

Exercise 2 - AR, ARMA, ARIMA Financial Time Series Modelling (in R)

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Auto-Regressive - Lags of the variable itself

Integrated - Differencing steps required to make stationary

Moving Average - Lags of previous information shocks

ARIMA(p,d,q)

AR Model - If only AR terms are there, i.e. $ARIMA(1,0,0) = AR(1)$

MA Model - If only error terms are there, i.e. $ARIMA(0,0,1) = MA(1)$

ARMA - If both are there, i.e. $ARIMA(1,0,1) = ARMA(1,1)$

ARIMA - If differencing term is also included, i.e. $ARIMA(1,1,1) = ARMA(1,1)$ with first differencing

ARIMAX - If some exogenous variables are also included.

AR Modelling of Financial Times Series (Bitcoin ~16 days)

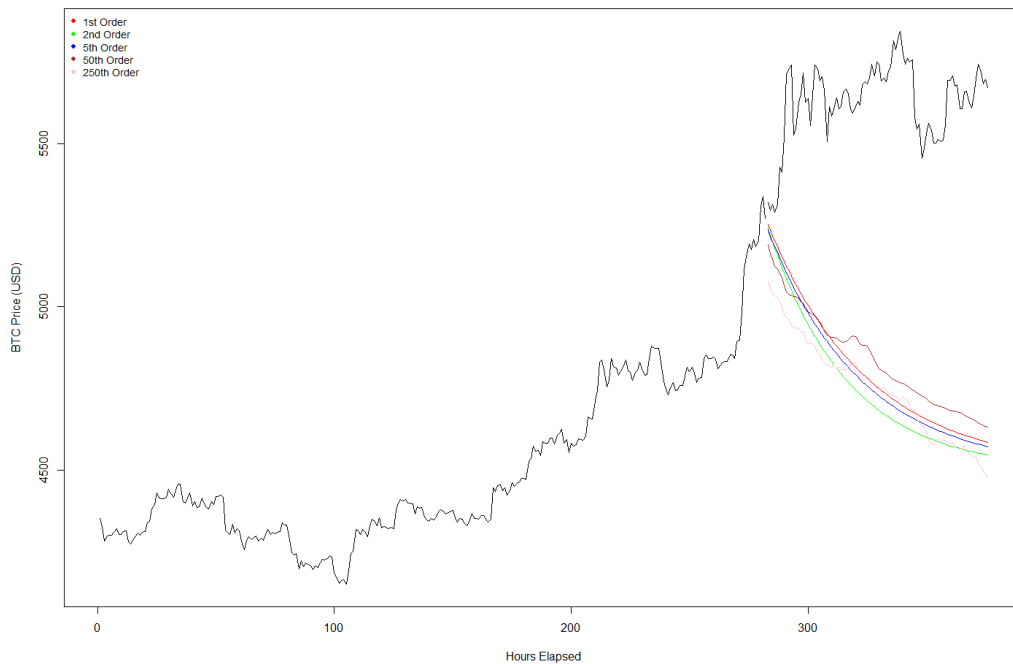


Figure 1.1 - Bitcoin price last 400h (16days) with AR Yule Prediction

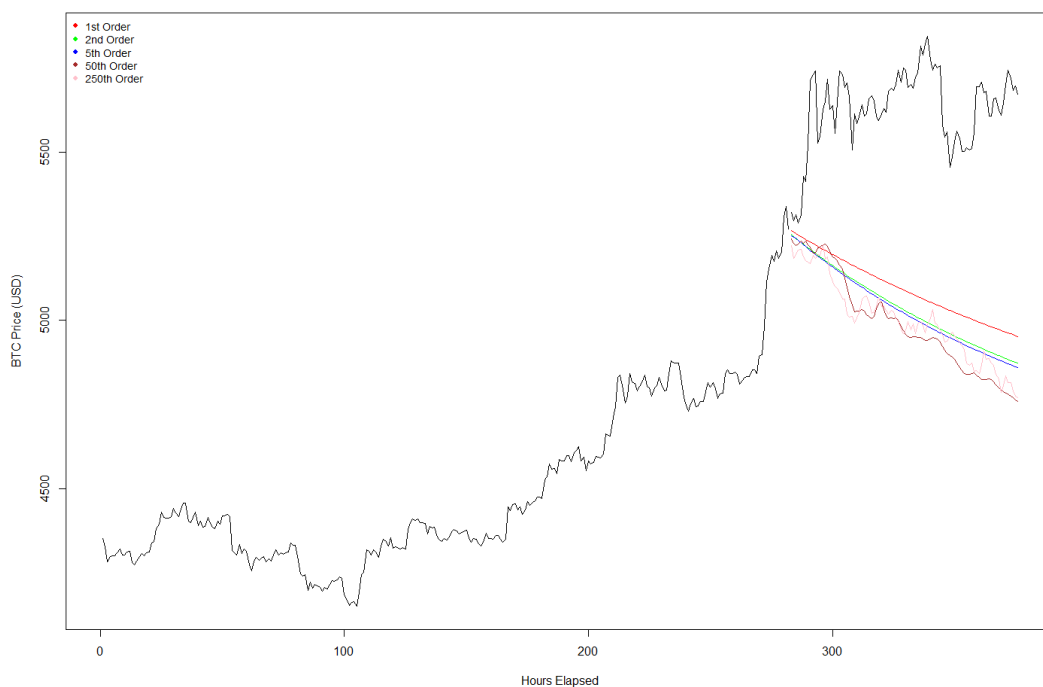


Figure 1.2 - Bitcoin price last 400h (16days) with AR Burger Prediction

ARMA Modelling of Financial Times Series (Bitcoin ~16 days)



A common approach in statistics to quantify the goodness of fit test is the AIC (for Akaike Information Criteria) statistic.

ARIMA Modelling of Financial Time Series (Bitcoin ~16 days)

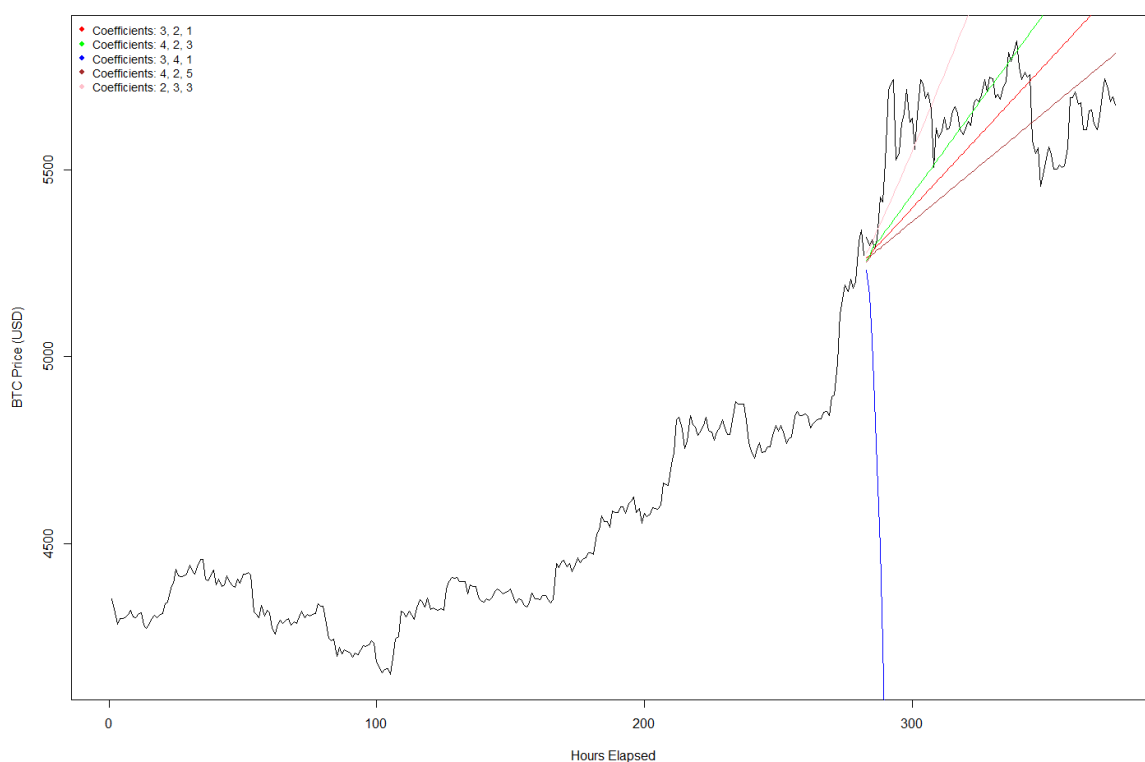


Figure 3.1 - Bitcoin price last 400h (16days) with ARIMA Prediction

Fitting an ARIMA model requires the series to be stationary. A series is said to be stationary when its mean, variance, and autocovariance are time invariant

R Script used:

```
data <- read.csv("R/BTC400h.csv")

data_train <- data[1:282,2]
data_test <- data[283:376,2]

btc_ar <- arima(data_train, order = c(3, 1, 1), method = "CSS")
btc_pred <- predict(object = btc_ar, n.ahead = 94)

x1 <- seq(283,376,1)
plot(data_train, ylim=range(data[,2]), xlim=range(1,376), xlab="Hours Elapsed", ylab="BTC Price (USD)", type = "l", col = "black")
lines(x = x1, data_test, ylim=range(data[,2]), xlim=range(1,376), axes = FALSE, xlab = "", ylab = "", type = "l", col = "black")
lines(x = x1, btc_pred$pred, ylim=range(data[,2]), xlim=range(1,376), axes = FALSE, xlab = "", ylab = "", type = "l", col = "red")

btc_ar <- arima(data_train, order = c(4,1,3), method = "CSS")
btc_pred <- predict(object = btc_ar, n.ahead = 94)
lines(x = x1, btc_pred$pred, ylim=range(data[,2]), xlim=range(1,376), axes = FALSE, xlab = "", ylab = "", type = "l", col = "green")

btc_ar <- arima(data_train, order = c(1,1,3), method = "CSS")
btc_pred <- predict(object = btc_ar, n.ahead = 94)
lines(x = x1, btc_pred$pred, ylim=range(data[,2]), xlim=range(1,376), axes = FALSE, xlab = "", ylab = "", type = "l", col = "blue")

btc_ar <- arima(data_train, order = c(4,1,5), method = "CSS")
btc_pred <- predict(object = btc_ar, n.ahead = 94)
lines(x = x1, btc_pred$pred, ylim=range(data[,2]), xlim=range(1,376), axes = FALSE, xlab = "", ylab = "", type = "l", col = "brown")

btc_ar <- arima(data_train, order = c(2,1,3), method = "CSS")
btc_pred <- predict(object = btc_ar, n.ahead = 94)
lines(x = x1, btc_pred$pred, ylim=range(data[,2]), xlim=range(1,376), axes = FALSE, xlab = "", ylab = "", type = "l", col = "pink")

legend("topleft", legend=c("Coefficients: 3, 1, 1", "Coefficients: 4, 1, 3", "Coefficients: 1, 1, 3", "Coefficients: 4, 1, 5", "Coefficients: 2, 3, 3"), col=c("red", "green", "blue", "brown", "pink"), bty = "n", cex = 0.9, pch = 16, text.col = "black")
```

