High Frequency Meets High Dimension: a Story of Big Data

Capturing asset portfolio risk

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1. Why should we care?

“High Frequency Trading is a curse and blessing!”
N. Hautsch, 3. Symposium on Financial Engineering and FERM Tokyo, 4 March 2015

Why blessing?

✓ liquidity
✓ transaction costs

Why curse?

✗ dark trading
✗ riskiness

2. Can we predict riskiness?

“Surprisingly little is known about intraday asset risk variation.”
From Bibinger et al. (2015) working paper on Estimating Spot Covariation

What are the issues?

1. Latent process
   - Volatility
   - unobservable directly hence difficult to predict

2. Curse of high frequency
   - micro effects
   - noise in observations
   - precision

3. Curse of dimensionality
   - # of assets
   - a-synchronicity
   - effective observations

4. Computation al costs
   - 4GB max 30 assets
   - 256GB max 100 assets

3. Does LMM work in practice?

Empirical evidence based on OCTOBER data

- 100 SP constituents’ mid-quotes
- Over 10^6 observations per day
- 994 trading days

- proportion of waste (70%)
- differences in sampling frequency

- Empirical evidence
- Curse of dimensionality

4. Adjusting LMM

Step 1
Compute any pilot covariance estimator

Use gLASSO on pilot to obtain precision matrix

Step 2
Apply Cuthill-McKee bandwidth reduction

Step 3
Use the structure to compute LMM block-wise

Step 4

5. Discussion

Pros of the approach
✓ Exploits almost full covariance structure
✓ Avoid unrealistic assumptions & comp. burden

Cons of the approach
✗ Introduces many tuning parameters
✗ Data-driven optimality ✓ comp. burden

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