# Homework 1

February 9, 2017

**Homework due**: March 1 before class (Wed. 6pm). Please send your code to Leo through email and hand in your writings and graphs in hard copy before the class.

## 1 Data

Data Sets will be posted soon. It contains 9 currencies trade data for every 5 minutes bar. We have Open, High, Low Close, Date and Time for each currency.

## 2 Problem

Usually we use standard deviation as the proxy of volatility. We are trying to build volatiltiy forecaster and use the data provided to test the performance of the forecaster. We want to look at the volatiltiy at Daily, Weekly, and Monthly level. Here are the methods we want the student to test:

1. Today's vol as a forecast of tomorrow's volatiltiy (the same for weekly and monthly)
2. Linear Regression (Using past 1, 3, 5, 10 vols)
3. ARCH(1)
4. GARCH(1,1)

There are two measures we use here for the performance of forecasting. One is the Mean Squared Error (MSE), which is defined by

$$MSE = \frac{1}{T}\sum \left(X_t - \hat{X}_t\right)^2$$

where $\hat{X}_t$ is the forecasted value. Another measure is Quasi-Likelihood, which is defined by

$$QL = \frac{X_t}{\hat{X}_t} - log\frac{X_t}{\hat{X}_t} - 1.$$

Notice that QL = 0 when $X_t = \hat{X}_t$.

| Forecaster | MSE | QL |
|---|---|---|
| $X_{t-1}$ | | |
| LR(1) | | |
| LR(3) | | |
| LR(5) | | |
| LR(10) | | |
| ARCH(1) | | |
| GARCH(1,1) | | |

Table 1: Template

# 3 Homework Format

Student should hand in 3 tables for daily, weekly and monthly volatility, each one is formatted as following in Table 1. For each table, there should be the plot of Squared Error for each methods, thus there will be 7 graphs associated with each table. In total, each group of students should hand in 3 tables and 21 graphs with clear description.

# 4 Code Requirement

Please write your code in a clear manner and put description of each function you build. See the following link for coding style.

https://google.github.io/styleguide/pyguide.html#Python_Style_Rules

Also, we suggest the students to build functions for volatility proxy, forecasting measures as it will help you build a good infrastructure for future homework assignment and final projects.