0.1 Data Analysis

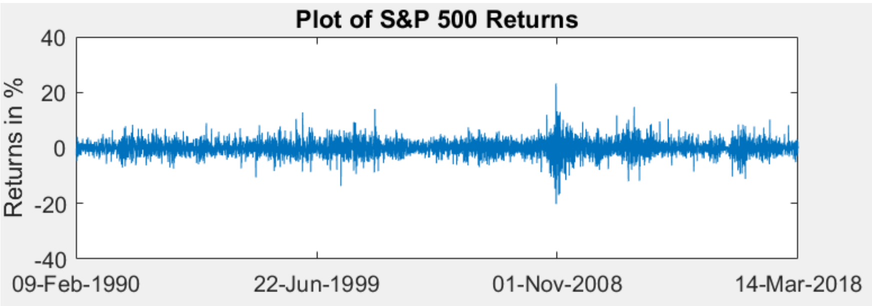
Problem 1

The aim of this part of the section is to analyse some financial time series returns.

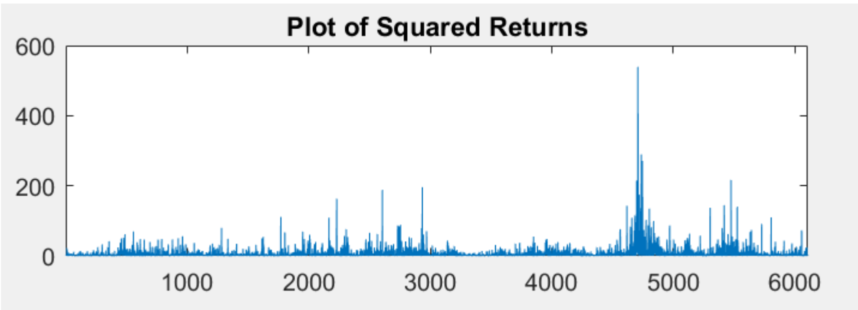
1. Download a daily series of quotes from http://finance.yahoo.com/.

Range January 3, 1990 till March 15, 2018. If data is not available from January 3, 1990 use the oldest date available.

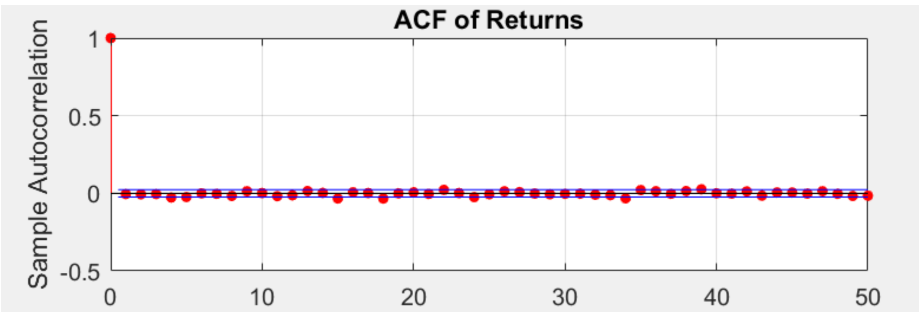
The oldest date available for the "COG" daily series of return is 9th February 1990.

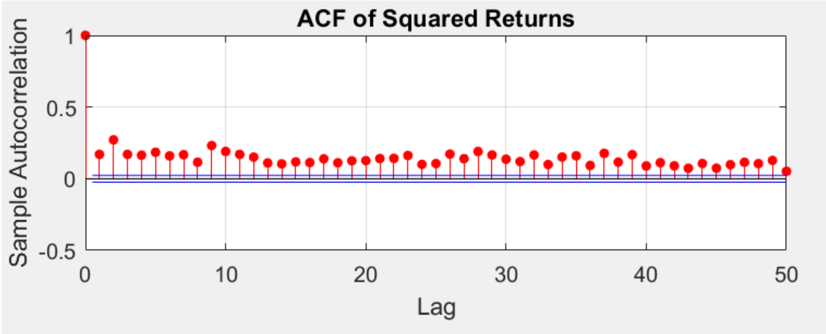


From the plot of the time series we can see that the volatility changes over time, with a peak around 2008, which increases its general range from that moment on.

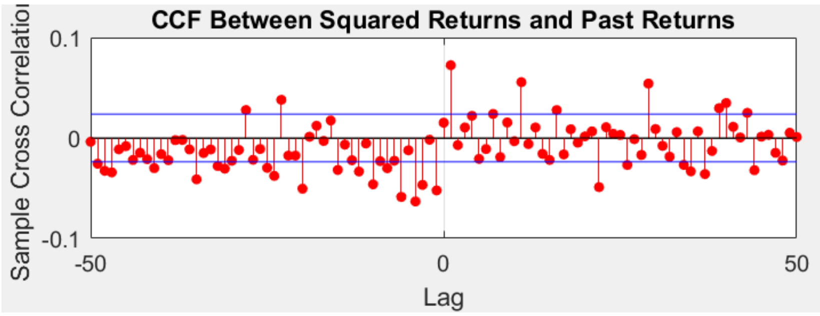


The squared returns plot shows the peak around 2008 more clearly; moreover there are higher values in the last part, supporting what the previous plot was suggesting.





By comparing the ACF of the returns and squared returns we can see that the squared returns are more autocorrelated, even after the first lag, which does not happen with the returns.



The CCF plot displays the cross-correlation between returns and squared returns by multiplying and summing the two-time series together. There are many points outside the upper and lower boundaries at the significance level of 0.05 and the general trend is sinusoidal, with the highest peak appears to be at lag 1 as happens in the ACF and PACF plots.

2. Analyse the series in terms of sample properties and comment the results.

	COG
Mean	0.043052223275219
Standard Deviation	2.495895656251885
Skewness	0.005442721687003
Kurtosis	7.924094158055529

From the statistics of the time series we can learn that there is slightly positive skewness in the data and a significant value for the Kurtosis since it is greater than the threshold value of 3 for the Gaussian distribution.

```
>> archtest(retsp)

ans =

  logical

   1
```

After applying the ARCH test to both the residuals we obtain a p-value equal to 0, which let us reject the Null Hypothesis of no conditional residuals heteroskedasticity, therefore we can conclude that there are significative ARCH() effects in the time series.

0.2 Univariate GARCH models

Problem 2

The aim of this part of the section is to fit a GARCH-type model to a financial time series returns.

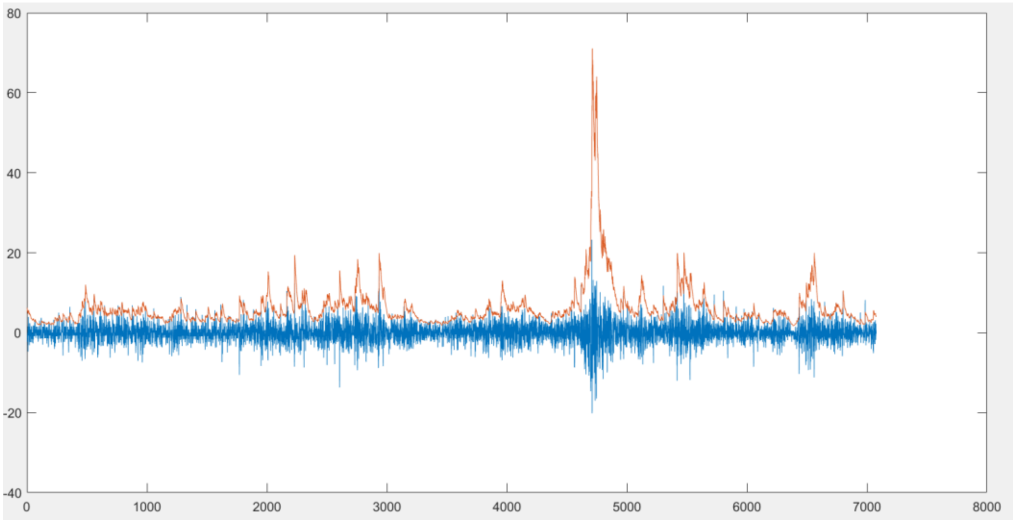
1. Fit a GARCH(1,1) model with errors that follow a Gaussian distribution to the daily returns and comment on the implied volatility persistence obtained with this model.

```
GARCH(1,1) Conditional Variance Model:
----------------------------------------
Conditional Probability Distribution: Gaussian

                                  Standard          t
 Parameter       Value              Error       Statistic
-----------    -----------      ------------   -----------
 Constant       0.0597149        0.00773481       7.72028
 GARCH{1}        0.944228        0.00374051       252.433
  ARCH{1}       0.0458332        0.00307778       14.8916
```

The goodness of fit measures of the model are the following:

AIC = 3.1709e+04

BIC = 3.1730e+04



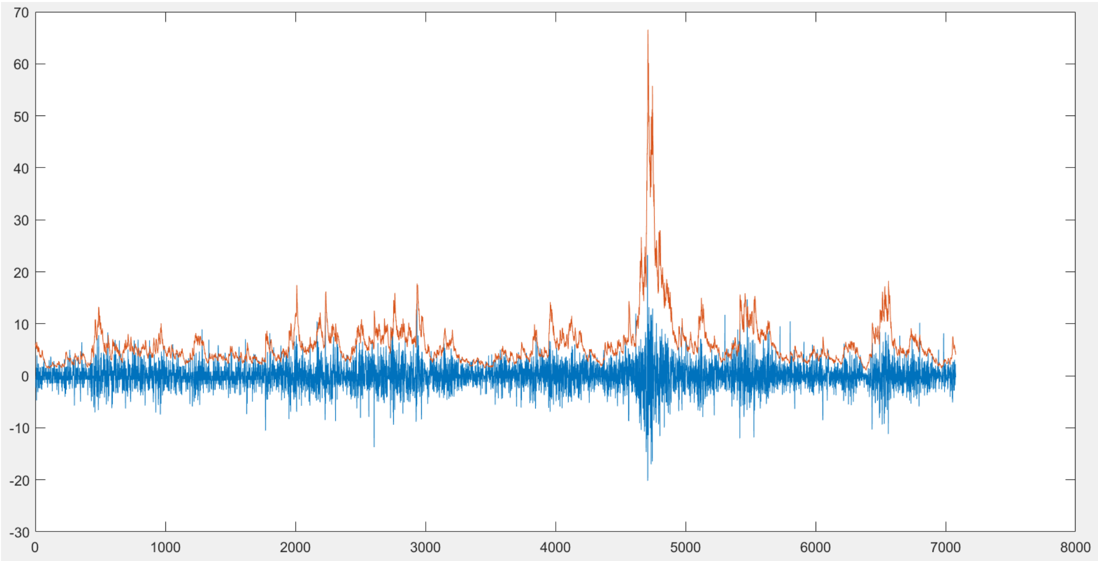
2. Is the model able to fit the characteristics of the data (mainly asymmetry)? Use a test to justify your answer.

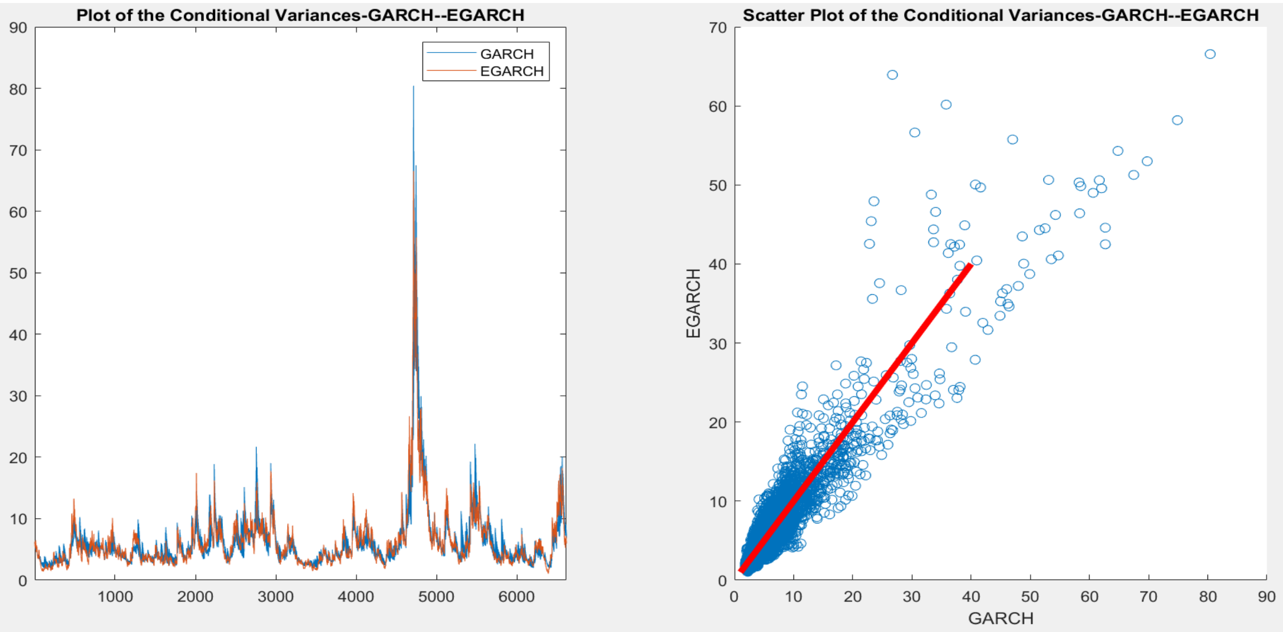
```
stats =

    0.0030    7.1090    0.0001    3.8887
```

After applying the Engle and NG test the obtained pvalue is equal to 0.003 allowing to reject the hypothesis of the chisquared test. Therefore the conclusion is that an asymmetric model is needed.

3. According to the previous answer, fit a GARCH-type model to your data and compare its estimation results to those obtained with the GARCH(1,1).

```
EGARCH(1,1) Conditional Variance Model:
--------------------------------------
Conditional Probability Distribution: Gaussian

                                 Standard          t
 Parameter        Value            Error        Statistic
-----------     -----------     ------------    -----------
 Constant        0.0240283      0.00244617        9.82283
 GARCH{1}         0.988129      0.00143333        689.392
  ARCH{1}         0.105313      0.00666777        15.7943
Leverage{1}     -0.0432779      0.00392476       -11.0269
```





The above plot shows that the performances of the GARCH (1,1) and the EGARCH(1,1) are pretty much the same; even if it will not be included in the report the same happens by using a GJR model or by trying to change the GARCH and ARCH parameters.

Actually the two model follows the time series quite well, even though they tend to overestimate volatility. In particular in the comparison plot it is clearly shown that the conditional variances of the two models are positively and high correlated between them, with only few points distance themselves from the red line.

By checking out the goodness of fit measure for the EGARCH(1,1) model

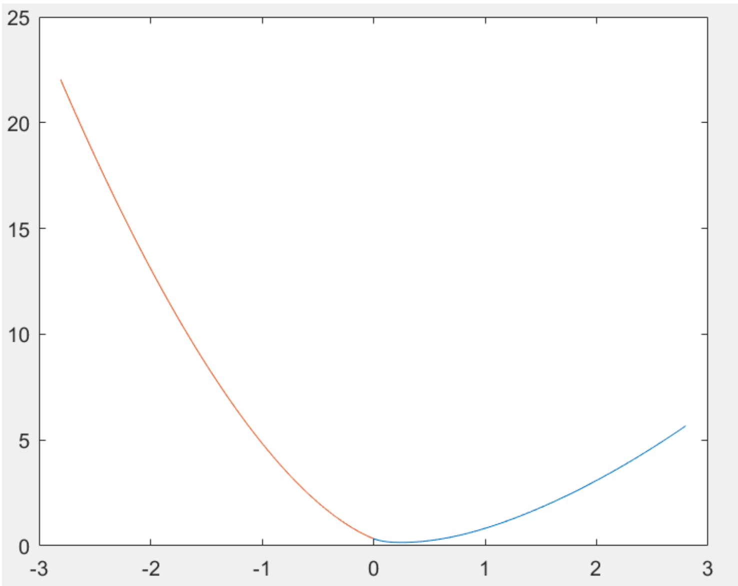
AIC = 3.1619e+04

BIC =3.1647e+04

We can consider this last as a slightly better model than the GARCH(1,1).

4. Plot the NIC of the chosen model and explain it.

Taken into account the previous point the chosen model to produce the NIC plot is the EGARCH(1,1). To that purpose the model has been estimated again with a different covariance matrix by taking into account negative and positive shocks.



The NIC plot for the EGARCH(1,1) model shows the asymmetry in the response for negative and positive shocks.