arima

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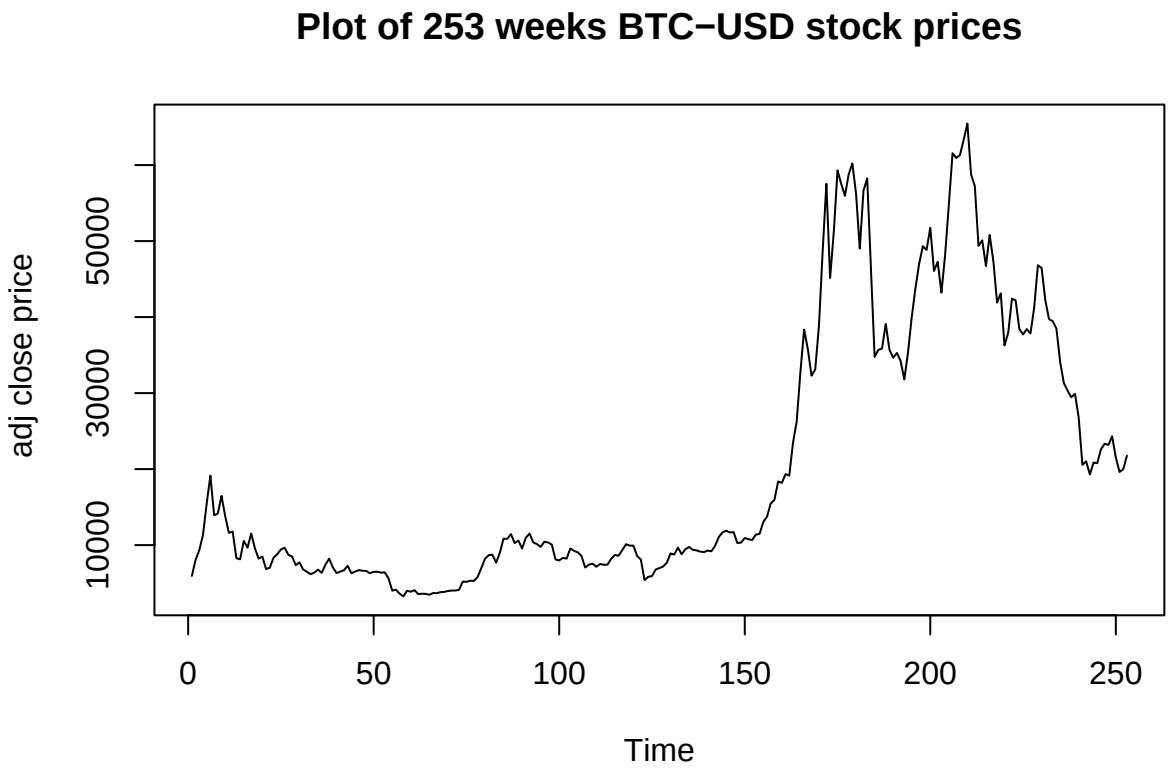
Data Preparation

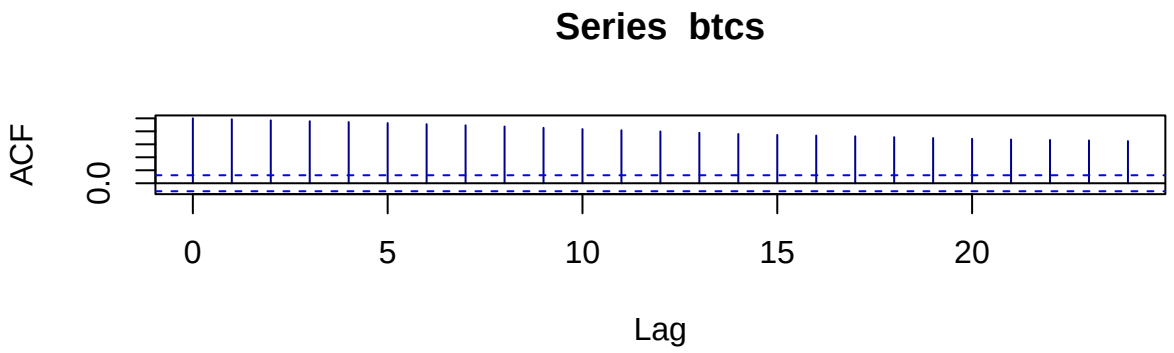
Diagnosis of Data

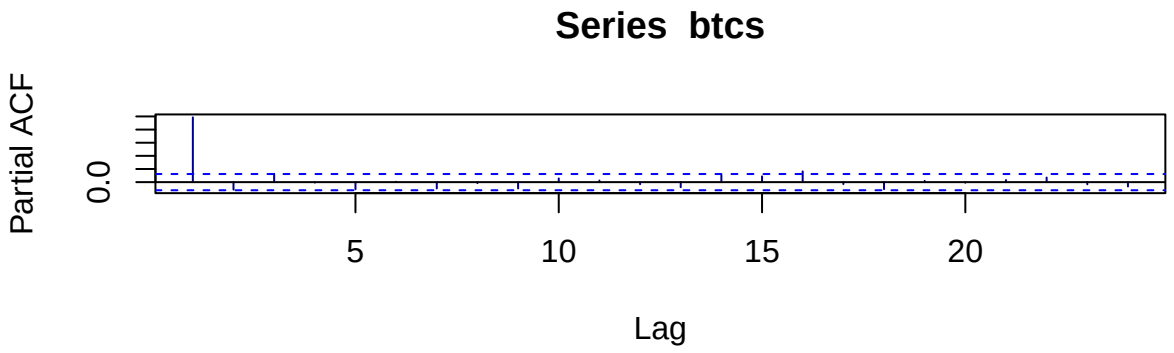
```
library(tseries)

#Check stationarity
plot.ts(btcs,ylab = " adj close price", main="Plot of 253 weeks BTC-USD stock prices")
```




```
par(mfrow=c(2, 1))
acf(btcs, col = "darkblue")
pacf(btcs, col = "darkblue")
```

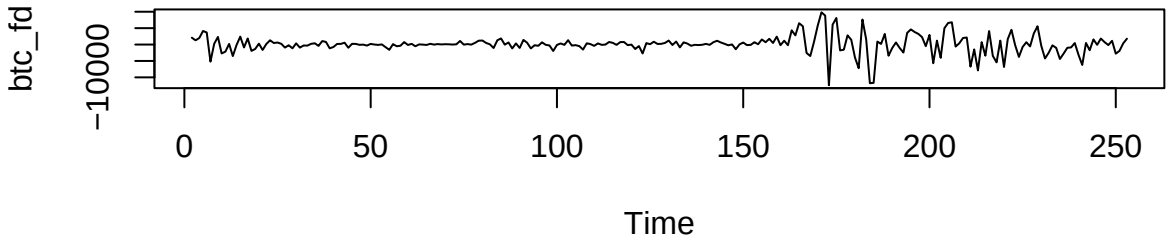


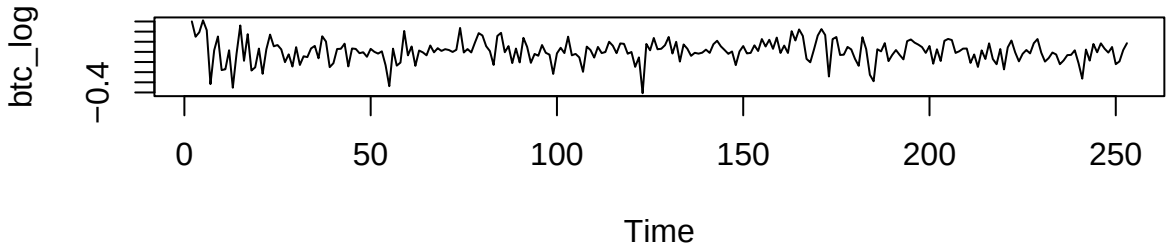



```
adf.test(btcs)
```

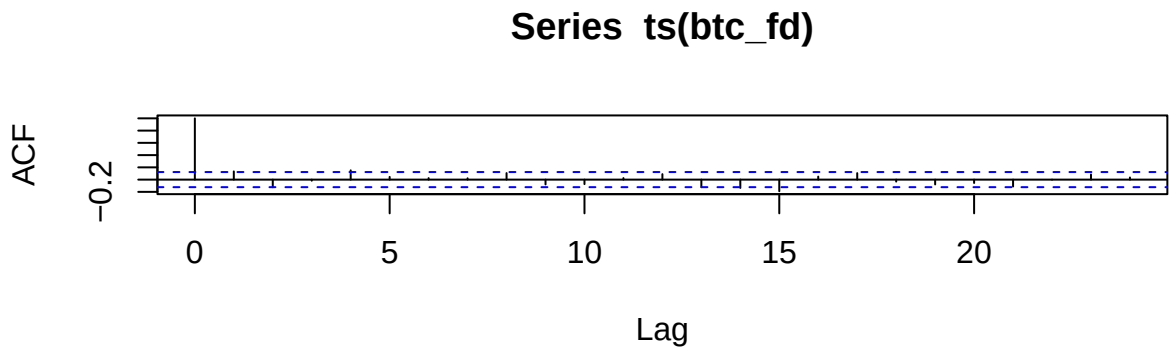
```
##
##  Augmented Dickey-Fuller Test
##
## data:  btcs
## Dickey-Fuller = -2.1919, Lag order = 6, p-value = 0.495
## alternative hypothesis: stationary
```

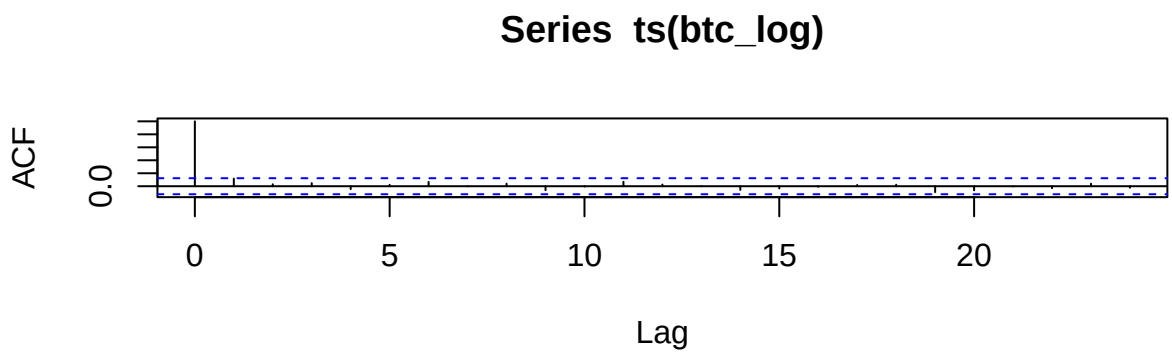
```
#take the first difference and log return
btc_fd <-diff(btcs, lag = 1, differences = 1)
btc_log <- diff(log(btcs), lag=1)
par(mfrow=c(2, 1))
plot.ts(btc_fd)
plot.ts(btc_log)
```






```
acf(ts(btc_fd))
acf(ts(btc_log))
```






```
adf.test(btc_fd)
```

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

```
##
##  Augmented Dickey-Fuller Test
##
## data:  btc_fd
## Dickey-Fuller = -5.0489, Lag order = 6, p-value = 0.01
## alternative hypothesis: stationary
```

```
adf.test(btc_log)
```

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

```
##
##  Augmented Dickey-Fuller Test
##
## data:  btc_log
## Dickey-Fuller = -5.5019, Lag order = 6, p-value = 0.01
## alternative hypothesis: stationary
```

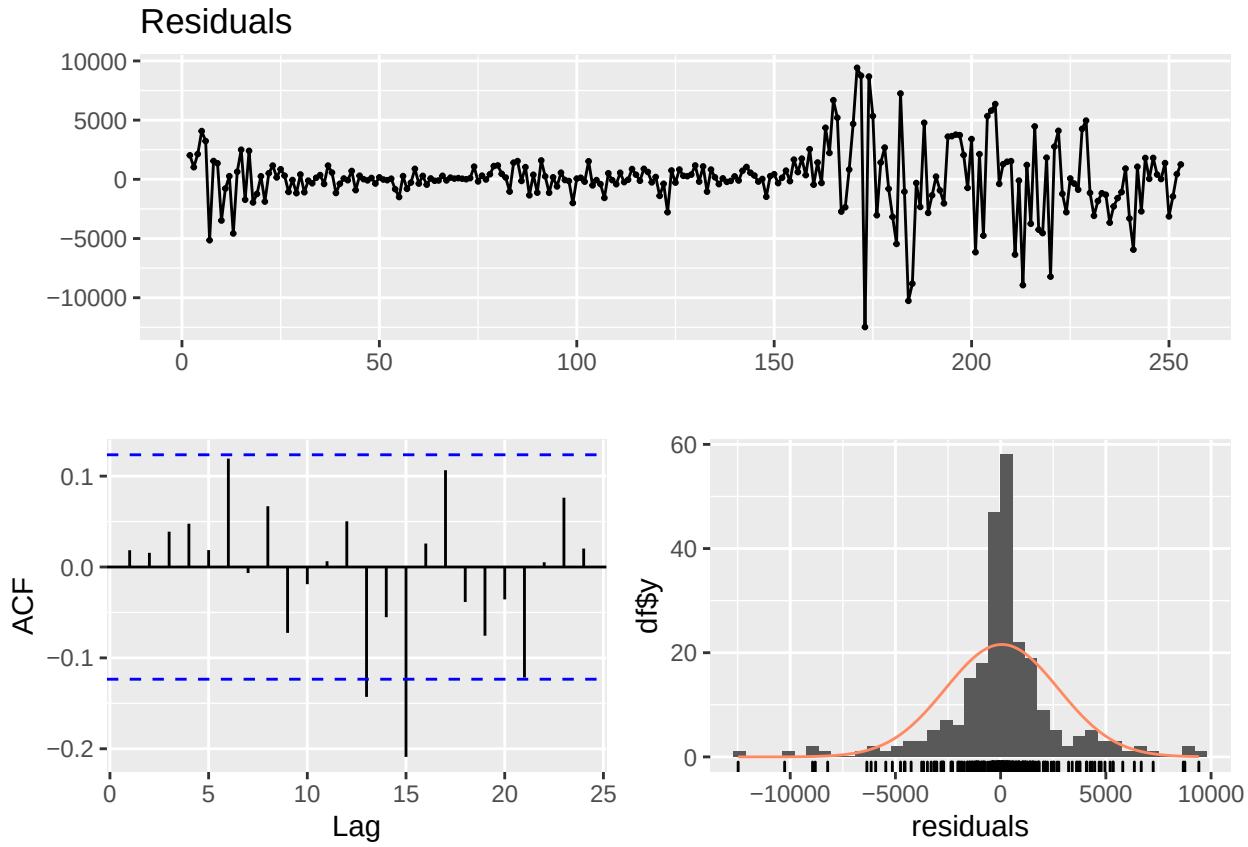
fit the model & forecasting with models:

```
#arma
library(forecast)
fd_full<-diff(btcs0)
log_full <-diff(log(btcs0), lag=1)

auto_arima <- auto.arima(btc_fd)

#check residuals
checkresiduals(auto_arima$residuals)
```

```
## Warning in modeldf.default(object): Could not find appropriate degrees of
## freedom for this model.
```



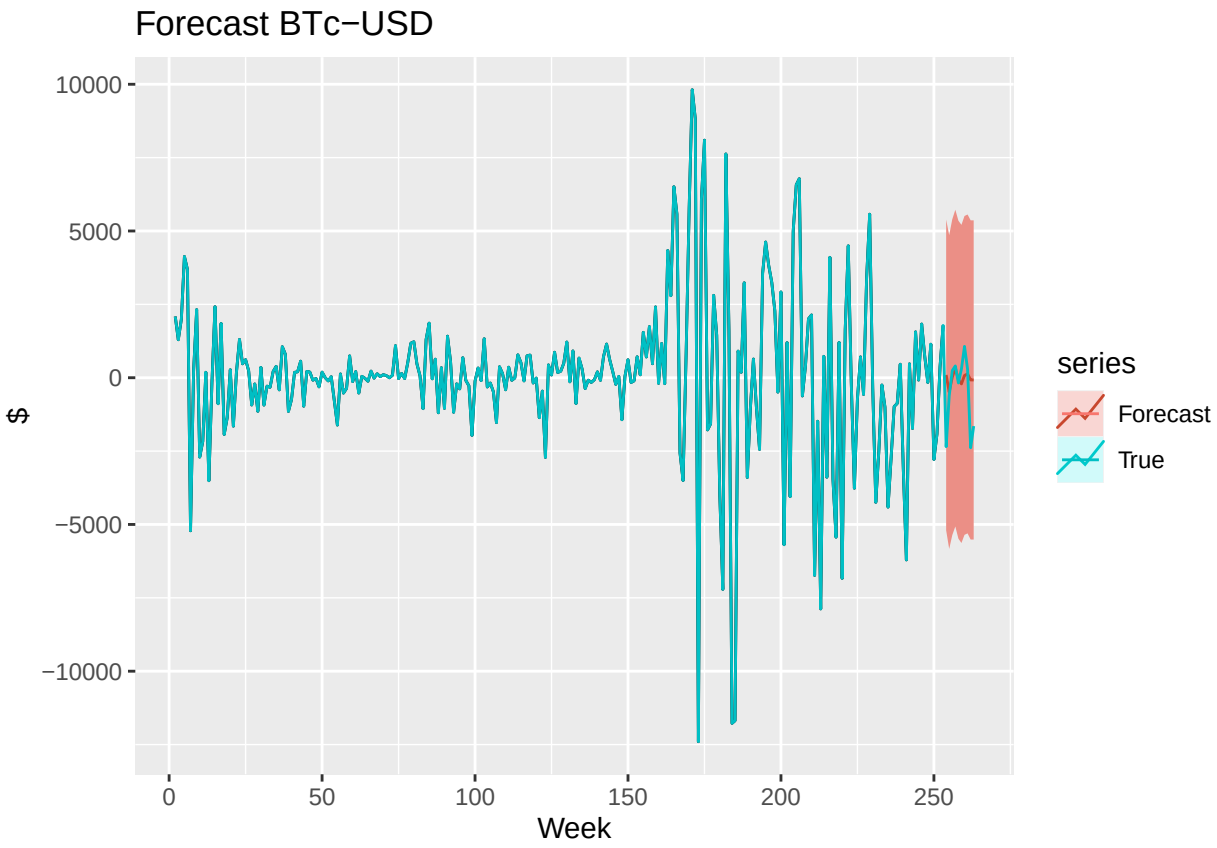

```
Box.test(auto_arima$residuals)
```

```
##
##  Box-Pierce test
##
## data:  auto_arima$residuals
## X-squared = 0.08598, df = 1, p-value = 0.7694
```

```
shapiro.test(auto_arima$residuals)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  auto_arima$residuals
## W = 0.8883, p-value = 1.119e-12
```

```
#forecast
fc <- forecast(auto_arima, level = .95, h=10)
autoplot(btc_fd,main = 'Forecast BTc-USD',xlab = 'Week',ylab = '$')+
  autolayer(fc, "Forecast")+
  autolayer(fd_full,series = 'True')
```




```
summary(auto_arima)
```

```
## Series: btc_fd
## ARIMA(2,0,2) with zero mean
##
## Coefficients:
##           ar1      ar2     ma1     ma2
##       -0.1660  -0.6771  0.3057  0.5845
## s.e.   0.2014   0.1729  0.2313  0.1770
##
```

```
## sigma^2 = 7296519:  log likelihood = -2346.79
## AIC=4703.59   AICc=4703.83   BIC=4721.23
##
## Training set error measures:
##                     ME     RMSE      MAE      MPE     MAPE     MASE        ACF1
## Training set 60.34815 2679.683 1656.638 92.15284 140.4416 0.771937 0.01847131
```

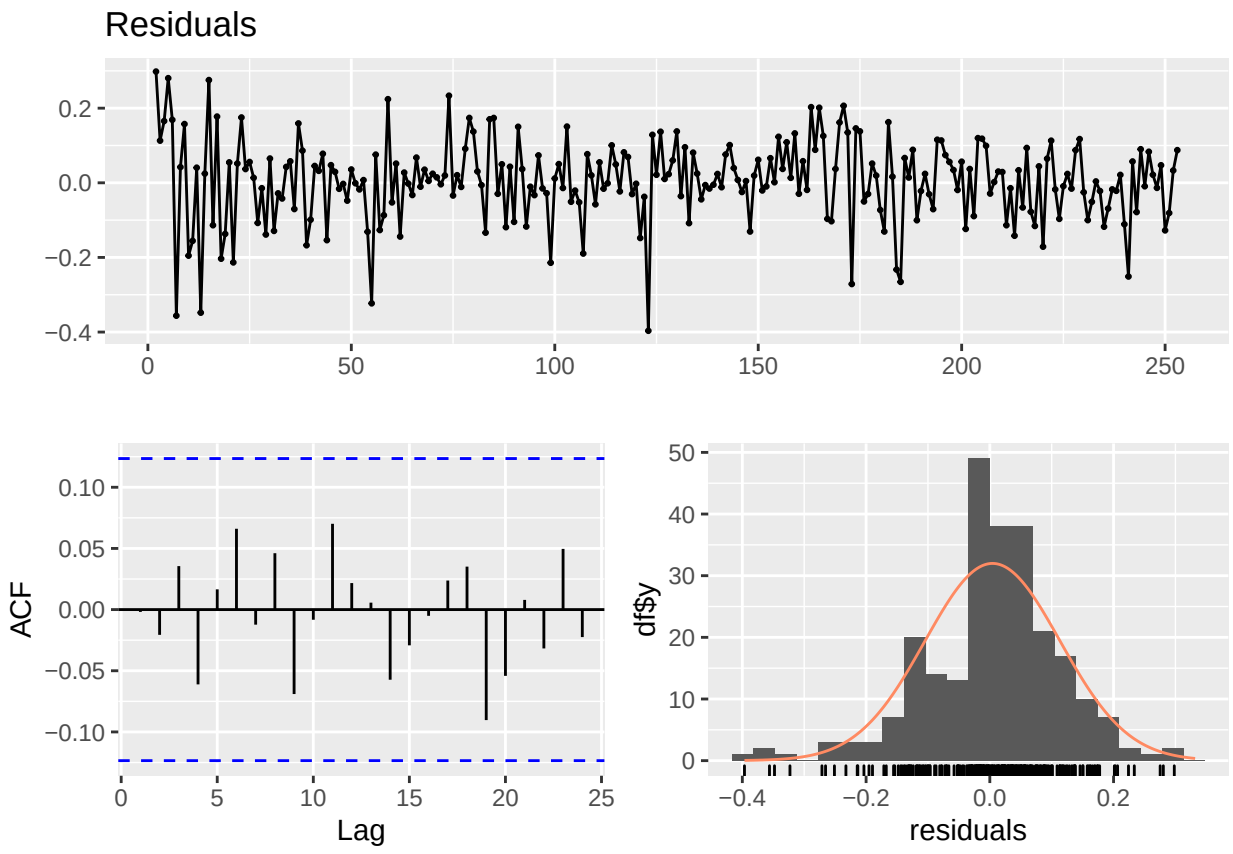
We have stationary of the residuals, however the normality assumption of residuals is not satisfied by Shapiro-Wilk test.

log diff

```
arma_fit_log <- auto.arima(btc_log)

#check residuals
checkresiduals(arma_fit_log$residuals)
```

```
## Warning in modeldf.default(object): Could not find appropriate degrees of
## freedom for this model.
```




```
Box.test(arma_fit_log$residuals)
```

```
##
##  Box-Pierce test
##
## data:  arma_fit_log$residuals
## X-squared = 0.00089854, df = 1, p-value = 0.9761
```

```
shapiro.test(arma_fit_log$residuals)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  arma_fit_log$residuals
## W = 0.97426, p-value = 0.0001578
```

```
fc_log <- forecast(arma_fit_log, level = .95, h=10)
autoplot(btc_log,main = '.',xlab = 'week',ylab = 'BTC-USD')+
  autolayer(fc_log, "pred")+
  autolayer(log_full,series = 'FULL')
```


```
summary(arma_fit_log)
```

```
## Series: btc_log
## ARIMA(1,0,1) with zero mean
##
```

```
## Coefficients:
##          ar1      ma1
##       0.4103  -0.2944
## s.e.  0.5360   0.5614
##
## sigma^2 = 0.01199:  log likelihood = 200.85
## AIC=-395.7   AICc=-395.61   BIC=-385.11
##
## Training set error measures:
##                       ME      RMSE        MAE      MPE    MAPE      MASE
## Training set 0.004336191 0.1090441 0.08134861 115.4371 119.714 0.7392506
##                      ACF1
## Training set -0.001888284
```

Garch

```
library(rugarch)
```

```
## Loading required package: parallel
```

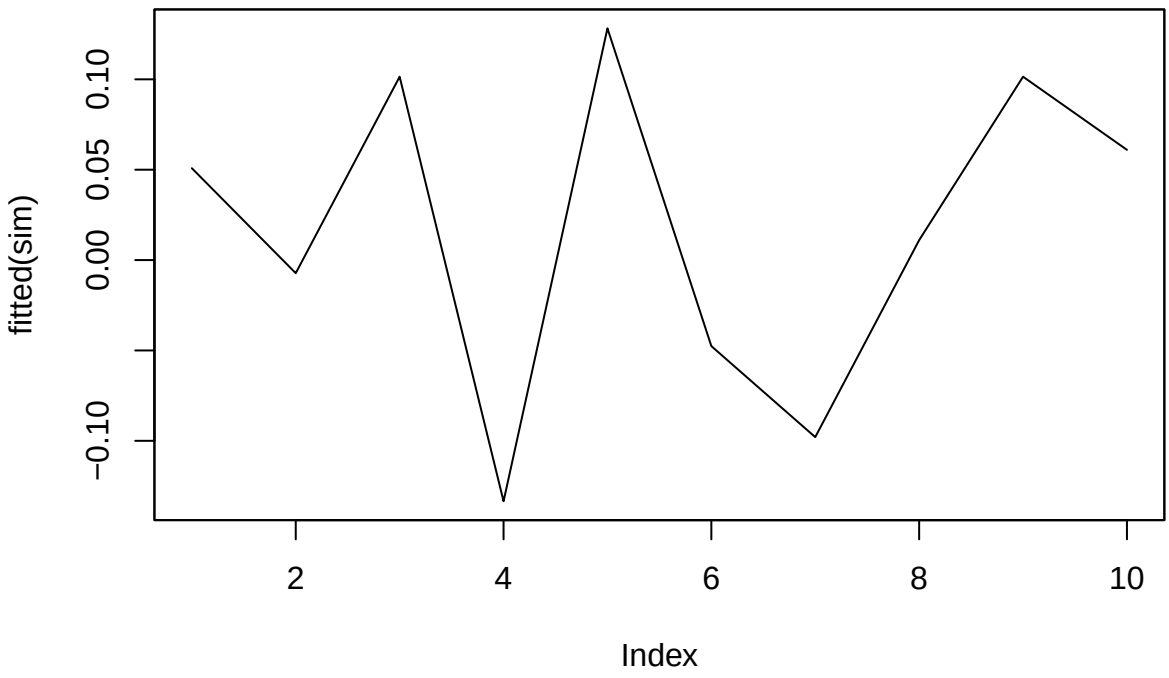
```
##
## Attaching package: 'rugarch'
```

```
## The following object is masked from 'package:stats':
##
##     sigma
```

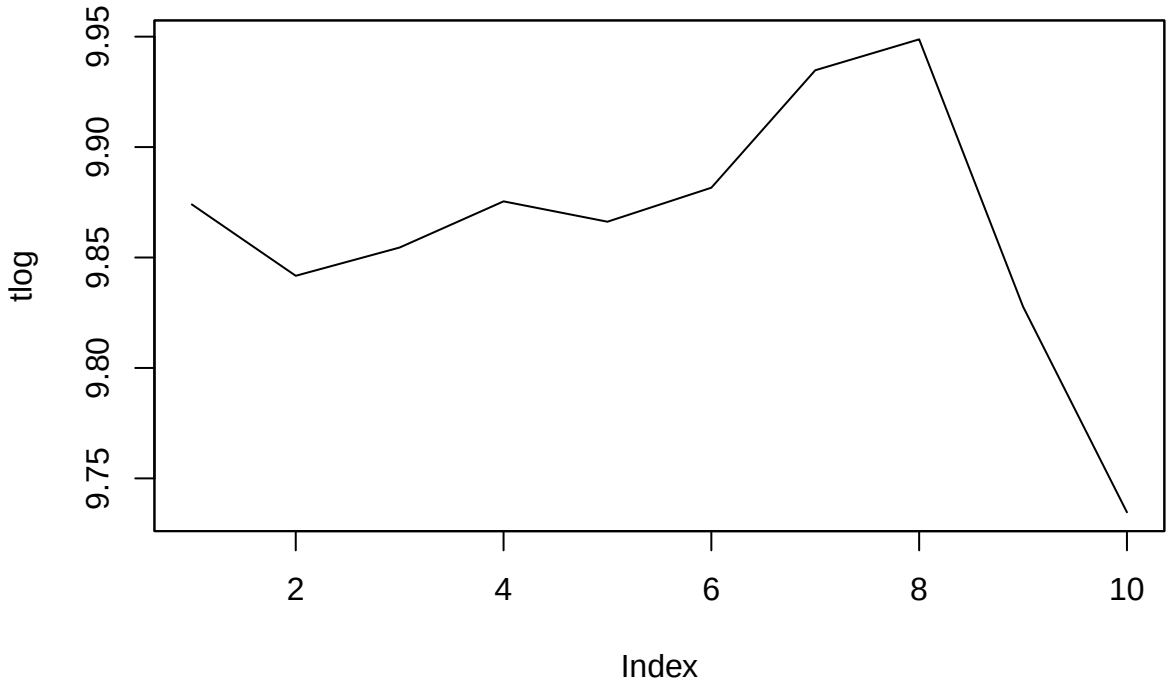
```
garch_spec <- ugarchspec(variance.model=list(model="sGARCH", garchOrder=c(1,1)), mean.model=list(armaOr
gm <- ugarchfit(spec = garch_spec, data = btc_log)
#fit_garch

f <- ugarchforecast(fitORspec = gm, n.ahead = 10)


setfixed(garch_spec) <- as.list(coef(gm))
sim <- ugarchpath(spec = garch_spec,
                  m.sim = 1,
                  n.sim = 1*10,
                  rseed = 16)
plot.zoo(fitted(sim))
```




```
plot.zoo(tlog)
```


tlog
9.75
9.80
9.85
9.90
9.95
2
4
6
8
10
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