**Work in teams of 2 people.**

In the excel spreadsheet “Workshop5 (Ch5).xlsx” available in comunidad you will find 1-minute intraday prices for IBM for 2 days: July 29 and 26, 2002. Report all the results as annualized realized volatilities (RVolatitity-daily \* sqrt(252)), NOT as daily realized variances.

**Questions to be entered in the excel spreadsheet.**

1. Using logreturns at the given frequencies compute the RV sparse estimator for the following frequencies and report it for July 29, 2002:
   1. 1 minutes
   2. 5 minutes
   3. 10 minutes
   4. 30 minutes

for July 26, 2002:

* 1. 1 minutes
  2. 5 minutes
  3. 10 minutes
  4. 30 minutes

1. Compute the RV average estimator for July 29, 2002:
   1. 30 minute returns starting every 5 minutes
   2. 30 minute returns starting every 1 minute
   3. 5 minute returns starting every 1 minute

for July 26, 2002:

* 1. 30 minute returns starting every 5 minutes
  2. 30 minute returns starting every 1 minute
  3. 5 minute returns starting every 1 minute

1. Compute the RV estimator with autocovariance adjustments for every day for the 1-minute frequency
   1. July 29, 2002
   2. July 26, 2002
2. Compute the RV estimator using the following jump robust methodologies using 5 minute returns for July 29, 2002 (then you will do it for July 26):
   1. Bipower Variation estimator

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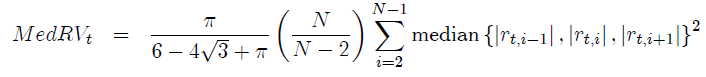
Where N is the total number of 5 minute returns within a day t, and *i* is the ith return within a day. Intuition/example: you are multiplying the absolute value of the 9:35-return with the absolute value of the 9:40-return.

* 1. Minimum RV Estimator



Where N is the total number of 5 minute returns within a day t, min is the minimum function and *i* is the ith return within a day. Intuition/example: you compare the absolute value of the 9:30-return with the absolute value of the 9:40-return and you choose the minimum to do the calculation. This way you avoid large (jump) returns.

* 1. Median RV estimator



Where N is the total number of 5 minute returns within a day t, median is the median function and *i* is the ith return within a day. Intuition/example: you compare the absolute value of the 9:30-return, the absolute value of the 9:40-return, and the absolute value of the 9:45-return. Then, you choose the median value of the three to do the calculation. This way you avoid large (jump) returns.

Note: for all three estimators you can include the constant inside the summation so that you can add up the total value of “return-squared” using pivot tables.

Compute the jump robust RV estimators for July 26, 2002 using 5 minute returns:

* 1. Bipower variation estimator
  2. Minimum RV estimator
  3. Median RV estimator

1. Compute the mean and standard deviation for each day of all the volatility measures (11 measures for each day). That is 4 for RV sparse, 3 for RV average, 1 for RV with autocovariance, and 3 for jump robust RV. Report
   1. Mean RV for July 29, 2002
   2. Standard deviation of RV for July 29, 2002
   3. Mean RV for July 26, 2002
   4. Standard Deviation for July 26, 2002
2. **(This is a previous exam question) HAR model:** Estimate the HAR model in logarithms on the RV data. We want to estimate the next 10-day RVt+1:t+10 on the left hand side and use daily (RVt), weekly (5 day), and monthly regressors (22 days) on the right hand side. Use all available data. Report
   1. Phi0 (Constant)
   2. Phi daily
   3. Phi weekly
   4. Phi monthly
   5. What is the 10-day RVt+1:t+10 forecast if you are standing on 6/30/2015? Note that the function {=LINEST()} provides the information on σɛ (row 3, column 2) besides the R square.

**Do NOT forget that you are reporting REALIZED VOLATILITY IN ANNUALIZED TERMS!!!!**