FNCE 5321: Finanical Risk Modeling II
Spring 2017
Homework 2

Instructions: You can work in groups of up to 5 students. Please hand in only one copy per group and indicate clearly the members of your group on the first page of your submitted homework.

Important: Include the codes with your solution.

Problems

1. On Black Monday, the return on the S&P 500 index was -22.8%. Ouch! This excercise attempts to answer the question, "what was the conditional probability of a return this small or smaller on Black Monday?" "Conditional" means given the information available the previous trading day.

   (a) Download daily returns on the S&P 500 index from the R package **Ecdat** using the following command
   data(SP500, package='Ecdat')
   You need to install the package first if your computer does not have it installed before. The S&P 500 returns are in the dataset **SP500**. The returns are the variable **r500**, which spans the period from January 1981 to April 1991.

   (b) Black Monday is the 1805th return in this dataset. Fit a GARCH(1,1) model to the last two years of data before Black Monday, assuming 250 trading days per year. What are the estimates of the parameters of the model?

   (c) Make a plot of the fitted volatility during the chosen two year period.

   (d) Calculate the conditional probability of a return less than or equal to -0.228 on Black Monday.

   (e) Compute and plot the standardized returns. Also plot the autocorrelations of the standardized returns and their squares. Do the standardized returns indicate that the GARCH(1,1) model fits adequately?

   (f) Are the standardized returns normally distributed? If not, does it have fatter or thinner tails than a normal distribution? Justify your answers.

   (g) Fit a GARCH(1,1) model with a t-distributed shock using the following command
   fit = garchFit(garch(1,1), data=SP500$r500, cond.dist='std')

The extra argument **cond.dist='std'** in the **garchFit** function indicates the shock in the GARCH model is t-distributed. Among the parameter estimates, the new parameter **shape** gives the estimated degree of freedom of the t distribution. Recalculate the conditional probability of a return less than or equal to -0.228 on Black Monday. You can use the **predict** function to get an estimate of one-step ahead volatility. Also you can use the **pt(q, df)** function to get the probability of a t distribution given the quantile **q** and the degree of freedom **df**.

2. You are interested investing in the financial industry, and would like to learn the behavior of stocks in this industry. The company you look at in particular is Bank of America (symbol **BAC**).

   (a) Download the daily stock prices using the **getSymbols** function in the **quantmod** R package for the period from January 3rd 2000 to March 24th 2017. Make a plot of the daily closing prices during this period.

   (b) Estimate the daily 1% VaR using the parametric GARCH(1,1) model. When estimating the model, use a window of 500 days. Make a plot of the estimated VaRs.

   (c) Redo the same exercise in (b) using the Filtered Historical Simulation method. Compare with the results in (b) and explain the differences.

   (d) Are returns of the Bank of America stock unconditionally normally distributed during this period?

   (e) Are returns of the Bank of America stock conditionally normally distributed if you standardize the returns with volatility estimated from a GARCH(1,1) model?

   (f) You would like to diversity a bit by investing one third in Bank of America, one third in Apple (symbol **AAPL**), and one third in BP (symbol **BP**). Calculate daily returns on your portfolio and redo parts (b) and (c) on your new portfolio. Can you find any sign that diversification reduces risk?