QF5210: FINANCIAL TIME SERIES: THEORY AND COMPUTATION

Tutorial 4

Homework Assignment 2

15 March 2016

Notes:

1. All tests are based on the **5% significance level** ($\alpha = 5\%$).
2. For the report (hard copy), do not hand in whole computer outputs, use copy-and-paste to **summarise the outputs**.
3. Submit the corresponding R commands and outputs (soft copy) online through IVLE.
4. To submit (both 2 and 3) before **31 March** 2016 (inclusive).
5. You can try your own models to gain further experience, in addition to the specified time series model in some of the problems.
6. The purpose of this assignment is to analyze the volatility series of daily and monthly asset returns. All models include both the mean and volatility equations. You should always perform model checking to confirm the adequacy of a fitted model.
7. For GARCH and TGARCH models, you can use commands of the package *fGarch*, and for IGARCH and GARCH-M models, you can use commands of the package *rugarch*.
8. For daily series, use ten (10) lags in all ACF or ARCH-effect tests. For monthly series, use twelve (12) lags.

1. The file **d-gmsp9908.txt** contains the daily simple returns of GM stock and the S&P composite index from 1999 to 2008. It has three columns denoting date, GM return, and S&P return.

(a) Compute the daily log returns of GM stock. Is there any evidence of ARCH effects in the log returns?

(b) Fit a Gaussian GARCH model for the log return series. Perform model checking and write down the fitted model.

(c) Find an adequate GARCH-M model for the series. Write down the fitted model.

2. Consider again the file **d-gmsp9908.txt**, but now focus on the daily returns of the S&P composite index.

(a) Compute the daily log returns of the S&P index. Is there any ARCH effect in the log returns? [Hint: First fit an ARMA model for the returns, and then check the residuals of the fitted model for ARCH effect.]

(b) Fit a Gaussian ARMA-GARCH model for the log return series. Refine the model. Perform model checking, and write down the fitted model.

(c) Compute 1-step to 4-step ahead forecasts of the log return and its volatility based on the fitted model.

3. Consider the monthly stock returns of the Coca-Cola Company (KO) from January 1961 to September 2011. The simple returns are available from CRSP and in the file **m-ko-6111.txt**. Transform the simple returns to **log returns**.

(a) Is the expected monthly log return zero? Is there any serial correlation in the log returns? Is there any ARCH effect in the log returns? [Hint:if there is no serial correlation in the log returns, then use the log returns minus the sample mean to check the ARCH effect.]

(b) Build a Gaussian GARCH model for the log returns. Perform model checking and write down the fitted model. [Hint: Try GARCH (1,1) and GARCH (2,1), choose the better one.]

(c) Build a GARCH model with Student-t innovations for the log returns. Perform model checking, obtain the QQ-plot of the standardized residuals, and write down the fitted model. Also, obtain 1- to 5-step ahead volatility predictions. [Hint: Use the same order as the chosen model in (b).]

4. Consider again the monthly log returns of KO stock. Multiply the log returns by 100, i.e., use **percentage** log returns.

(a) Fit a TGARCH model to the series. Perform model checking and write down the fitted model. Is the leverage effect different from zero, that is whether the estimate of the parameter for asymmetry is significant? [Hint: Try Gaussian TGARCH (1,1) and Student-t TGARCH(1,1), then choose the better one.]

(b) Fit a GARCH-M model to the series. Perform model checking and write down the fitted model. Is the risk premium significant? Why? [Hint: Use the volatility in mean (with *rugarch*: archm=TRUE, archpow=1), instead of conditional variance in mean (archm=TRUE, archpow=2).]

5. Use the *quantmod* package to obtain the daily exchange rate between EURO and US Dollar. Compute the first **3606 daily log returns** of the exchange rate with the following commands:

```
> getSymbols("DEXUSEU",src="FRED")
> dexuseu=DEXUSEU[!is.na(DEXUSEU)]
> idx=c(3608:length(dexuseu))
> rtn=diff(log(as.numeric(dexuseu[-idx,1])))
> length(rtn)
[1] 3606
```

(a) Build a GARCH model (including mean equation) for the log return series. Write down the fitted model. [Hint: Try Gaussian GARCH (1,1) and Student-t GARCH(1,1), then choose the better one.]

(b) Use the model of part (a) to obtain 1-step to 5-step ahead predictions of the log return and its volatility.

(c) Build an IGARCH model for the log return series. Is the model adequate? Why?