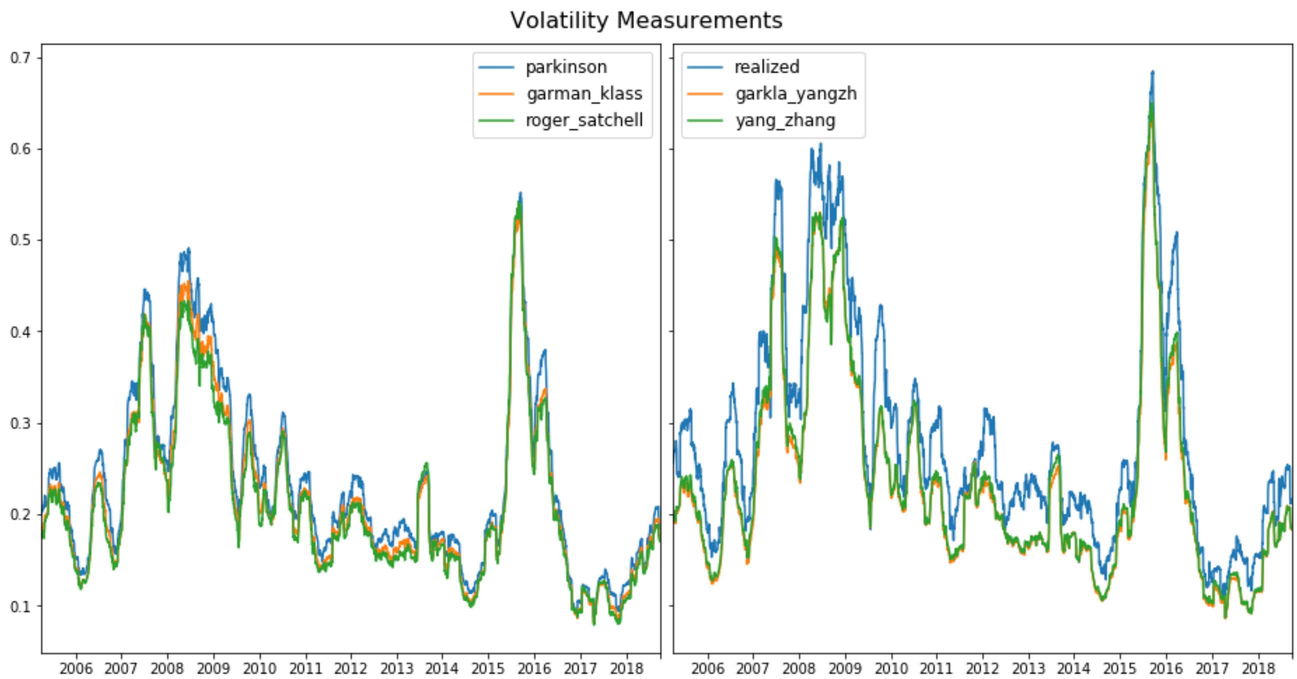
volatility

计算波动率的六种方法（仅供参考）：

Volatility	Price Information
Realized	Close
Parkinson	High，Low
Garman-Klass	Open, High, Low, Close
Roger-Satchell	Open, High, Low, Close
Garman-Klass-Yang-Zhang	Open, High, Low, Close
Yang-Zhang	Open, High, Low, Close

后五种方法均采用了连续收益率，导致波动率被低估

中证500指数的波动率的计算结果如下图所示



Parkinson，Garman-Klass，Roger-Satchell都是只用到当日的价格信息，可以看做是日内波动率；

Realized，Garman-Klass-Yang-Zhang，Yang-Zhang都用到了前一日和当日的价格信息，可以看做是日间波动率，从图上来看，前三者得到的波动率明显小于后三者得到波动率。

1. Realized Volatility: Close-Close

$\sigma_{realized} = \sqrt{\frac{N}{n-2}\sum_{i=1}^{n-1}(r_t - \bar{r})^2}$

$r_t = \log\frac{C_t}{C_{t-1}}$：收益率

$\bar{r} = \frac{1}{n}\sum_{n}^{t=1} r_t$：平均收益率

2. Parkinson Volatility: High-Low Volatility

$\sigma_{parkinson} = \sqrt{\frac{1}{4*\ln 2} * \frac{252}{n} * \sum_{t=1}^{n} \ln\left(\frac{H_t}{L_t}\right)^2}$

一般的波动率只考虑了收盘价，Parkinson Volatility 将最高价和最低价纳入了考虑范围，underestimate

3. Garman-Klass Volatility: OHLC volatility

Assumes Brown motion with zero drift and no opening jumps.

$\sigma_{garman-klass} = \sqrt{\frac{N}{n}\sum_{i=1}^{N}[\frac{1}{2} * (\log\frac{H_i}{L_i})^2 - (2*\log 2 - 1) * (\log\frac{C_i}{O_i})^2]}$

相比于Parkinson Volatility进一步考虑了开盘价和收盘价，纳入了更多的价格信息， underestimate

4. Roger-Satchell Volatility: OHLC Volatility

Assumes for non-zero drift, but assumed no opening jump.

$\sigma_{roger-satchel} = \sqrt{\frac{N}{n}\sum_{i=1}^{n}[\log\frac{H_i}{L_i} * \log\frac{H_i}{O_i} + \log\frac{HL_i}{L_i} * \log\frac{L_i}{O_i}]}$

underestimate

5. Garman-Klass-Yang-Zhang Volatility: OHLC Volatility

A modified version of Garman-Klass estimator that allows for opening jumps.

$\sigma_{garkla-yangzh} = \sqrt{\frac{N}{n}\sum_{i=1}^{n}[(\log\frac{O_i}{C_{i-1}})^2 + \frac{1}{2} * (\log\frac{H_i}{L_i})^2 - (2*\log 2 - 1) * (\log\frac{C_i}{O_i})^2]}$

当资产收益率均不为零时，会高估波动率

6. Yang-Zhang Volatility: OHLC Volatility

$\sigma_{yang-zhang} = \sqrt{\sigma_o^2 + k*\sigma_c^2 + (1-k)*\sigma_{rs}^2}$

$\mu_o = \frac{1}{n}\sum_{i=1}^{n}\log\frac{O_i}{C_{i-1}}$

$\sigma_o^2 = \frac{N}{n-1}\sum_{i=1}^{n}(\log\frac{O_i}{C_{i-1}} - \mu_o)^2$, Open-Close Volatility or Overnight Volatility

$\mu_c = \frac{1}{n}\sum_{i=1}^{n}\log\frac{C_i}{O_i}$, Close-Open Volatility

$\sigma_c^2 = \frac{N}{n-1}\sum_{i=1}^{n}(\log\frac{C_i}{O_i} - \mu_c)^2$

$\sigma_{rs}^2 = \sigma_{roger-satchel}^2$

$k^* = \frac{\alpha}{1+\alpha+\frac{n+1}{n-1}}$, α通常为0.34

Has minimum estimator error, and is independent of drift and open gaps. It van be interpreted as a weighted average of the Roger-Satchell estimator, the Close-Open Volatility and the Open-Close Volatility.

References

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3. volatility function | R Documentation
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