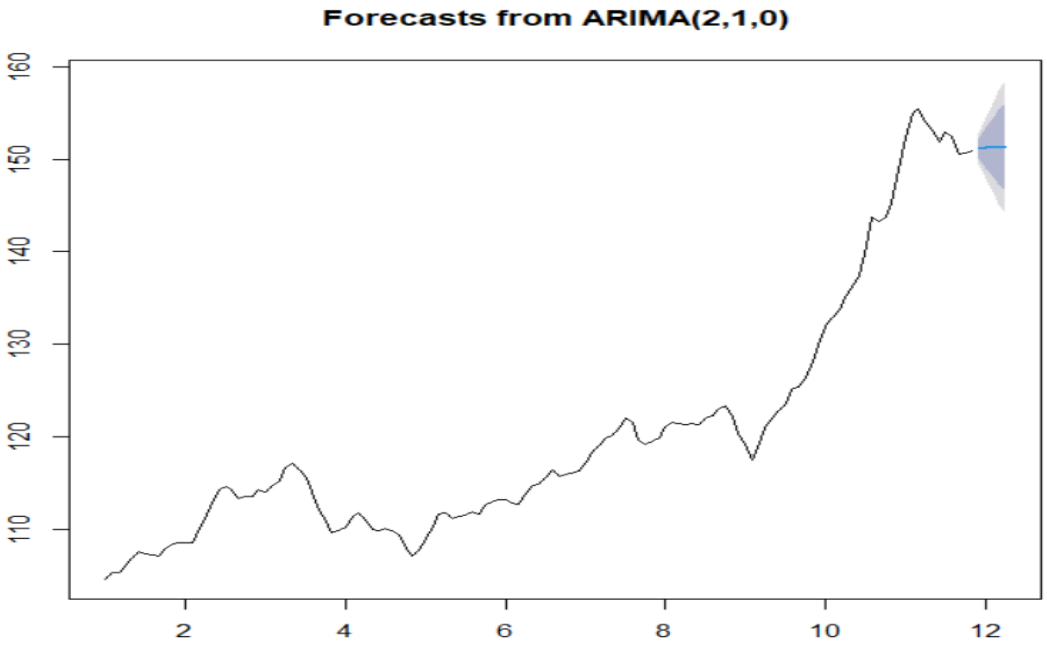
```
Call:
arima(x = wpitimeseries, order = c(2, 1, 0))

Coefficients:
         ar1      ar2
      0.7102  -0.1316
s.e.  0.0867   0.0864

sigma^2 estimated as 0.723:  log likelihood = -163.64,  aic = 333.29
```

9. Command -

wpitimeseriesforecasts <- forecast(wpitimeseriesarima, h=5)
wpitimeseriesforecasts

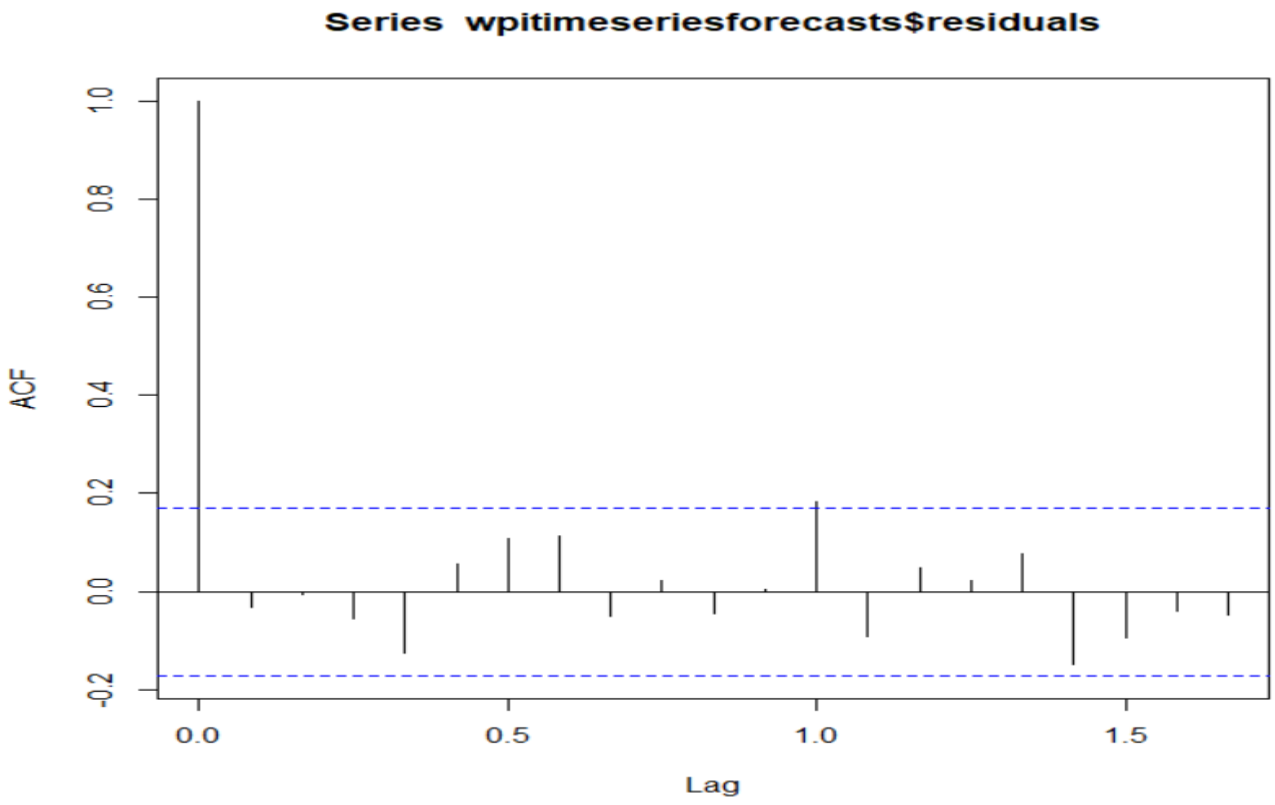
```
        Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
Dec 11       151.0999 150.0102 152.1896 149.4334 152.7664
Jan 12       151.2024 149.0436 153.3611 147.9009 154.5038
Feb 12       151.2488 148.1165 154.3811 146.4584 156.0393
Mar 12       151.2683 147.2878 155.2488 145.1807 157.3559
Apr 12       151.2760 146.5568 155.9953 144.0585 158.4935
```

plot(wpitimeseriesforecasts)



10. Commands -

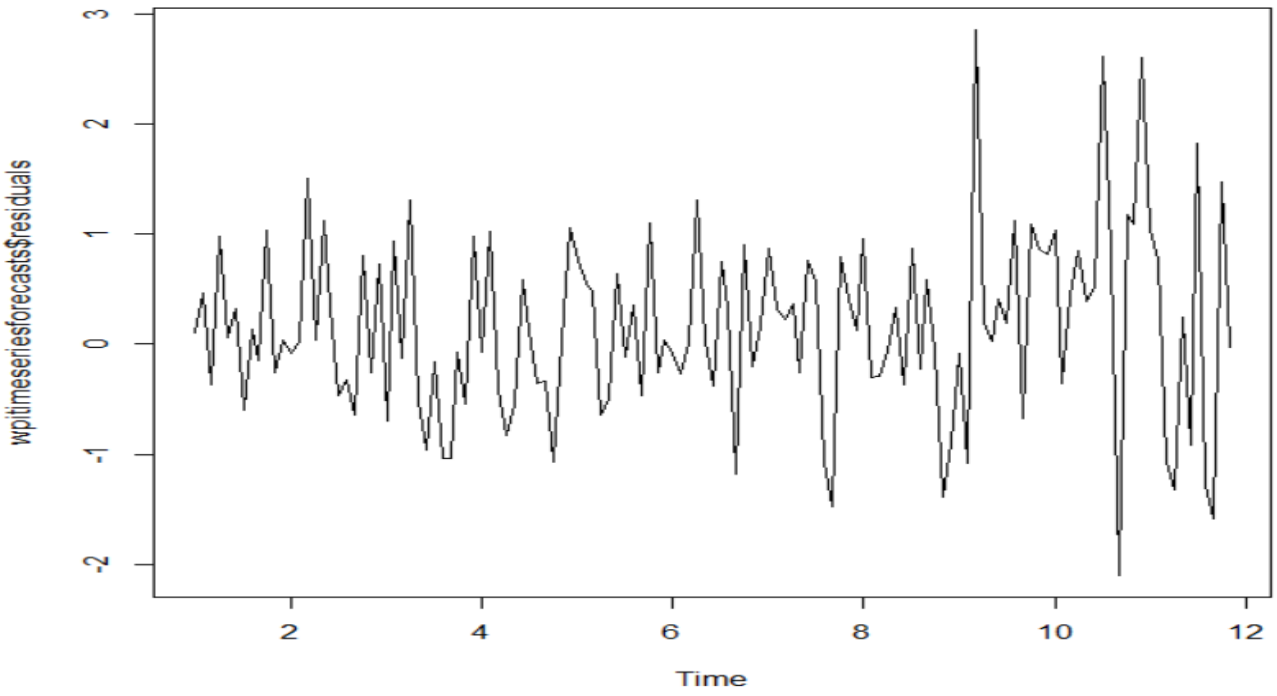
acf(wpitimeseriesforecasts$residuals, lag.max=20)



```
Box.test(wpitimeseriesforecasts$residuals, lag=20, type="Ljung-Box")
```

```
        Box-Ljung test

data:  wpitimeseriesforecasts$residuals
X-squared = 20.198, df = 20, p-value = 0.4456
```

```
plot.ts(wpitimeseriesforecasts$residuals)
```




```
hist(wpitimeseriesforecasts$residuals)
```