```r
library(forecast)
```

```
## Warning: package 'forecast' was built under R version 4.2.3
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```r
library(tseries)
```

```
## Warning: package 'tseries' was built under R version 4.2.3
```

```r
## 1
usip = read.csv(file = "D:/Semester VIII/Analisis Runtun Waktu/uts 2/DATA
USIP2.csv", header = TRUE, sep = ";")
attach(usip)
usip
```

```
##    TAHUN BULAN JUMLAH
## 1   2018   jan   7092
## 2   2018   feb   5278
## 3   2018   mar   6525
## 4   2018   apr   6888
## 5   2018   mei   8646
## 6   2018   jun  10388
## 7   2018   jul   8417
## 8   2018   agu   6877
## 9   2018   sep    743
## 10  2018   okt    698
## 11  2018   nov   9505
## 12  2018   des   1272
## 13  2019   jan   8970
## 14  2019   feb   6676
## 15  2019   mar  10427
## 16  2019   apr   8933
## 17  2019   mei  12299
## 18  2019   jun  14578
## 19  2019   jul   9651
## 20  2019   agu  11844
## 21  2019   sep  11162
## 22  2019   okt  13570
## 23  2019   nov  12757
## 24  2019   des  14699
## 25  2020   jan   5785
## 26  2020   feb   3636
## 27  2020   mar   4956
## 28  2020   apr   4208
## 29  2020   mei   8336
## 30  2020   jun   6996
## 31  2020   jul   4907
## 32  2020   agu   6570
```

```
## 33  2020   sep   5562
## 34  2020   okt   6383
## 35  2020   nov   6501
## 36  2020   des   9101
## 37  2021   jan   5871
## 38  2021   feb   4822
## 39  2021   mar   4889
## 40  2021   apr   6287
## 41  2021   mei   7837
## 42  2021   jun   5397
## 43  2021   jul   5571
## 44  2021   agu   3924
## 45  2021   sep   2737
## 46  2021   okt   3406
## 47  2021   nov   3552
## 48  2021   des   5735
## 49  2022   jan   5525
## 50  2022   feb   5311
## 51  2022   mar   5144
## 52  2022   apr   5417
## 53  2022   mei   7681
## 54  2022   jun   3787
## 55  2022   jul   6879
## 56  2022   agu   5802
## 57  2022   sep   5492
## 58  2022   okt   6146
## 59  2022   nov   6176
## 60  2022   des  10863
```

```
Xt = (usip$JUMLAH)
Xt
```

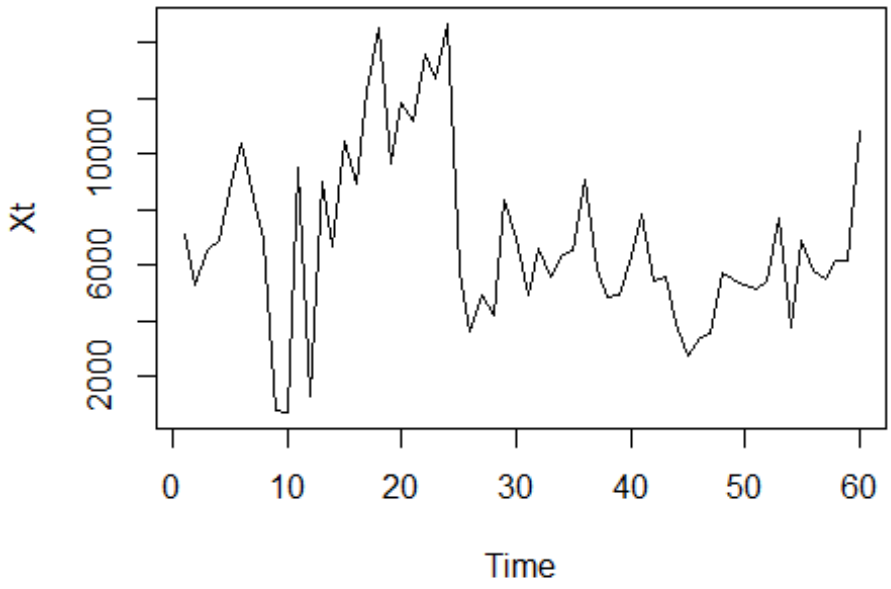
```
##  [1]  7092  5278  6525  6888  8646 10388  8417  6877   743   698  9505
1272
## [13]  8970  6676 10427  8933 12299 14578  9651 11844 11162 13570 12757
14699
## [25]  5785  3636  4956  4208  8336  6996  4907  6570  5562  6383  6501
9101
## [37]  5871  4822  4889  6287  7837  5397  5571  3924  2737  3406  3552
5735
## [49]  5525  5311  5144  5417  7681  3787  6879  5802  5492  6146  6176
10863
```

```
# Melakukan tes ADF pada data
adf.test(Xt)
```

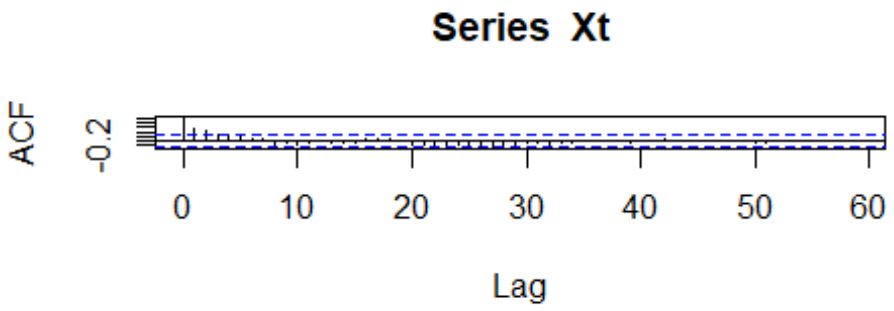
```
##
##  Augmented Dickey-Fuller Test
##
## data:  Xt
```

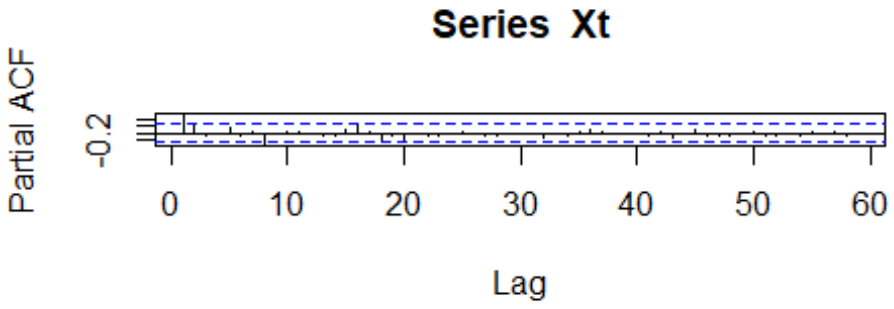
```
## Dickey-Fuller = -2.7998, Lag order = 3, p-value = 0.2515
## alternative hypothesis: stationary

# Menampilkan plot data
par(mfrow=c(1,1))
plot.ts(Xt)
```



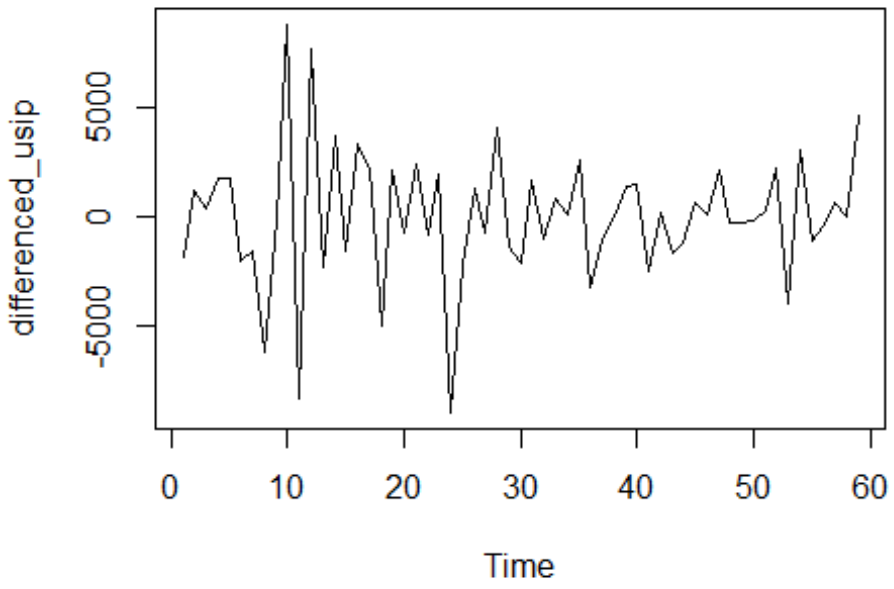

```
# Menampilkan plot ACF dan PACF
par(mfrow=c(2,1))
acf(Xt, lag.max = 120)
pacf(Xt, lag.max = 120)
```






```r
# Melakukan diferensiasi pada data untuk membuatnya stasioner
differenced_usip <- diff(Xt)

# Menampilkan plot data yang sudah didiferensiasi
par(mfrow=c(1,1))
plot.ts(differenced_usip)
```

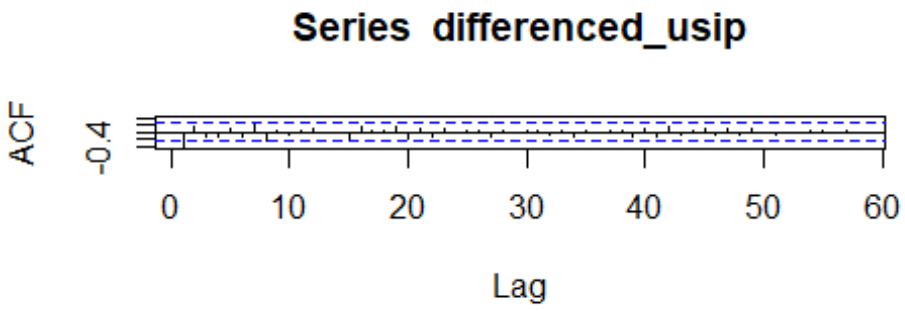


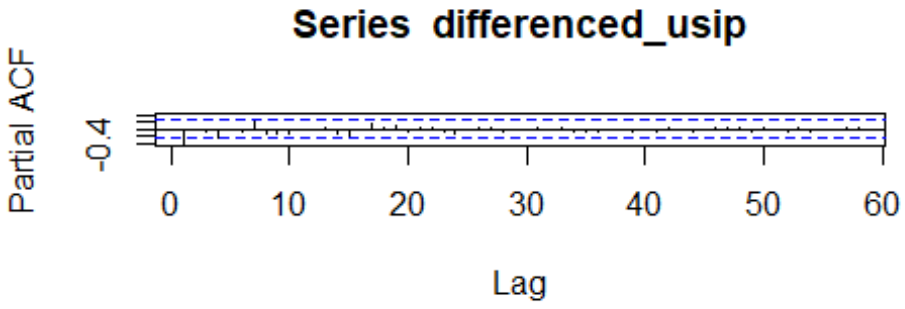

```r
# Melakukan tes ADF pada data yang sudah didiferensiasi
adf.test(differenced_usip)
```

```
## Warning in adf.test(differenced_usip): p-value smaller than printed p-
value

##
##  Augmented Dickey-Fuller Test
##
## data:  differenced_usip
## Dickey-Fuller = -5.2144, Lag order = 3, p-value = 0.01
## alternative hypothesis: stationary
```

```r
# Menampilkan plot ACF dan PACF dari data yang sudah didiferensiasi
par(mfrow=c(2,1))
Acf(differenced_usip, lag.max = 120)
Pacf(differenced_usip, lag.max = 120)
```






```
fit = auto.arima(Xt)
summary(fit)
```

```
## Series: Xt
## ARIMA(0,1,1)
##
## Coefficients:
##           ma1
##       -0.4855
## s.e.   0.1349
##
## sigma^2 = 7635568:  log likelihood = -550.87
## AIC=1105.75   AICc=1105.96   BIC=1109.9
##
## Training set error measures:
##                     ME     RMSE      MAE       MPE     MAPE      MASE
## Training set 54.28668 2716.809 1949.862 -33.80457 55.76716 0.9057632
##                      ACF1
## Training set -0.001985753
```

```
## estimasi
#estimasi2
estimasi2=arima(Xt,order=c(0,1,0))
estimasi2
```

```
##
## Call:
```

```
## arima(x = Xt, order = c(0, 1, 0))
##
##
## sigma^2 estimated as 9206750:  log likelihood = -556.76,  aic = 1115.53
```

```
residual1=resid(estimasi2)
shapiro.test(residual1)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  residual1
## W = 0.94845, p-value = 0.01317
```

```
Box.test(residual1,lag=6,type="Ljung-Box")
```

```
##
##  Box-Ljung test
##
## data:  residual1
## X-squared = 16.507, df = 6, p-value = 0.01128
```

```
#estimasi2
estimasi2=arima(Xt,order=c(1,1,0))
estimasi2
```

```
##
## Call:
## arima(x = Xt, order = c(1, 1, 0))
##
## Coefficients:
##           ar1
##       -0.4283
## s.e.   0.1192
##
## sigma^2 estimated as 7538668:  log likelihood = -550.97,  aic = 1105.94
```

```
residual2=resid(estimasi2)
shapiro.test(residual2)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  residual2
## W = 0.95066, p-value = 0.01673
```

```
Box.test(residual2,lag=6,type="Ljung-Box")
```

```
##
##  Box-Ljung test
##
```

```
## data:  residual2
## X-squared = 4.3917, df = 6, p-value = 0.6238
```

```
#estimasi3
estimasi3=arima(Xt,order=c(0,1,1))
estimasi3
```

```
##
## Call:
## arima(x = Xt, order = c(0, 1, 1))
##
## Coefficients:
##           ma1
##       -0.4855
## s.e.   0.1349
##
## sigma^2 estimated as 7506151:  log likelihood = -550.87,  aic = 1105.75
```

```
residual3=resid(estimasi3)
shapiro.test(residual3)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  residual3
## W = 0.96369, p-value = 0.07141
```

```
Box.test(residual3,lag=6,type="Ljung-Box")
```

```
##
##  Box-Ljung test
##
## data:  residual3
## X-squared = 4.2163, df = 6, p-value = 0.6474
```

```
#estimasi4
estimasi4=arima(Xt,order=c(1,1,1))
estimasi4
```

```
##
## Call:
## arima(x = Xt, order = c(1, 1, 1))
##
## Coefficients:
##          ar1      ma1
##       0.5415  -0.9842
## s.e.  0.1574   0.1784
##
## sigma^2 estimated as 7195012:  log likelihood = -550.56,  aic = 1107.12
```

```
residual4=resid(estimasi4)
shapiro.test(residual4)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  residual4
## W = 0.96979, p-value = 0.1425
```

```
Box.test(residual4,lag=6,type="Ljung-Box")
```

```
##
##  Box-Ljung test
##
## data:  residual4
## X-squared = 6.8429, df = 6, p-value = 0.3356
```

```
## 3. Persamaan
# ARMA (0,1,1)
library(astsa)
```

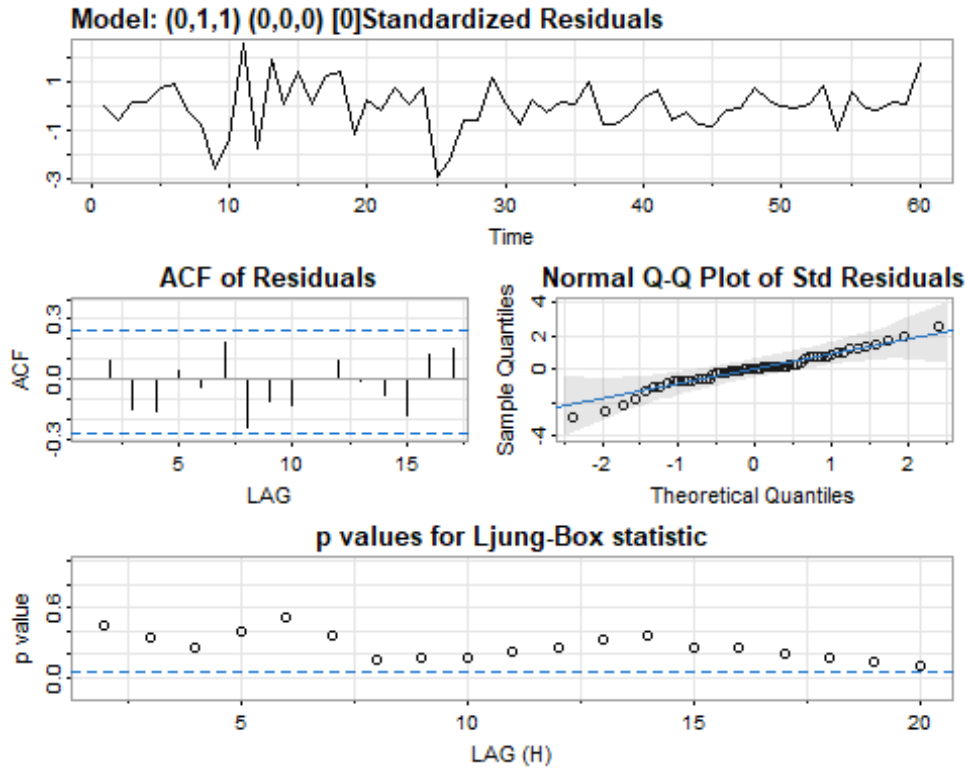
```
## Warning: package 'astsa' was built under R version 4.3.0
```

```
##
## Attaching package: 'astsa'
```

```
## The following object is masked from 'package:forecast':
##
##     gas
```

```
Xt3<-sarima(Xt,0,1,1,0,0,0,0)
```

```
## initial  value 8.017502
## iter   2 value 7.918634
## iter   3 value 7.917425
## iter   4 value 7.916216
## iter   5 value 7.915639
## iter   6 value 7.915633
## iter   7 value 7.915633
## iter   7 value 7.915633
## iter   7 value 7.915633
## final  value 7.915633
## converged
## initial  value 7.917696
## iter   2 value 7.917672
## iter   3 value 7.917639
## iter   4 value 7.917628
## iter   4 value 7.917628
## iter   4 value 7.917628
## final  value 7.917628
## converged
```




```
Xt3$ttable
```

```
##          Estimate       SE t.value p.value
## ma1       -0.4850   0.1347 -3.6010  0.0007
## constant  33.0827 187.0056  0.1769  0.8602
```

```
auto.arima(Xt)
```

```
## Series: Xt
## ARIMA(0,1,1)
##
## Coefficients:
##           ma1
##       -0.4855
## s.e.   0.1349
##
## sigma^2 = 7635568:  log likelihood = -550.87
## AIC=1105.75   AICc=1105.96   BIC=1109.9
```

```
## 4. Peramalan
library(forecast)
# ARIMA (0,1,1)
fit <- Arima(Xt, order = c(0, 1, 1))
forecasted_values <- forecast(fit, h = 7)
forecasted_values
```

```
##    Point Forecast    Lo 80    Hi 80     Lo 95    Hi 95
## 61       8528.797 4987.545 12070.05 3112.9201 13944.67
```

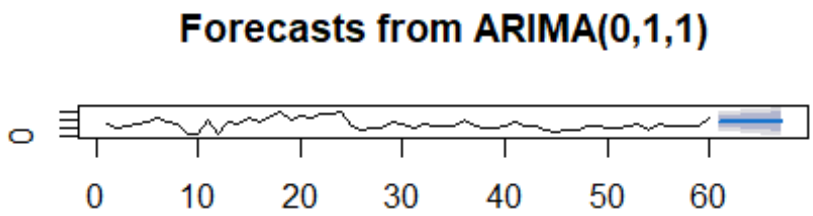
```
## 62       8528.797 4546.312 12511.28 2438.1112 14619.48
## 63       8528.797 4149.309 12908.28 1830.9477 15226.65
## 64       8528.797 3785.418 13272.18 1274.4248 15783.17
## 65       8528.797 3447.520 13610.07  757.6550 16299.94
## 66       8528.797 3130.733 13926.86  273.1699 16784.42
## 67       8528.797 2831.532 14226.06 -184.4177 17242.01
```

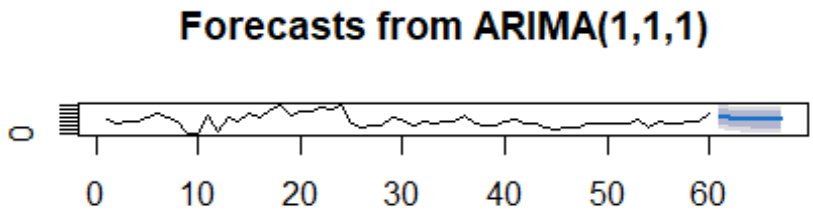
```r
# Plot
plot(forecasted_values)
```

```r
# ARIMA (1,1,1)
fit <- Arima(Xt, order = c(1, 1, 1))
forecasted_values <- forecast(fit, h = 7)
forecasted_values
```

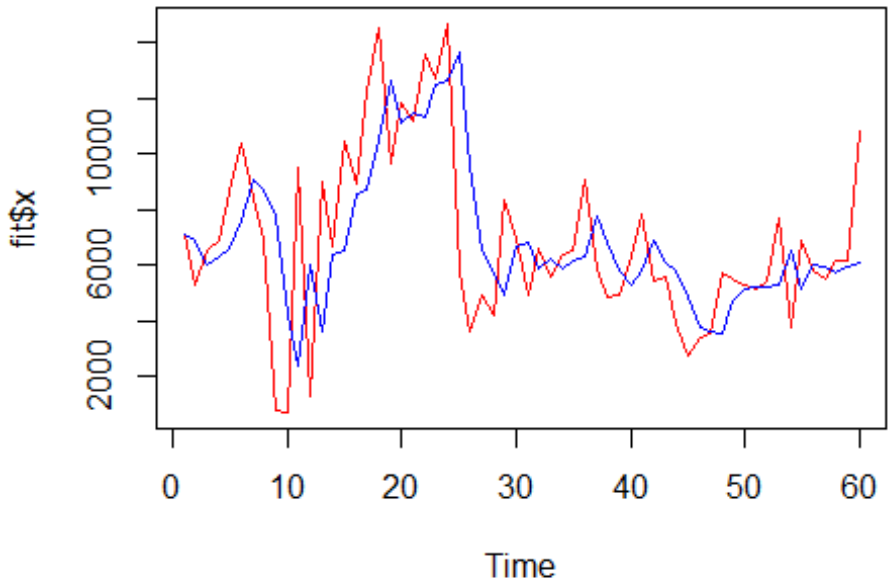
```
##    Point Forecast    Lo 80    Hi 80     Lo 95    Hi 95
## 61       9054.743 5548.653 12560.83 3692.6407 14416.85
## 62       8075.582 4053.742 12097.42 1924.7082 14226.46
## 63       7545.372 3365.790 11724.95 1153.2524 13937.49
## 64       7258.266 3023.054 11493.48  781.0684 13735.46
## 65       7102.800 2845.214 11360.39  591.3842 13614.22
## 66       7018.616 2750.594 11286.64  491.2398 13545.99
## 67       6973.031 2699.298 11246.76  436.9200 13509.14
```

```r
# Plot
plot(forecasted_values)
```

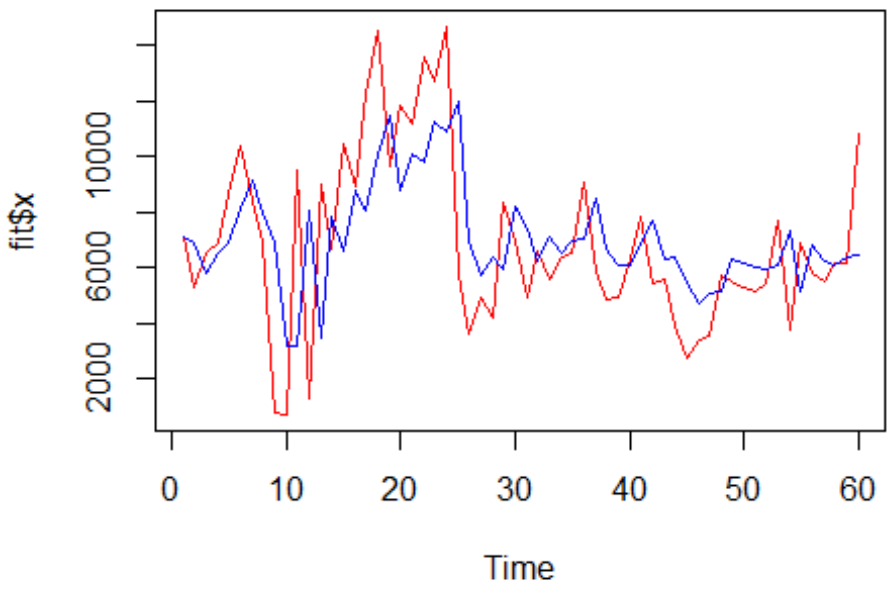




```r
## 5. Perbandingan
# ARIMA (0,1,1)
library(forecast)
par(mfrow=c(1,1))
fit<-Arima(Xt,order=c(0,1,1))
plot.ts(fit$x,col="red")
lines(fitted(fit),col="blue")
```




```r
#ARIMA (1,1,1)
library(forecast)
par(mfrow=c(1,1))
fit<-Arima(Xt,order=c(1,1,1))
plot.ts(fit$x,col="red")
lines(fitted(fit),col="blue")
```


fit$x
2000
6000
10000
0
10
20
30
40
50
60
Time