Problem Set 10

Statistics 509 – Winter 2018

Due by Wednesday, April 11 in class

Instructions. You may work in teams, but you must turn in your own work/code/results. Also for the problems requiring use of the R-package, you need to include a copy of your R-code. This provides us a way to give partial credit in case the answers are not totally correct.

1. Consider the daily price data of the NYSE Composite from Jan 1, 2015 to Dec 31, 2017 which is in the file NYA-2015-2017.csv – this data file is in the Data subdirectory under Homework. The following R-commands can be used to read in the data:

```
X = read.csv("NYA-2015-2017.csv",header=TRUE)
NYSE_lret = diff(log(X$AdjClose))
NYSE_lret.ts <- ts(data=NYSE_lret,start=c(2015,1),frequency=252,names=c('logret'))
```

(a) Fit a GARCH(1,1) model assuming iid standard normal innovations. Provide standard errors of the parameter estimates $\alpha_o, \alpha_1, \beta_1$. Also, specify the half-life of the volatility based on the estimated parameters.

(b) Generate plots of the estimated conditional volatilities $\hat{\sigma}_n$ and of the estimated innovations (residuals) $\hat{\epsilon}_n$.

(c) Carry out the appropriate diagnostics on your GARCH estimation and summarize your findings.

(d) Be specific about more general GARCH methods/models that are likely to be better fit to this data. In particular, utilizing residuals from your GARCH estimation in **(a)**, analyze/estimate the appropriate t-distribution for the white noise process, and carry out the appropriate diagnostics for how well this fits the residuals – provide a discussion/interpretation of the results.

Remark. For this problem, utilize garchFit from fGarch package to generate results, and utilize plot commands to generate all of the appropriate diagnostic plots for this.

2. Following up on problem **1**, utilize the estimated GARCH model to derive the relative VaR for the week following the last week of data for $q = .005$. Do this for two cases: (i) assuming the white noise process is normal and (ii) assuming white noise process follows the estimated t-distribution from part **(d)**.

3. (a) Investigate utilizing an AR(p)+GARCH(1,1) model on the log-returns and consider using either normal/t-distribution for the innovations in the GARCH error process. Determine the appropriate model order p and distribution, and provide a discussion on the rationale for your final choice. Provide a solid set of diagnostics for your final model and provide a summary of what the diagnostics show. Utilize the AIC criteria for your choice of model.

(b) Repeat problem 2 for the final model you selected in part **(a)**.