

Homework 3: GARCH model and value at risk

Instruction: there are four questions. Each question is worth 1 point. You can discuss the homework with each other. However, you need to turn in your individual answer. See syllabus for the due date.

You need to read Engle paper (2001, Journal of Economic Perspectives) to finish this homework.

Q1: Descriptive statistics of return of Dow Jones Index

Please download the DJ data (Dow Jones Index from 03-23-1990 to 03-23-2000) from my webpage. Please compute the return (difference of log of DJ index), plot the return series, and compute the mean, standard deviation, skewness and kurtosis of the return series (you need to download and load the package `moments`). What do the values of skewness and kurtosis imply? Be specific!

Q2: Predictability of return and squared return

Continue Q1. Please use command `acf` to show the values of the autocorrelations of the return series, and apply the command `Box.test` to the return in order to obtain the Box–Pierce or Ljung–Box statistics (using one and two lags). What is the null hypothesis? What is your conclusion? Do the `acf` and `Box.test` again for the *squared* return. What is your new conclusion? Hint

?`acf`

?`Box.test`

Q3: GARCH(1,1) model

Please load the package `tseries`, and estimate the GARCH(1,1) model for the return. Please interpret each coefficient. Is the conditional variance h_t mean-reverting? Why? Please plot the autocorrelations of the *squared residual* of the GARCH(1,1) model. Is the GARCH(1,1) model adequate? Why? Hint

`?garch`

and read page 163 of Engle paper.

Q4: 1 percent value at risk

First please find the 1 percent quantile of the whole return series. Hint

```
o.r = r[order(r)]
```

```
o.r[round(0.01*length(r))]
```

Next compute the forecasted standard deviation for March 24, 2000 based on the GARCH(1,1) model. Please show how to use the forecasted standard deviation to obtain a new 1 percent quantile of the return. Do you need any assumption? Hint: read page 160 and page 164 of Engle paper.