

FINANCIAL TIME SERIES: Assignment 2

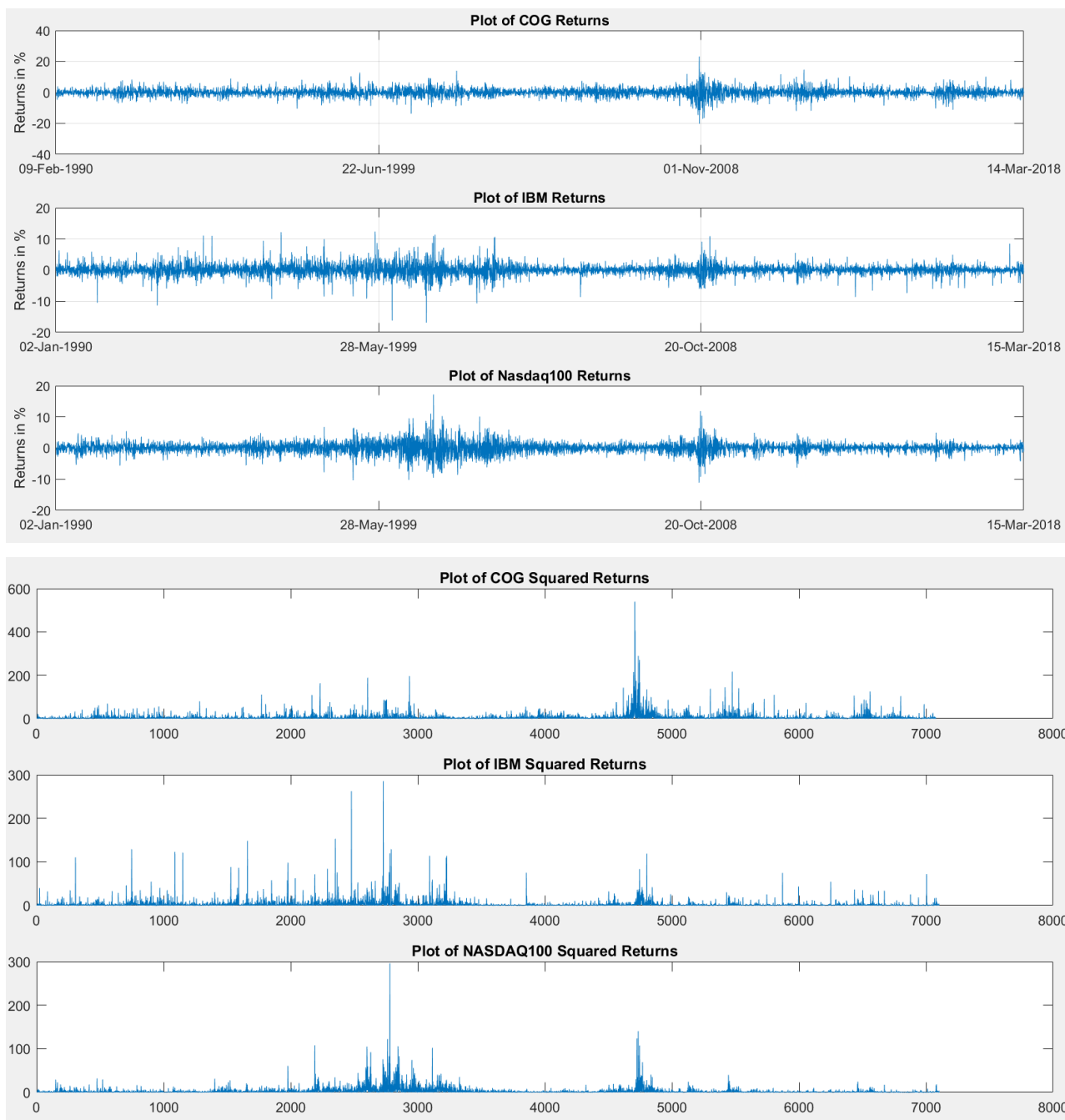
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0.1 Multivariate GARCH models

Problem 1

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

1. For this part, please use three financial time series of returns. Range January 3, 1990 till March 15, 2018.
2. Plot the three return series against time and comment on their evolution. Is there any evidence of clustered volatility? In which periods do you think the returns were more volatile?



From the plot of returns we can learn that the higher volatility around 2008, which was already founded in the previous assignment for COG returns, is true for the three times series; moreover the return of IBM and Nasdaq100 show a greater volatility since the beginning. By looking at the plot of squared returns the IBM

series has clearly a greater variance right from 1990 with a lot of peaks throughout the time, on the contrary the Nasdaq100 time series is subjected to a neat increase from 1999-2000 on.

Therefore we can suppose that a cluster volatility exist among the three times series and this is particularly true for IBM and NASDAQ since their trend is more similar.

3. Estimate a Normal DCC-GARCH model for the daily returns. Use the whole sample data. Obtain the estimated parameters, as well as the conditional covariance matrices.

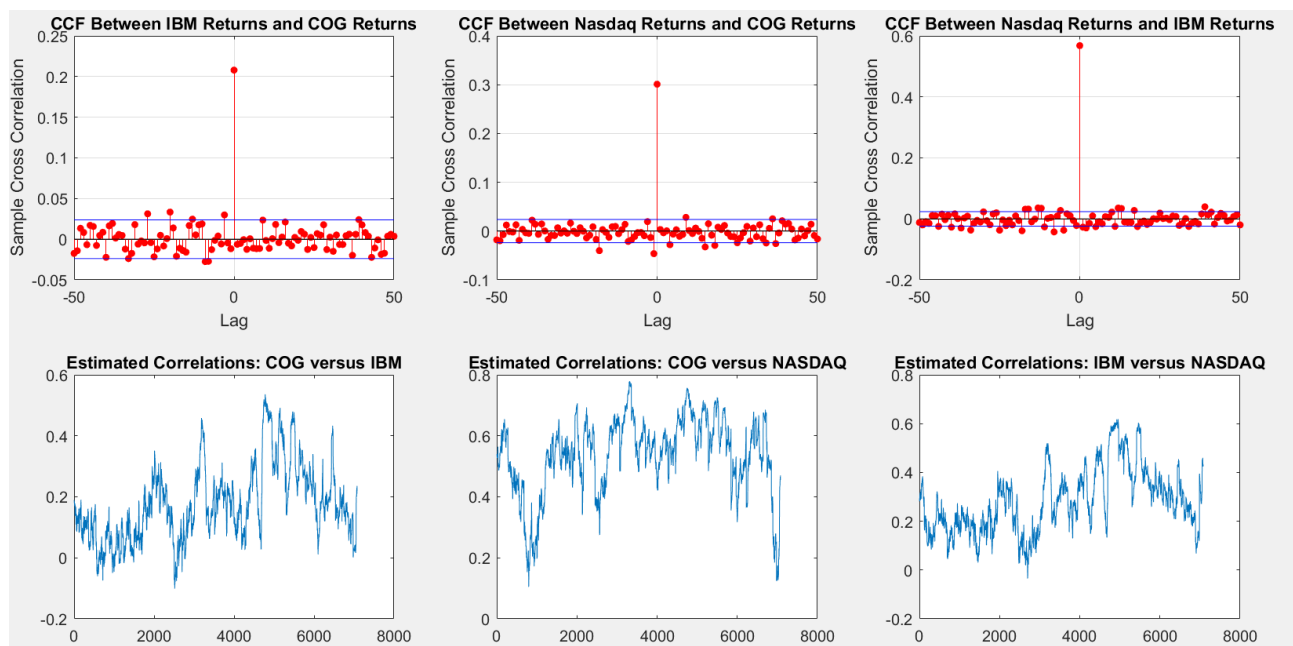
To achieve the DCC-GARCH model estimation the IBM and NASDAQ series needed to be adjusted temporally since the COG returns start 9th February 1990.

```
parameters1 =
    0.0440
    0.0623
    0.9242
    0.0597
    0.0458
    0.9442
    0.0186
    0.0757
    0.9174
    0.0123
    0.9830
```

4. Comment on the covariance matrix of the last return observations (sayT). According to the estimation results, which return series is more volatile at T? Is there any sign of negative cross-correlation among the three series?

```
Ht1(:, :, 7078) =
    2.1262    0.6728    0.8905
    0.6728    3.9076    1.0965
    0.8905    1.0965    1.6873
```

By looking at the diagonal of the covariance matrix of the last return observations we can see that the IBM return series is more volatile at T (3.9076) and it is jointly more volatile with the NASDAQ returns rather than with the COG time series since the (2,3) value in the matrix is the highest among the out of diagonal values.



The first three plots regarding cross correlation between the return series clearly shows that a negative cross correlation exists among them since there are lines outside the significative boundaries; therefore by calculating the correlations based on the H_t matrices of the DCC GARCH model we should find negative values. This is true, according to the following three plots of estimated correlations, especially for the COG and IBM correlations.

5. Finally, re-estimate the Normal DCC-GARCH model but for the first 2000 observations of the daily returns. Find again the covariance matrix of the last observation. Comment on the differences between the covariance matrix found before with this new one.

```
parameters1 =  
  
    0.2833  
    0.0691  
    0.8469  
    0.0450  
    0.0303  
    0.9596  
    0.0534  
    0.0621  
    0.9089  
    0.0072  
    0.9885
```

Ht1 (:, :, 7078) =

2.1262	0.6728	0.8905
0.6728	3.9076	1.0965
0.8905	1.0965	1.6873

Ht1 (:, :, 2000) =

3.0320	0.9115	1.7168
0.9115	8.0754	1.1923
1.7168	1.1923	2.5136

The conditional covariance matrix of the last observation obtained with the first 2000 daily observations of the time series has higher values in every place. The diagonal referring to the series itself especially grows for the IBM returns, which immediately appeared more volatile right from the initial plot of the series; both the volatility of COG and NASDAQ increased as well, but not in the same extent.

Considering the out of diagonal elements, the joint volatility of COG and NASDAQ is the most increased, even though all the time series are now more volatile either considered on their own or in relation to the others.