Group 5 ASSG2

2025-03-23

Importing Ford Motor Company stock statistics

```
#This code does it.
getSymbols('F', src = 'yahoo', from = as.Date('2022-01-01'), to =
             as.Date('2025-03-20'))
```

```
## [1] "F"
```

Some Ford's stock closing prices

```
##            F.Close
## 2022-01-03   21.77
## 2022-01-04   24.31
## 2022-01-05   23.66
## 2022-01-06   24.46
## 2022-01-07   24.44
## 2022-01-10   23.85
```

Time series plot of Ford's Closing prices

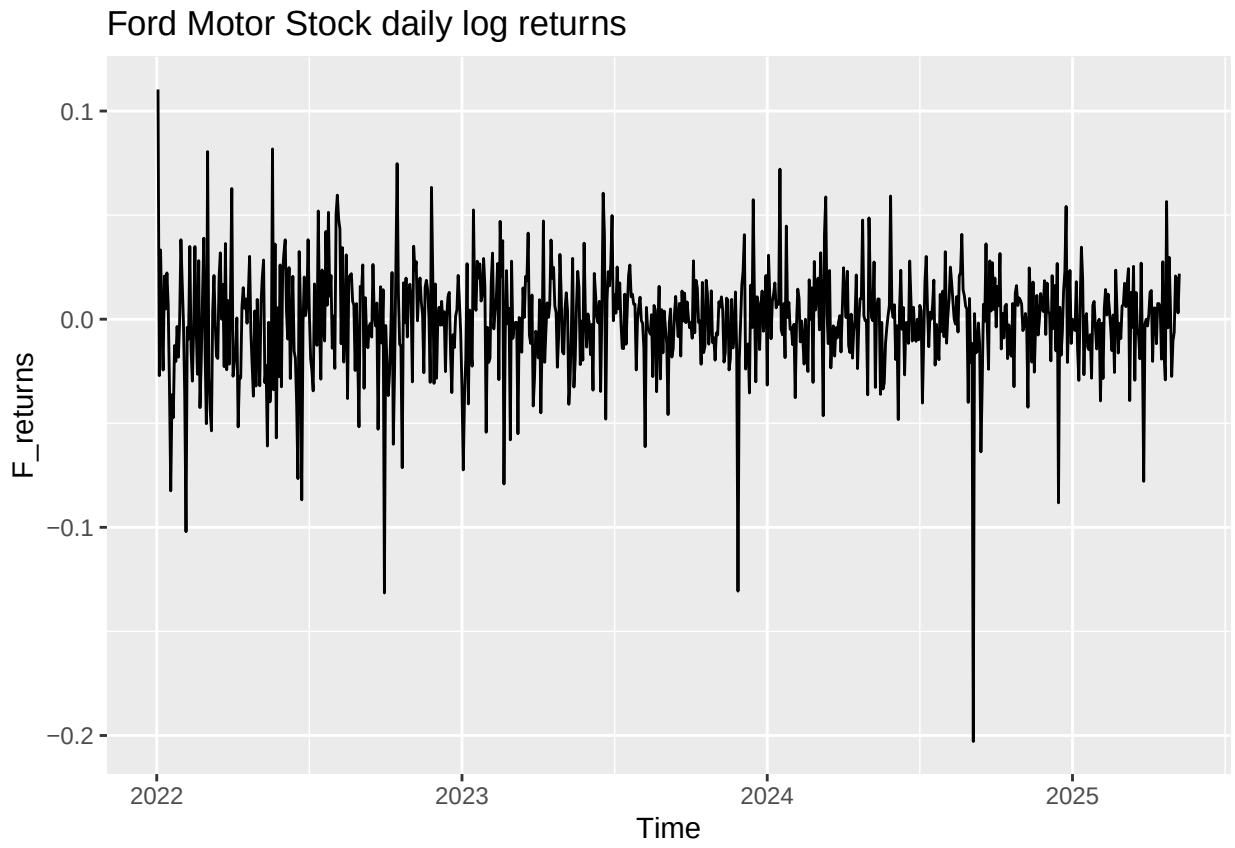

```
#This computes the daily log returns
F_returns <- diff(log(F_closing_ts))
```

Some daily log returns

```
## Time Series:
## Start = c(2025, 80)
## End = c(2025, 85)
## Frequency = 240
##            F.Close
## [1,] -0.010373478
## [2,] -0.006276215
## [3,]  0.020769160
## [4,]  0.019339080
## [5,]  0.003019603
## [6,]  0.021869686
```

PART 1: EXPLORATORY DATA ANALYSIS

Log-returns ts plot



Summary statistics of the returns

```
##    vars   n mean   sd median trimmed  mad  min  max range skew kurtosis se
## X1    1 804    0 0.03      0       0 0.02 -0.2 0.11  0.31   -1     7.03  0
```

Ford Company's stock returns have a mean of zero and a variance of 1. This can imply stationarity since these statistics do not change over time, but further tests are needed to truly confirm this.

-Skewness measures asymmetry. This tells us whether there are extreme values on the left or on the right.

The negative skewness of -1 suggests the returns have a slightly longer left tail. Large losses are therefore more likely to occur.

-Kurtosis measures the tailedness of a distribution. This shows how often extreme values occur as compared to a normal distribution (Where kurtosis = 3).

Results show that returns have a high kurtosis (returns are leptokurtic). Losses (or gains) occur more frequently than normal. This implies higher risk involved with this stock.

ADF Stationarity test

-Null hypothesis: The Series is non-stationary

Fail to reject if P > [level of significance]

-Alternative hypothesis: The Series is stationary

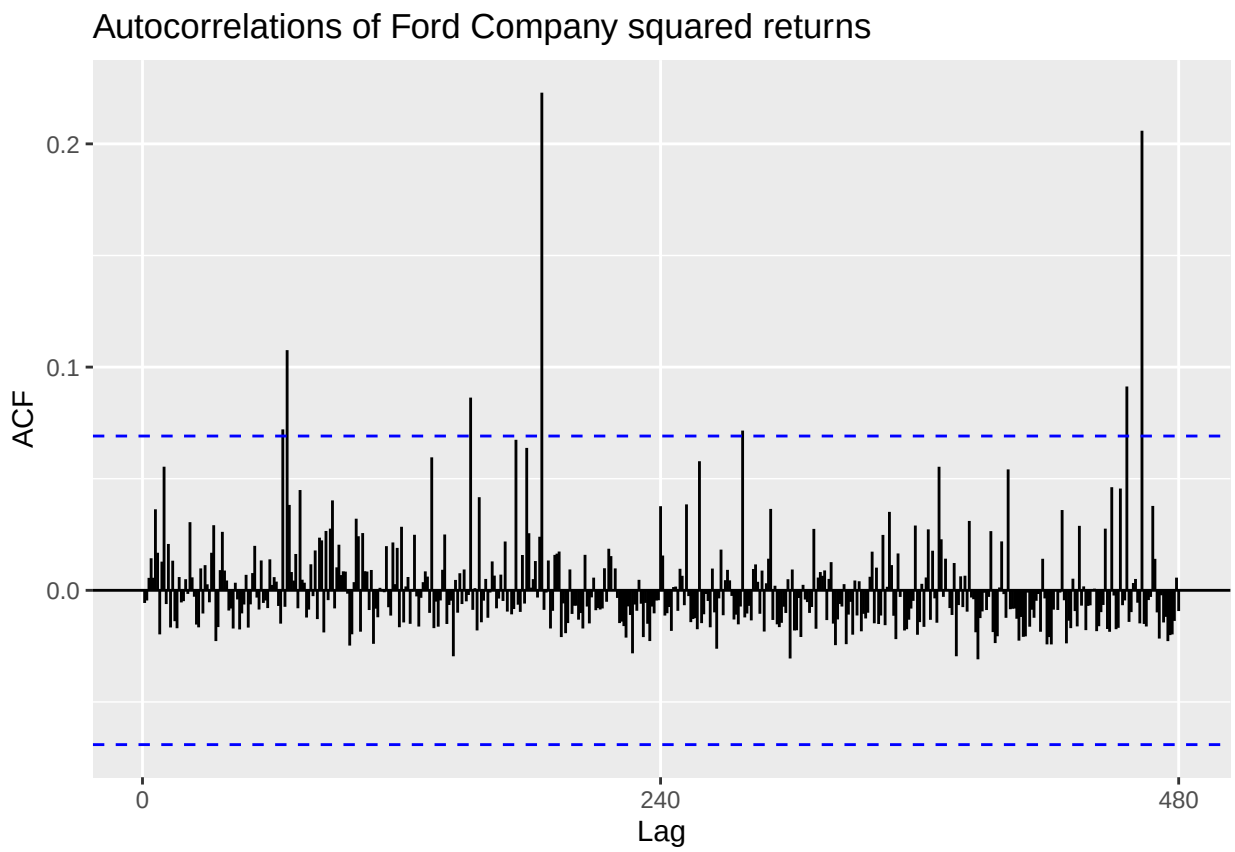
Reject Null in favour of the alternative if P < [level of significance]

-The results are as shown:

```
##
##  Augmented Dickey-Fuller Test
##
## data:  F_returns
## Dickey-Fuller = -8.8182, Lag order = 9, p-value = 0.01
## alternative hypothesis: stationary
```

-Assuming the default significance level of 5% (0.05), The p-value shown is less than this. We therefore reject the null hypothesis in favour of the alternative one and conclude that Ford's returns are indeed stationary.

Checking for ARCH effects on squared returns



-Only 7 out of 480 lags exceed the confidence interval(~1.458%). At 5% significance, 24 lags (480 * 5%) or more exceeding the confidence level would be regarded as statistically significant. We can therefore safely ignore the lags appearing above the ci as there are statistically insignificant

-The above plot therefore shows no significant autocorrelations seen from the squared returns; and therefore no volatility clustering. This means that volatility (squared returns) is homoscedastic (not heteroscedastic)... the variance, or volatility, is therefore constant.

-ARCH effects can further be tested in depth using the Lagrange Multiplier (LM) test.

ARCH-LM test

-Null hypothesis: No ARCH effects (homoscedasticity)

-Alternative hypothesis: There is ARCH effects (heteroscedasticity)

Reject Null hypothesis if P < [level of significance]

```
##
##  ARCH LM-test; Null hypothesis: no ARCH effects
##
## data:  F_returns
## Chi-squared = 3.7086, df = 12, p-value = 0.9881
```

-The p-value (0.9881) is significantly more than 0.05. We therefore fail to reject the Null hypothesis and conclude that Ford Company's stock returns are homoscedastic; they exhibit no ARCH effects.

PART 2 ARCH

Estimating ARCH(p)