Financial Econometrics I: Homework 3

April 12, 2023

Instructions:

- The contact person for all agenda regarding this homework is František Čech, e-mail: frantisek.cech@fsv.cuni.cz
- Submit one file for the whole homework per group, the file needs to contain names of both students. Submit by SIS in the module "Study group roster" - Financial Econometrics I - Lecture - Homework 3.
- Deadline for submissions is **Tuesday, April 25, 2023, 23:59**. Any late submissions will be awarded zero points.
- Your solution should have a form of Jupyter Notebook with R source-code. Code should be properly commented, interpretations of results as well as theoretical derivations should be written in markdown cells. This is the only file you need to send. If you prefer not to write formulas in LATEX, you can send PDF with your derivations and interpretations in additional file and R code in Jupyter Notebook.
- Solutions with no comments will not be awarded any points, and only solutions with sufficient reasoning of all the steps will be awarded the full amount of points. Please, be concise though.

Problem 1 (8 points)
Using 1 minute data you will compare various Realized Measures and you will contrast your results to traditional time-series models, i.e. ARMA-GARCH. Data for the homework are stored in "HW_3_data.zip" file. In this file you will find 1 minute prices of three highly liquid stocks (BAC, MSFT, XOM) stored in separate ".fst" files, i.e. "HW_3_BAC_1min.fst", "HW_3_MSFT_1min.fst" and "HW_3_XOM_1min.fst". For each stock do the following:

1. load the data into the R session - data contain time-stamp and 1 minute prices
2. restrict data to include years 2012-2016 and NYSE trading hours, i.e. 9:30-16:00
3. create intraday 1 minute returns from the original 1 minute prices
    - *hint: you will need to subset your data by days as "makeReturns" function from highfrequency package does not take days into account*
4. to study the behavior of the functions in the highfrequency package calculate and compare
    - Realized Variance calculated from 1 minute prices, i.e. *rCov(1 min prices, makeReturns = TRUE)*
    - Realized Variance calculated from 1 minute returns, i.e. *rCov(1 min returns, makeReturns = FALSE)*
5. using 1 minute returns, calculate and compare graphically Realized Variance for following intraday sub-periods
    - 9:30 - 10:59 , i.e. create $RV_{9:30-10:59}$
    - 11:00 - 14:29, i.e. create $RV_{11:00-14:29}$
    - 14:30 - 16:00, i.e. create $RV_{14:30-16:00}$
6. compute and plot the difference between daily RV and sum of intraday RV, i.e. RV_{daily} vs $RV_{9:30-10:59} + RV_{11:00-14:29} + RV_{14:30-16:00}$
    - comment your findings - what is the possible source for such result?
7. calculate and plot the percentage share of individual intraday RV on total daily RV
    - comment your findings - how important are trading hours?
8. repeat the analysis in points 5, 6 and 7 using 1 minute prices and comment your findings
    - *hint: the most distinct difference will be comparison of* RV_{daily} *vs* $RV_{9:30-10:59} + RV_{11:00-14:29} + RV_{14:30-16:00}$ - **What is driving the results?**
9. using 1 minute prices, compute the Bipower Variation and MedRV estimators and compare your results to RV
    - do not forget to test for presence of jumps!

10. calculate daily returns and find the appropriate ARMA-GARCH model. Compare the conditional volatility from ARMA-GARCH model with Realized Volatility($\sqrt{RV}$) and comment the results.

Problem 2 (4 points)

A) For all three stocks convert the 1-minute prices to the 5-minute frequency and repeat the analysis from Problem 1.

B) Compare results obtained in Problem 1 and Problem 2A), i.e. compare results obtained from 1 minute data with results obtained from 5 minute data.