基于快照的高频特征

1 特征列表

A 类特征都是 Time-insensitive 特征。第一组是一些基础量，第二组是一些基础 imbalance 特征，第三组是基于 shape 的 imbalance 特征，第四组是一些更为复杂的特征。

特征类别	特征编号	特征名称	具体表达式
Time-insensitive basic	A1-A10	bid-ask spreads	$\left\{P_i^{ask} - P_i^{bid}\right\}_{i=1}^{10}$
	A11-A20	mid-prices	$\left\{(P_i^{ask} + P_i^{bid})/2\right\}_{i=1}^{10}$
	A21-A37	ask price differences	$\left\{P_i^{ask} - P_1^{ask}\right\}_{i=2}^{10}, \left\{\lvert P_i^{ask} - P_{i-1}^{ask}\rvert\right\}_{i=3}^{10}$
	A38-A54	bid price differences	$\left\{P_1^{bid} - P_i^{bid}\right\}_{i=2}^{10}, \left\{\lvert P_i^{bid} - P_{i-1}^{bid}\rvert\right\}_{i=3}^{10}$
	A55-A58	mean prices and mean volumes	$\frac{1}{10}\sum_{i=1}^{10} P_i^{ask}, \frac{1}{10}\sum_{i=1}^{10} P_i^{bid}, \frac{1}{10}\sum_{i=1}^{10} V_i^{ask}, \frac{1}{10}\sum_{i=1}^{10} V_i^{bid}$
	A59-A60	accumulated spreads	$\sum_{i=1}^{10}(P_i^{ask} - P_i^{bid}), \sum_{i=1}^{10}(V_i^{ask} - V_i^{bid})$
	A61	log quote slope	$\frac{logP_1^{ask} - logP_1^{bid}}{logV_1^{ask} + logV_1^{bid}}$
	A62	spdr	$\frac{P_1^{ask} - P_1^{bid}}{(P_1^{ask} + P_1^{bid})/2}$
Time-insensitive imbalance	A63-A80	price diff imbalance	$\left\{\lvert P_i^{bid} - P_1^{bid}\rvert - \lvert P_i^{ask} - P_1^{ask}\rvert\right\}_{i=2}^{10}, \left\{\frac{\lvert P_i^{bid} - P_1^{bid}\rvert}{\lvert P_i^{ask} - P_1^{ask}\rvert}\right\}_{i=2}^{10}$
	A81-A90	volume imbalance	$\left\{\frac{V_i^{bid} - V_i^{ask}}{V_i^{bid} + V_i^{ask}}\right\}_{i=1}^{10}$
	A91-A99	acc volume imbalance	$\left\{\frac{\sum_{i=1}^{k} V_i^{bid} - \sum_{i=1}^{k} V_i^{ask}}{\sum_{i=1}^{k} V_i^{bid} + \sum_{i=1}^{k} V_i^{ask}}\right\}_{k=2}^{10}$
	A100-A101	acc num imbalance	$\left\{\frac{\sum_{i=1}^{k} N_i^{bid} - \sum_{i=1}^{k} N_i^{ask}}{\sum_{i=1}^{k} N_i^{bid} + \sum_{i=1}^{k} N_i^{ask}}\right\}_{k=1,10}$
	A102-A103	average volume imbalance	$AveVol_{bid,k} = \frac{1}{k}\sum_{i=1}^{k} \frac{V_i^{bid}}{N_i^{bid}}$ $AveVolImb_k = \frac{AveVol_{bid,k} - AveVol_{ask,k}}{AveVol_{bid,k} + AveVol_{ask,k}}$, $k = 1, 10$
	A104	weighted volume imbalance	$V^{bid\_w} = \sum_{i=1}^{10} V_i^{bid} \times w_i$, $V^{ask\_w} = \sum_{i=1}^{10} V_i^{ask} \times w_i$, $\text{VIR} = \frac{V^{bid\_w} - V^{ask\_w}}{V^{bid\_w} + V^{ask\_w}}$, $w_i = \frac{11-i}{55}$.

特征类别	特征编号	特征名称	具体表达式
	A105	weighted amount imbalance	$\text{BID} = \sum_{i=1}^{10} P_i^{bid} \times V_i^{bid} \times w_i$, $\text{ASK} = \sum_{i=1}^{10} P_i^{ask} \times V_i^{ask} \times w_i$, $\text{Spread} = \frac{\text{BID}-\text{ASK}}{\text{BID}+\text{ASK}}$, $w_i = \frac{11-i}{55}$.
	A106-A108	liquidity imbalance	成交量为 Q 的买卖市价单的成交均价距离 mid price 之差: $LB(Q) = \frac{1}{2}(P_1^{ask} + P_1^{bid}) - \frac{1}{Q}(\sum_{j=1}^{m_1-1} P_j^{bid} V_j^{bid} + P_{m_1}^{bid} V_{m_1}^{'bid})$, 其中 $\sum_{i=1}^{m_1-1} V_i^{bid} + V_{m_1}^{'bid} = Q$, $LA(Q)$ 对称定义。$LR(Q) = \frac{LB(Q)-LA(Q)}{LB(Q)+LA(Q)}, Q = 500, 1000, 2000.$
Time-insensitive imbalance (shape)	A109-A117	volume proportion imbalance	$S_i^{bid} = \left\{ p \middle\| p \in \left[P_1^{bid} - \left\| P_1^{bid} - P_{10}^{bid} \right\| \times 10\% \times i, P_1^{bid} \right] \right\}$, $\widetilde{V}_i^{bid} = \sum_{P_k^{bid} \in S_i^{bid}} V_k^{bid}$, $\text{imbalance}_\text{i} = \frac{\widetilde{V}_i^{bid} - \widetilde{V}_i^{ask}}{\widetilde{V}_i^{bid} + \widetilde{V}_i^{ask}}$, $i = 1, \cdots, 9.$
	A118	weighted price imbalance	$\overline{P}_{bid} = \frac{\sum_{i=1}^{k} P_i^{bid} V_i^{bid}}{\sum_{i=1}^{k} V_i^{bid}}, \quad k = 5$ $\text{imbalance} = \left\| \overline{P}_{bid} - P_1^{bid} \right\| - \left\| \overline{P}_{ask} - P_1^{ask} \right\|.$
	A119	orderbook dispersion	$\text{dispimb} = \frac{\sum_{i=1}^{k} \left[V_i^{bid} \times (P_{i-1}^{bid} - P_i^{bid}) \right]}{\sum_{i=1}^{k} V_i^{bid}} - \frac{\sum_{i=1}^{k} \left[V_i^{ask} \times (P_i^{ask} - P_{i-1}^{ask}) \right]}{\sum_{i=k}^{k} V_i^{ask}}, \quad k = 2$
	A120-A121	shape imbalance	将买卖方看作价格的分布（对应的 volume 看作概率） $\text{imbalance}_1 = \text{sigma}_{bid} - \text{sigma}_{ask}$; $\text{imbalance}_2 = \text{skew}_{bid} + \text{skew}_{ask}.$
	A122	average local slope imbalance	$S_{bid} = \frac{1}{10} \left\{ \frac{\log \tau_1^{bid}}{P_1^{bid}/P^{mid}-1} + \sum_{i=2}^{10} \frac{\log(\tau_i^{bid})/\log(\tau_{i-1}^{bid})-1}{P_i^{bid}/P_{i-1}^{bid}-1} \right\}$, 其中 $\tau_i^{bid} = \sum_{k=1}^{i} V_k^{bid}$. $\text{imbalance} = \frac{S_{bid}-S_{ask}}{S_{bid}+S_{ask}}$

特征类别	特征编号	特征名称	具体表达式
Time-insensitive complex	A123	weighted volume imbalance1	$\widetilde{V}^{bid}=\sum_{i=2}^{10}\frac{V_i^{bid}}{\left\|P_i^{bid}-P_1^{bid}\right\|}$, imbalance $=\frac{\widetilde{V}^{bid}-\widetilde{V}^{ask}}{\widetilde{V}^{bid}+\widetilde{V}^{ask}}$.
	A124	weighted volume imbalance2	$\widetilde{V}^{bid}=\sum_{i=2}^{10}\frac{V_i^{bid}+N_i^{bid}\times 3000}{\left\|P_i^{bid}-P_1^{bid}\right\|}$, imbalance $=\frac{\widetilde{V}^{bid}-\widetilde{V}^{ask}}{\widetilde{V}^{bid}+\widetilde{V}^{ask}}$.
	A125	press imbalance	$press_{bid}=\sum_{i=1}^{10}\left[V_i^{bid}\times\frac{mp/(mp-P_i^{bid})}{\sum_{i=1}^{10}mp/(mp-P_i^{bid})}\right]$, imbalance $=\log(press_{bid})-\log(press_{ask})$.
	A126	slope imbalance	$S_{bid}=\frac{\left\|P_1^{bid}-P_{10}^{bid}\right\|}{\sum_{i=1}^{10}V_i^{bid}}$, imbalance $=\frac{S_{bid}-S_{ask}}{S_{bid}+S_{ask}}$.
	A127*	slope imbalance fine	$\beta^{ask}=\frac{\frac{2}{3}\left[\sum_{i=1}^{10}(P_i^{ask}-mp)(\tilde{V}_{i,ask}^2-\tilde{V}_{i-1,ask}^2)\right]}{\sum_{i=1}^{10}(\tilde{V}_{i,ask}^3-\tilde{V}_{i-1,ask}^3)}$, imbalance $=\beta^{ask}-\beta^{bid}$
	A128*	next up probability	$p^{up}=\frac{1}{\pi}\int_0^{\pi}\left[(2-\cos t-\sqrt{(2-\cos t)^2-1})^{N_1^{ask}}\frac{\sin(N_1^{bid}t)\cos(\frac{t}{2})}{\sin(\frac{t}{2})}\right]dt$
	A129	microprice	$\frac{\sum_{i=1}^{k}(P_i^{bid}V_i^{ask}+P_i^{ask}V_i^{bid})}{\sum_{i=1}^{k}(V_i^{ask}+V_i^{bid})}+\frac{\sum_{i=1}^{k}(P_i^{bid}V_i^{bid}+P_i^{ask}V_i^{ask})}{\sum_{i=1}^{k}(V_i^{ask}+V_i^{bid})}-2MidP,\quad k=5$

注:

1. A127: 记 $\tilde{V}_i=\sum_{k=1}^{i}V_k^{ask}$, $\tilde{V}_0=0$, 关于市场买单 Volume 的边际价格函数为:

$$s(x)=\begin{cases}P_1^{ask} & 0\le x\le\tilde{V}_1\\ P_2^{ask} & \tilde{V}_1\le x\le\tilde{V}_2\\ \cdots & \\ P_{10}^{ask} & \tilde{V}_9\le x\le\tilde{V}_{10}\end{cases}$$

因此 ask 方斜率为最佳线性逼近值如下, 其中 mp 为 MidPrice:

$$\beta^{ask}=\arg\min_{\beta}\int_0^{\tilde{V}_{10}}(s(x)-mp-\beta x)^2\mathrm{d}x$$

解得:

$$\beta^{ask}=\frac{\frac{2}{3}\left[\sum_{i=1}^{10}(P_i^{ask}-mp)(\tilde{V}_i^2-\tilde{V}_{i-1}^2)\right]}{\sum_{i=1}^{10}(\tilde{V}_i^3-\tilde{V}_{i-1}^3)}$$

2. A128: 这是 Cont R(2013) [1] 中 Possion 过程建模推导出来的结果。

从 B 类特征起，都是 Time-sensitive 特征。B 类特征反应各类买卖量与 Δt 前相比的增量的 imbalance。Δt 指的是我们特征提取的频率。其中 B1-B10 是从 snapshot 中自有的统计列中做 imbalance 直接获取的。WithdrawBuyNumber, WithdrawSellNumber, WithdrawBuyVolume, WithdrawSellVolume 是累计量，而 TotalBuyVolume,TotalSellVolume, TotalBuyNumber, TotalSellNumber, NumBuyOrders, NumSellOrders 是快照量，对于快照量来说，做差分是可能出现负值的，因此 imbalance2 的分母采用绝对值之和进行去量纲。

特征类别	特征编号	特征名称	具体表达式
Time-sensitive imbalance	B1-B10	snapshot direct imbalance	5 对 (buy,sell) 量见注释 1，对每对做相同 imbalance： $\Delta_{buy,t} = buy_t - buy_{t-\Delta t}, \Delta_{sell,t} = sell_t - sell_{t-\Delta t}.$ $\text{imbalance1}_t = \Delta_{buy,t} - \Delta_{sell,t},$ $\text{imbalance2}_t = \frac{\Delta_{buy,t} - \Delta_{sell,t}}{\lvert\Delta_{buy,t}\rvert + \lvert\Delta_{sell,t}\rvert},$
	B11-B14	average volume change imbalance	$AveVol_{t,bid} = \frac{1}{k}\sum_{i=1}^{k} \frac{V_i^{t,bid}}{N_i^{t,bid}}$ $pct_{t,bid} = \frac{AveVol_{t,bid} - AveVol_{t-\Delta t,bid}}{AveVol_{t-\Delta t,bid}}$ $\text{imbalance} = pct_{t,bid} - pct_{t,ask}, \quad k = 1, 2, 5, 10$

C 类特征主要基于把一些简单的事件数量化的思路，因此都是用这个 tick 与上一个 tick 进行比较来计算值，然后把值按一定方式聚合到提取特征的 Δt 频率上。下面的 $t-1$ 均指前一个 tick。其中，C1-C7、C9 做 sum 聚合，C8 做 mean 聚合。

特征类别	特征编号	特征名称	具体表达式
Time-sensitive imbalance	C1	净委买增额	委买增额 = 当前时间戳委买价大于等于前一个时间戳买一价的所有委买单的委托金额之和-前一个时间戳买一价的委托金额，净委买增额 = 委买增额-委卖增额。
	C2-C3	订单失衡 (VOI)	$\Delta V_t^{bid} = \begin{cases} 0 & P_t^{bid} < P_{t-1}^{bid} \\ V_t^{bid} - V_{t-1}^{bid} & P_t^{bid} = P_{t-1}^{bid} \\ V_t^{bid} & P_t^{bid} > P_{t-1}^{bid} \end{cases}$ $\text{VOI1}_\text{t} = \Delta V_t^{bid} - \Delta V_t^{ask}$(买卖一档交易量) $\text{VOI2}_\text{t} = \Delta V_t^{bid\_w} - \Delta V_t^{ask\_w}$(A100，衰减加权)

特征类别	特征编号	特征名称	具体表达式
Time-sensitive imbalance	C4-C6	多层次订单失衡 (MOFI)	$\Delta V_t^{bid} = \begin{cases} -V_{t-1}^{bid} & P_t^{bid} < P_{t-1}^{bid} \\ V_t^{bid} - V_{t-1}^{bid} & P_t^{bid} = P_{t-1}^{bid} \\ V_t^{bid} & P_t^{bid} > P_{t-1}^{bid} \end{cases}$ $\mathrm{OFI}_{t,i} = \Delta V_{t,i}^{bid} - \Delta V_{t,i}^{ask}$(第 i 档) $\mathrm{MOFI1_t} = \frac{1}{10}\sum_{i=1}^{10} \mathrm{OFI}_{t,i}$ $\mathrm{MOFI2_t} = \sum_{i=1}^{10} \mathrm{OFI}_{t,i} \times w_i, w_i = \frac{11-i}{55}$ $\mathrm{MOFI3_t} = \sum_{i=1}^{10} \mathrm{OFI}_{t,i} \times w_i, w_i = \frac{i}{55}$
	C7	内部 volume 变化失衡	$S_t^{bid} = \left\{ p \middle\| \min\left\{P_{t,10}^{bid}, P_{t-1,10}^{bid}\right\} \le p \le \max\left\{P_{t,1}^{bid}, P_{t-1,1}^{bid}\right\}\right\},$ $\Delta V_t^{bid} = \sum_{P_{t,k}^{bid} \in S_t^{bid}} V_{t,k}^{bid} - \sum_{P_{t-1,k}^{bid} \in S_t^{bid}} V_{t-1,k}^{bid},$ $\mathrm{imbalance}_t = \Delta V_t^{bid} - \Delta V_t^{ask}$
	C8	市价偏离度	$\overline{TP}_t = \begin{cases} \frac{\Delta A_t}{\Delta V_t} & \Delta V_t \neq 0 \\ \overline{TP}_{t-1} & \Delta V_t = 0 \end{cases}$ $\mathrm{MPB}_t = \overline{TP}_t - \frac{1}{2}(P_t^{mid} + P_{t-1}^{mid})$ 其中 $\overline{TP}_t$ 计算 $(t-1, t]$ 时间内的平均成交价
	C9	买入情绪	$\mathrm{emotion} = \Delta V_t \mathrm{I}_{\left\{\overline{TP}_t > P_{t-1,1}^{ask}\right\}} - \Delta V_t \mathrm{I}_{\left\{\overline{TP}_t < P_{t-1,1}^{bid}\right\}}$

D 类特征都是由过去一段时间的数据计算得到的，比如过去 15s,30s,1min,3min 等，脱离了 C 类特征要求 tick 级别按一定方式聚合到 Δt 频率的限制，可以做任意复杂的 Time-sensitive 特征。

其中，complex1 类最为简单，是基于对数收益率的时序上的量。为了表达式的可读性，采用简单写法，r_1 指过去一段时间上第 1 个 tick 的对数收益率，r_N 指当前 tick 的对数收益率，D 类中出现的 $\sum_{i=1}^{N}$ 一律表示这个意思。

特征类别	特征编号	特征名称	具体表达式
Time-sensitive complex1	D1	realized absolute variation	$RAbsVar = \sqrt{\frac{\pi}{2N}} \sum_{i=1}^{N} \lvert r_i \rvert$
	D2	realized volatility	$RVol = \sum_{i=1}^{N} r_i^2$
	D3	realized skew	$RSkew = \frac{\sqrt{N} \sum_{i=1}^{N} r_i^3}{RVol^{3/2}}$
	D4	realized kurtosis	$RKur = \frac{N \sum_{i=1}^{N} r_i^4}{RVol^2}$
	D5	integrated quarticity	$Intq = \frac{N}{3} \sum_{i=1}^{N} r_i^4$
	D6	realized bipower variation	$RBip = \frac{\pi N}{2(N-2)} \times \sum_{i=2}^{N} \lvert r_i r_{i-1} \rvert$
	D7	jump process	$Jump = \max(RVol - RBip, 0)$
	D8	downside-volatility proportion	$DVol = \frac{\sum_{i=1}^{N} r_i^2 \mathrm{I}_{\{r_i<0\}}}{\sum_{i=1}^{N} r_i^2}$
	D9	trend strength	$trendstrength = \frac{\sum_{i=1}^{N} r_i}{\sum_{i=1}^{N} \lvert r_i \rvert}$
Time-sensitive complex2	D10-D12*	net inflow ratio, amout flow imbalance, num flow imbalance.	$AmtPerTrdInFlow = \frac{\sum_{i=1}^{N} Amt_i \mathrm{I}_{\{r_i>0\}}}{\sum_{i=1}^{N} Num_i \mathrm{I}_{\{r_i>0\}}}$ $AmtPerTrdOutFlow = \frac{\sum_{i=1}^{N} Amt_i \mathrm{I}_{\{r_i<0\}}}{\sum_{i=1}^{N} Num_i \mathrm{I}_{\{r_i<0\}}}$ $NetInflowRatio = \frac{AmtPerTrdInFlow}{AmtPerTrdOutFlow}$ $AmtFI = \sum_{i=1}^{N} Amt_i \mathrm{I}_{\{r_i>0\}} - \sum_{i=1}^{N} Amt_i \mathrm{I}_{\{r_i<0\}}$ $NumFI = \sum_{i=1}^{N} Num_i \mathrm{I}_{\{r_i>0\}} - \sum_{i=1}^{N} Num_i \mathrm{I}_{\{r_i<0\}}$
	D13*	modeling shape feature	$\alpha_{t,bid} = mean_{t,bid} - mean_{t-\Delta t,bid}$ $\beta_{t,bid} = \frac{1}{5} \sum_{i=1}^{5} (sigma_{t-i,bid}^2/2)$ $\alpha_e = \frac{\alpha_{t,bid}\beta_{t,ask} + \alpha_{t,ask}\beta_{t,bid}}{\beta_{t,ask} + \beta_{t,bid}}$ $pricing\_error = \log MidP_{t-\Delta t} - a_e - \log MidP_t$

注：

1. D9-D11：Amt_i, Num_i 分别指该 tick 上的成交金额和交易笔数，net inflow ratio 衡量平均单笔流入流出金额之比，amount/num flow imbalance 其实就是模糊版的主买主卖 imbalance。

2. D13：这里的 $mean$ 和 $sigma^2$ 指的是订单簿两边把价格做成自然对数以后，Volume 关于对数价格分布的均值

和方差。根据 Federico Platania(2018) [2] 模型的结果近似有：

$$\log MidP_t \sim N(\log MidP_{t-\Delta t} - \alpha_e, \sigma^2).$$

因此 $E[\log MidP_t] = \log MidP_{t-\Delta t} - \alpha_e$, 将对数价格的偏离 $\log MidP_{t-\Delta t} - \alpha_e - \log MidP_t$ 作为特征。

2 其他没做出效果的复杂特征

1. 基于预建模的特征
   Yang T W(2012) [3] 中模型的简化版为：用前一天数据，将 $MidP_{t+\Delta t} - MidP_t$ 关于 $MidP_t$ 和 A127 中的 $\beta_t^{ask}, \beta_t^{bid}$ 做线性回归，回归参数用于计算当天每个时间点的未来 Δt 预期收益，作为特征。但这个效果相比直接用 β^{ask}, β^{bid} 做 Time-insensitive 的 imbalance 特征几乎毫无变化，且相关性非常高。

2. 基于 MicroPrice 的特征加强
   Stoikov S.(2017) [4] 的核心为

$$P_t^{micro} = \lim_{i\to\infty} P_t^i = M_t + \sum_{i=1}^{\infty} \mathbb{E}\left[M_{\tau_i} - M_{\tau_{i-1}} | I_t = I, S_t = S\right].$$

   其中 M_t 为 t 时刻的中间价，τ_i 为未来第 i 个中间价发生变化的时间点，I_t 为 imbalance 的值，S_t 为买卖价差，计算方法就是根据历史数据估计状态 (I_t, S_t) 的转移概率矩阵和吸收态的矩阵，从而计算出 P_t^{micro} 作为特征。但做出来的效果相对于原来的 imbalance 并没有改善。采用原文思想尝试更符合直观的思路：估计 tick 级别的状态转移概率矩阵和中间价变动的期望矩阵，来求未来 15s 中间价的变动作为特征，效果仍然比原来的 imbalance 差。

参考文献

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A 特征效果

评价标准：未来 Δt 收益率与当前特征的日 corr 的均值（2021 年下半年作为数据集）。

高频特征基本上会随着 Δt 的增大，效果有所衰减，以下只展示 $\Delta t = 15s$ 在 688001-688010 上的特征效果。第一列 mean 为每个特征在 9 个股票上的均值（不包括 688009，这是低价股，微观结构特点不同）。

A.1 A 类特征效果

	mean	688001	688002	688003	688004	688005	688006	688007	688008	688009	688010
featureA1	-0.006059	-0.016780	0.000627	-0.008622	-0.013199	0.005648	0.000079	-0.000593	0.002723	0.003110	-0.024418
featureA2	0.002127	0.006955	0.007851	0.000824	-0.002776	0.010839	-0.007622	0.003713	0.009526	0.002343	-0.010164
featureA3	0.004315	0.007988	0.006736	0.002312	0.001563	0.012204	-0.007497	0.009526	0.011210	0.003641	-0.005205
featureA4	0.004374	0.009771	0.005386	0.005433	0.000670	0.012631	-0.008915	0.006251	0.012275	0.003210	-0.004137
featureA5	0.005895	0.013853	0.007024	0.007555	0.002497	0.012485	-0.009465	0.008224	0.011813	0.002280	-0.000930
featureA6	0.005663	0.013945	0.005446	0.006125	0.002552	0.013134	-0.008383	0.008416	0.009682	0.001947	0.000049
featureA7	0.004840	0.012555	0.002712	0.006839	0.000794	0.010876	-0.007927	0.007522	0.010677	0.002254	-0.000490
featureA8	0.004837	0.013007	0.001796	0.006707	0.001221	0.009691	-0.004508	0.007202	0.009148	0.002489	-0.000734
featureA9	0.004860	0.012534	0.002580	0.007708	0.001295	0.010389	-0.004752	0.006914	0.007429	0.001944	-0.000355
featureA10	0.004380	0.010520	0.003066	0.007249	0.001994	0.008956	-0.005027	0.006515	0.007144	0.001750	-0.001001
featureA11	-0.087741	-0.083265	-0.084416	-0.078991	-0.099073	-0.083382	-0.097581	-0.079317	-0.087448	-0.136877	-0.096196
featureA12	-0.072780	-0.067853	-0.072592	-0.063720	-0.067718	-0.076869	-0.082281	-0.072476	-0.078676	-0.136809	-0.072835
featureA13	-0.068747	-0.063603	-0.068818	-0.060159	-0.061175	-0.074162	-0.077485	-0.070261	-0.075425	-0.136790	-0.067637
featureA14	-0.066509	-0.061666	-0.065875	-0.057982	-0.057852	-0.072633	-0.074667	-0.068589	-0.073986	-0.136788	-0.065328
featureA15	-0.064962	-0.059720	-0.064541	-0.056639	-0.054909	-0.071423	-0.072165	-0.067463	-0.072904	-0.136788	-0.064898
featureA16	-0.063890	-0.058441	-0.063371	-0.055162	-0.054051	-0.070149	-0.071244	-0.066751	-0.072295	-0.136788	-0.063543
featureA17	-0.063170	-0.058015	-0.062739	-0.054304	-0.051884	-0.069078	-0.072049	-0.066298	-0.071608	-0.136788	-0.062555
featureA18	-0.062177	-0.056948	-0.062246	-0.053598	-0.049662	-0.068378	-0.070437	-0.066074	-0.071281	-0.136788	-0.060972
featureA19	-0.061509	-0.056391	-0.061932	-0.052697	-0.049317	-0.067507	-0.068787	-0.066067	-0.070972	-0.136788	-0.059910
featureA20	-0.060680	-0.055908	-0.061594	-0.052132	-0.048309	-0.067013	-0.066448	-0.065646	-0.070986	-0.136767	-0.058088
featureA21	0.131947	0.138593	0.145832	0.138947	0.138289	0.120480	0.123210	0.114453	0.133132	0.010813	0.134585
featureA22	0.126741	0.128939	0.142557	0.125713	0.127905	0.127490	0.120335	0.109587	0.138185	0.003408	0.119958
featureA23	0.118035	0.117475	0.137222	0.116990	0.115236	0.124422	0.110069	0.101534	0.131961	0.006955	0.107411
featureA24	0.111076	0.111607	0.128842	0.109103	0.108177	0.118650	0.103353	0.095309	0.124761	0.006417	0.099879
featureA25	0.104548	0.104419	0.120305	0.102645	0.100334	0.115494	0.097861	0.088048	0.116824	0.009938	0.094999
featureA26	0.098281	0.096822	0.111034	0.097484	0.093125	0.111218	0.091707	0.081624	0.112180	0.003956	0.089332
featureA27	0.093945	0.092971	0.104835	0.093297	0.089323	0.106004	0.090014	0.077422	0.106095	0.007870	0.085549
featureA28	0.089962	0.087607	0.100176	0.091363	0.083870	0.103918	0.086669	0.073130	0.100692	0.003564	0.082234
featureA29	0.086201	0.082691	0.095772	0.087548	0.079168	0.099564	0.084633	0.070974	0.096229	0.011148	0.079231
featureA30	0.046754	0.044584	0.054914	0.037485	0.038680	0.059920	0.048367	0.044739	0.060554	-0.008690	0.031546

	mean	688001	688002	688003	688004	688005	688006	688007	688008	688009	688010
featureA31	0.027424	0.023432	0.039449	0.028362	0.016650	0.039260	0.024690	0.023684	0.034569	0.004434	0.016722
featureA32	0.022212	0.023852	0.025964	0.022315	0.014576	0.028434	0.021595	0.023970	0.025336	-0.007354	0.013868
featureA33	0.017525	0.015186	0.017907	0.017990	0.007406	0.031026	0.020445	0.014660	0.018340	0.004856	0.014762
featureA34	0.012643	0.007378	0.009083	0.016000	0.006735	0.023359	0.011941	0.011391	0.020107	-0.003679	0.007795
featureA35	0.013230	0.012840	0.012073	0.013089	0.009073	0.017915	0.021778	0.010435	0.011859	0.002665	0.010009
featureA36	0.011042	0.004883	0.013100	0.017256	-0.000057	0.024240	0.013945	0.006972	0.010086	-0.011573	0.008955
featureA37	0.009020	0.003620	0.011617	0.007816	0.003734	0.012517	0.014086	0.008705	0.009941	0.008552	0.009147
featureA38	-0.131945	-0.124896	-0.136498	-0.138380	-0.150372	-0.114980	-0.136594	-0.115399	-0.123610	-0.003002	-0.146776
featureA39	-0.128498	-0.122496	-0.136052	-0.131471	-0.139129	-0.121651	-0.135625	-0.105728	-0.129069	-0.008981	-0.135259
featureA40	-0.121295	-0.111766	-0.134097	-0.120781	-0.129511	-0.118570	-0.128248	-0.102894	-0.122868	-0.002642	-0.122923
featureA41	-0.113067	-0.101615	-0.124666	-0.111439	-0.120222	-0.113041	-0.122998	-0.095080	-0.117562	-0.005072	-0.110979
featureA42	-0.107014	-0.096292	-0.119074	-0.108324	-0.109780	-0.110106	-0.115101	-0.087980	-0.113474	-0.005084	-0.102994
featureA43	-0.102058	-0.090751	-0.113945	-0.102232	-0.104369	-0.109241	-0.107920	-0.083509	-0.108061	-0.008447	-0.098496
featureA44	-0.097350	-0.085922	-0.109663	-0.096842	-0.098908	-0.105467	-0.101483	-0.079461	-0.104207	-0.003407	-0.094200
featureA45	-0.092995	-0.081030	-0.104347	-0.092873	-0.090732	-0.102828	-0.098166	-0.075384	-0.101778	-0.014839	-0.089816
featureA46	-0.089032	-0.079032	-0.099609	-0.088845	-0.083772	-0.099872	-0.093737	-0.072950	-0.097368	-0.017893	-0.086104
featureA47	-0.047499	-0.047323	-0.055445	-0.041692	-0.038929	-0.056321	-0.055664	-0.034750	-0.057666	-0.009402	-0.039702
featureA48	-0.031162	-0.021407	-0.045480	-0.025114	-0.024794	-0.036366	-0.036191	-0.034645	-0.031701	0.001804	-0.024757
featureA49	-0.019405	-0.011895	-0.021777	-0.013897	-0.013615	-0.026631	-0.030646	-0.019340	-0.026187	-0.003174	-0.010654
featureA50	-0.018687	-0.015382	-0.022798	-0.025158	-0.006313	-0.027941	-0.017686	-0.013765	-0.023620	0.000929	-0.015523
featureA51	-0.017420	-0.010451	-0.018999	-0.012979	-0.016360	-0.033058	-0.018888	-0.014566	-0.015573	-0.005891	-0.015906
featureA52	-0.014368	-0.010288	-0.017317	-0.011791	-0.011488	-0.021705	-0.013413	-0.012939	-0.017631	-0.000947	-0.012742
featureA53	-0.013032	-0.004255	-0.010774	-0.011235	-0.005369	-0.020764	-0.022743	-0.010421	-0.019389	-0.009128	-0.012338
featureA54	-0.012503	-0.012184	-0.010773	-0.007720	-0.006603	-0.018408	-0.020664	-0.013487	-0.009577	0.001496	-0.013114
featureA55	-0.065878	-0.059557	-0.065680	-0.056587	-0.058122	-0.071089	-0.074389	-0.067723	-0.073439	-0.136258	-0.066318
featureA56	-0.066979	-0.063209	-0.067803	-0.060131	-0.057327	-0.072789	-0.073573	-0.069068	-0.075294	-0.136196	-0.063622
featureA57	-0.027221	-0.027669	-0.026578	-0.024904	-0.028422	-0.029460	-0.023743	-0.022317	-0.032355	-0.044466	-0.029542
featureA58	0.041710	0.038232	0.040587	0.040561	0.041077	0.044733	0.032165	0.046876	0.047888	0.028747	0.043274
featureA59	0.004806	0.011810	0.004864	0.006082	0.000045	0.011882	-0.006394	0.007829	0.010346	0.003828	-0.003214
featureA60	-0.047570	-0.046509	-0.046313	-0.044202	-0.047525	-0.048843	-0.037587	-0.048192	-0.057520	-0.070005	-0.051435
featureA61	-0.007019	-0.018039	-0.000201	-0.008382	-0.012982	0.003581	-0.000241	-0.002982	0.001839	-0.006630	-0.025764
featureA62	-0.005203	-0.016134	0.001480	-0.007822	-0.012595	0.006708	0.001416	0.000449	0.003499	0.009303	-0.023827
featureA63	-0.186107	-0.187119	-0.200333	-0.194055	-0.200848	-0.166580	-0.186421	-0.161665	-0.180580	-0.014790	-0.197364
featureA64	-0.179928	-0.178380	-0.198803	-0.178840	-0.184961	-0.177597	-0.184349	-0.152522	-0.187411	-0.013160	-0.176488
featureA65	-0.167907	-0.161293	-0.193951	-0.164441	-0.168255	-0.173006	-0.171106	-0.144314	-0.177594	-0.016741	-0.157203

	mean	688001	688002	688003	688004	688005	688006	688007	688008	688009	688010
featureA66	-0.156822	-0.149881	-0.180822	-0.151734	-0.158228	-0.164198	-0.160986	-0.133961	-0.167425	-0.033877	-0.144158
featureA67	-0.146971	-0.139646	-0.169462	-0.144308	-0.146973	-0.158740	-0.148129	-0.123127	-0.157331	-0.012318	-0.135025
featureA68	-0.137942	-0.129070	-0.157734	-0.136168	-0.139469	-0.153483	-0.135205	-0.114161	-0.148707	-0.017230	-0.127485
featureA69	-0.131086	-0.122361	-0.148971	-0.129363	-0.134535	-0.145968	-0.128894	-0.107071	-0.140389	-0.023228	-0.122222
featureA70	-0.124882	-0.114625	-0.140913	-0.125082	-0.126346	-0.141467	-0.124241	-0.100413	-0.133805	-0.030017	-0.117041
featureA71	-0.119214	-0.108963	-0.133705	-0.119752	-0.119648	-0.135165	-0.119174	-0.096500	-0.126795	-0.015264	-0.113228
featureA72	-0.144263	-0.145739	-0.144185	-0.158176	-0.155131	-0.120427	-0.136371	-0.134792	-0.141515	-0.014820	-0.162032
featureA73	-0.145320	-0.150584	-0.150576	-0.148184	-0.151523	-0.132255	-0.132345	-0.131213	-0.156997	-0.013186	-0.154202
featureA74	-0.140776	-0.140480	-0.152129	-0.140296	-0.145936	-0.136044	-0.129207	-0.125509	-0.151731	-0.016759	-0.145652
featureA75	-0.133531	-0.131403	-0.146281	-0.131203	-0.139004	-0.133324	-0.127589	-0.115117	-0.144280	-0.012920	-0.133576
featureA76	-0.127793	-0.124637	-0.139500	-0.125927	-0.131797	-0.133727	-0.123481	-0.106456	-0.139600	-0.012030	-0.125015
featureA77	-0.122165	-0.117041	-0.133920	-0.119911	-0.125410	-0.130992	-0.117491	-0.101183	-0.133284	-0.017244	-0.120249
featureA78	-0.116649	-0.111077	-0.128856	-0.114941	-0.119555	-0.126149	-0.111307	-0.094628	-0.126764	-0.021053	-0.116559
featureA79	-0.111885	-0.104714	-0.122726	-0.111555	-0.113996	-0.124349	-0.105971	-0.088764	-0.121570	-0.029987	-0.113317
featureA80	-0.107337	-0.100287	-0.117060	-0.107287	-0.108520	-0.119325	-0.101770	-0.085269	-0.116418	-0.014819	-0.110094
featureA81	0.099199	0.108541	0.092907	0.103008	0.107523	0.074906	0.089452	0.094929	0.099023	0.313057	0.122505
featureA82	0.054028	0.049521	0.060357	0.048483	0.042651	0.054624	0.053800	0.057433	0.069447	0.079216	0.049934
featureA83	0.031316	0.028612	0.035938	0.023872	0.015749	0.043549	0.036346	0.037105	0.043730	-0.049578	0.016940
featureA84	0.023479	0.017556	0.030639	0.019311	0.012006	0.031666	0.024905	0.028410	0.033763	-0.057837	0.013055
featureA85	0.018639	0.013863	0.024502	0.013854	0.013959	0.026799	0.017416	0.024993	0.022552	-0.063899	0.009814
featureA86	0.016109	0.015979	0.021321	0.010435	0.004277	0.023826	0.016061	0.014590	0.025991	-0.061366	0.012498
featureA87	0.011692	0.006493	0.010576	0.010208	0.001153	0.017712	0.014996	0.014203	0.018870	-0.052190	0.011019
featureA88	0.012019	0.004824	0.013058	0.008668	0.003903	0.018097	0.015441	0.013565	0.023813	-0.043873	0.006803
featureA89	0.010805	0.009458	0.013203	0.010019	0.010305	0.017617	0.003471	0.010076	0.016277	-0.030819	0.006823
featureA90	0.008236	0.003350	0.014166	0.008586	0.007349	0.009511	0.002053	0.012486	0.014960	-0.043692	0.001664
featureA91	0.091339	0.094509	0.092099	0.090636	0.089228	0.077506	0.082582	0.089038	0.103241	0.257198	0.103214
featureA92	0.082033	0.081890	0.083177	0.078787	0.073867	0.077709	0.076617	0.082549	0.097260	0.224704	0.086437
featureA93	0.075249	0.072970	0.079602	0.072611	0.064536	0.073560	0.069469	0.076121	0.091273	0.192175	0.077094
featureA94	0.070055	0.067003	0.073607	0.067451	0.062308	0.070618	0.063946	0.071491	0.084438	0.163021	0.069631
featureA95	0.066410	0.064208	0.071346	0.062653	0.058891	0.066920	0.059254	0.066380	0.081367	0.136193	0.066668
featureA96	0.063344	0.059265	0.065585	0.059768	0.054962	0.064877	0.057270	0.064039	0.078344	0.110944	0.065989
featureA97	0.060610	0.054640	0.062377	0.056067	0.052468	0.061439	0.056381	0.062005	0.076175	0.098139	0.063939
featureA98	0.059124	0.053909	0.060586	0.055782	0.052660	0.060410	0.051861	0.060855	0.073681	0.089630	0.062370
featureA99	0.057375	0.051983	0.060684	0.054227	0.052246	0.058198	0.048306	0.060245	0.071775	0.078675	0.058711
featureA100	0.094542	0.105510	0.081102	0.095203	0.088161	0.079324	0.076395	0.118707	0.097804	0.291700	0.108673

	mean	688001	688002	688003	688004	688005	688006	688007	688008	688009	688010
featureA101	0.074719	0.068415	0.078492	0.070544	0.063007	0.089682	0.066461	0.087577	0.078641	0.110071	0.069649
featureA102	0.065816	0.074989	0.067463	0.069654	0.081674	0.044042	0.064014	0.040829	0.065483	0.218598	0.084194
featureA103	0.027119	0.023560	0.028958	0.028636	0.027323	0.020618	0.023815	0.025488	0.033197	0.007970	0.032477
featureA104	0.071705	0.068462	0.073439	0.068291	0.065281	0.070213	0.063476	0.072850	0.086731	0.180879	0.076604
featureA105	0.071708	0.068456	0.073432	0.068279	0.065300	0.070204	0.063499	0.072849	0.086717	0.180969	0.076639
featureA106	-0.131091	-0.139383	-0.145901	-0.133767	-0.139572	-0.110723	-0.136610	-0.110710	-0.123327	-0.131853	-0.139829
featureA107	-0.149829	-0.155659	-0.166463	-0.154607	-0.156490	-0.129707	-0.154446	-0.126918	-0.146718	-0.171945	-0.157455
featureA108	-0.161440	-0.164394	-0.181518	-0.162481	-0.165744	-0.145092	-0.162895	-0.138280	-0.164121	-0.222321	-0.168430
featureA109	0.086093	0.090149	0.089452	0.088875	0.100189	0.072708	0.089651	0.064291	0.075941	0.261981	0.103577
featureA110	0.097233	0.102341	0.103768	0.100083	0.110692	0.080642	0.100455	0.074291	0.093269	0.230187	0.109554
featureA111	0.096841	0.102140	0.106052	0.099634	0.108407	0.084842	0.096426	0.074239	0.098348	0.205408	0.101479
featureA112	0.091557	0.097037	0.102812	0.094300	0.101529	0.081498	0.091067	0.068976	0.094921	0.193888	0.091875
featureA113	0.082886	0.086605	0.094766	0.084422	0.091159	0.074254	0.084388	0.060418	0.088525	0.180021	0.081435
featureA114	0.072932	0.076896	0.085096	0.072491	0.079273	0.067866	0.071692	0.054127	0.078946	0.158270	0.070001
featureA115	0.061939	0.064249	0.072119	0.061452	0.066293	0.060194	0.061087	0.044324	0.068231	0.122450	0.059503
featureA116	0.050222	0.050511	0.056231	0.048954	0.052951	0.048323	0.051618	0.036151	0.058883	0.095109	0.048376
featureA117	0.035554	0.033510	0.036566	0.034474	0.035434	0.035379	0.037111	0.023636	0.044936	0.066740	0.038943
featureA118	-0.192327	-0.190058	-0.215328	-0.195314	-0.205266	-0.178776	-0.199495	-0.151584	-0.196803	-0.239488	-0.198319
featureA119	-0.161745	-0.162873	-0.173516	-0.167712	-0.182328	-0.136873	-0.163057	-0.138978	-0.152354	-0.284529	-0.178014
featureA120	-0.069373	-0.052712	-0.085672	-0.067743	-0.053307	-0.100602	-0.091658	-0.053254	-0.076564	0.176615	-0.042845
featureA121	-0.068187	-0.069895	-0.081466	-0.066074	-0.076002	-0.065318	-0.072690	-0.045461	-0.076106	-0.111652	-0.060675
featureA122	0.001752	0.000635	0.008246	0.000211	-0.002858	0.000761	0.003889	0.000169	0.006714	0.000649	-0.001996
featureA123	0.147356	0.133768	0.172319	0.145385	0.137795	0.161559	0.162666	0.124068	0.156478	0.000652	0.132168
featureA124	0.169747	0.162140	0.192369	0.171801	0.162165	0.181618	0.176364	0.150803	0.172624	0.003019	0.157838
featureA125	0.096522	0.099317	0.099214	0.093850	0.099918	0.085852	0.079881	0.092899	0.106782	0.289006	0.110983
featureA126	-0.111845	-0.097970	-0.124666	-0.111844	-0.109790	-0.124970	-0.121644	-0.089552	-0.123977	-0.078904	-0.102192
featureA127	-0.127117	-0.117266	-0.139615	-0.127300	-0.125988	-0.136763	-0.136100	-0.102713	-0.139465	0.001102	-0.118845
featureA128	0.094108	0.104882	0.080856	0.094914	0.087868	0.079124	0.075969	0.117737	0.097628	0.283910	0.107995
featureA129	0.189113	0.186709	0.213772	0.191734	0.199979	0.181516	0.195409	0.154530	0.193096	0.009038	0.185271

其中，mean 的绝对值大于 0.1 的有：

```
Index(['featureA21', 'featureA22', 'featureA23', 'featureA24', 'featureA25',
       'featureA38', 'featureA39', 'featureA40', 'featureA41', 'featureA42',
       'featureA43', 'featureA63', 'featureA64', 'featureA65', 'featureA66',
       'featureA67', 'featureA68', 'featureA69', 'featureA70', 'featureA71',
       'featureA72', 'featureA73', 'featureA74', 'featureA75', 'featureA76',
       'featureA77', 'featureA78', 'featureA79', 'featureA80', 'featureA106',
       'featureA107', 'featureA108', 'featureA118', 'featureA119',
       'featureA123', 'featureA124', 'featureA126', 'featureA127',
       'featureA129'],
      dtype='object')
```

A.2 B 类特征效果

	mean	688001	688002	688003	688004	688005	688006	688007	688008	688009	688010
featureB1	0.043117	0.059937	0.035177	0.062317	0.061708	0.044873	0.015853	0.020317	0.054211	-0.003627	0.033658
featureB2	0.045574	0.049043	0.041886	0.060139	0.049402	0.050304	0.029107	0.035788	0.052937	-0.005234	0.041559
featureB3	0.031259	0.038217	0.031507	0.047882	0.051257	0.034140	0.005972	0.013237	0.035022	0.008617	0.024102
featureB4	0.041568	0.043715	0.040410	0.058366	0.048267	0.043857	0.026685	0.027558	0.045078	-0.002153	0.040173
featureB5	0.103141	0.104119	0.113725	0.093241	0.045978	0.144646	0.107796	0.127253	0.127059	0.045562	0.064455
featureB6	0.082631	0.074723	0.094405	0.070197	0.029613	0.122342	0.094499	0.110072	0.102983	0.023066	0.044849
featureB7	0.104543	0.100978	0.119108	0.102441	0.044052	0.153266	0.112271	0.129089	0.131261	0.025868	0.048420
featureB8	0.067921	0.056384	0.079684	0.056910	0.017240	0.113779	0.083287	0.090772	0.087657	0.009074	0.025580
featureB9	0.025578	0.024696	0.032045	0.034019	0.014188	0.033719	0.032227	0.019101	0.033535	-0.072564	0.006670
featureB10	0.015934	0.009847	0.021882	0.020966	-0.001975	0.027105	0.022947	0.013525	0.027322	-0.085883	0.001787
featureB11	0.007098	0.009137	0.009611	0.009850	0.008841	0.007004	0.002481	0.002419	0.003605	0.028092	0.010933
featureB12	0.026565	0.035865	0.029122	0.026578	0.023569	0.021444	0.016178	0.027482	0.022712	0.083410	0.036136
featureB13	0.034475	0.049154	0.029768	0.034564	0.031986	0.026747	0.020071	0.037194	0.031749	0.054355	0.049038
featureB14	0.037524	0.054467	0.034985	0.034509	0.031046	0.032590	0.018965	0.037506	0.047446	0.026547	0.046202

其中，mean 的绝对值大于 0.1 的只有 B5、B7。

A.3 C 类特征效果

	mean	688001	688002	688003	688004	688005	688006	688007	688008	688009	688010
featureC1	0.102807	0.113715	0.104346	0.112995	0.077191	0.125177	0.084404	0.111380	0.118004	0.059697	0.078051
featureC2	0.094382	0.101101	0.093686	0.110482	0.079952	0.097244	0.077475	0.110908	0.094823	0.077098	0.083763
featureC3	0.073716	0.071926	0.077037	0.084779	0.061731	0.099782	0.072537	0.073396	0.079954	-0.179348	0.042302
featureC4	0.063312	0.056960	0.073293	0.064110	0.024057	0.115018	0.068130	0.072411	0.084586	-0.204788	0.011244
featureC5	0.071678	0.066911	0.082075	0.075308	0.031688	0.120194	0.073057	0.083563	0.091414	-0.200730	0.020892
featureC6	0.052581	0.045352	0.061690	0.050378	0.015339	0.104519	0.060443	0.059450	0.074686	-0.208703	0.001376
featureC7	0.083443	0.075800	0.099572	0.057754	0.022647	0.112677	0.104579	0.111520	0.117218	0.074590	0.049220
featureC8	0.060798	0.053453	0.070664	0.065173	0.060299	0.053690	0.067602	0.062877	0.051298	0.094596	0.062123
featureC9	0.057827	0.071743	0.061648	0.073873	0.037629	0.068457	0.032811	0.064315	0.071392	0.042377	0.038578

其中，mean 的绝对值大于 0.1 的只有 C1。

A.4 D 类特征效果

D 类特征较为特殊，虽然特征都是 15s 提取一个，但是回看时间可以不是 15s，下面的后缀表示回看时间。

	mean	688001	688002	688003	688004	688005	688006	688007	688008	688009	688010
realized absolute variation_15s	0.013475	0.010688	0.020109	0.015881	0.003143	0.002313	0.024623	0.011267	0.024444	0.013400	0.008803
realized absolute variation_60s	0.008015	0.009396	0.013397	0.015354	0.007027	0.004582	0.007017	0.005222	-0.000431	0.004649	0.010570
realized volatility_15s	0.008619	0.006473	0.012380	0.009923	-0.002967	-0.001048	0.021552	0.005051	0.021913	0.014523	0.004291
realized volatility_60s	0.006121	0.010697	0.009116	0.011293	0.001798	0.005510	0.008650	0.004621	-0.004678	0.006292	0.008082
realized skew_15s	-0.037365	-0.049881	-0.042842	-0.037820	-0.059588	0.006530	-0.043507	-0.017108	-0.023651	-0.199381	-0.068421
realized skew_60s	-0.033183	-0.038591	-0.032038	-0.019977	-0.053327	-0.016417	-0.039909	-0.022523	-0.022088	-0.153131	-0.053779
realized kurtosis_15s	0.007421	0.006637	0.015267	0.010859	0.002153	0.004885	0.011015	0.005826	0.016515	0.013339	-0.006370
realized kurtosis_60s	0.002798	0.005776	0.010069	0.004137	-0.000511	0.001533	-0.004825	0.001761	0.003793	0.009822	0.003451
integrated quarticity_15s	0.002793	-0.000982	0.006090	0.002048	-0.013029	-0.004341	0.018003	-0.002118	0.016299	0.014591	0.003168
integrated quarticity_60s	0.003163	0.007820	0.002114	0.003120	-0.002839	0.006538	0.012337	0.002202	-0.007739	0.007272	0.004919
realized bipower variation_15s	0.008496	0.004789	0.007301	0.011241	0.007031	-0.001985	0.020452	0.005152	0.019853	0.014903	0.002633
realized bipower variation_60s	0.005787	0.009401	0.008922	0.014208	0.007735	0.003455	0.008383	0.002144	-0.007163	0.004526	0.004999
jump process_15s	0.003497	0.009795	0.014782	0.005025	-0.006932	0.003429	0.009542	-0.003861	0.005019	0.004242	-0.005324
jump process_60s	0.004035	0.009708	0.003929	0.002007	-0.005200	0.006410	0.004368	0.005208	0.001979	0.004521	0.007903
downside volatility Proportion_15s	-0.010042	-0.004090	-0.009321	-0.013925	0.000643	-0.039359	-0.004273	-0.016048	-0.018040	0.138476	0.014035
downside volatility Proportion_60s	0.012880	0.010971	0.019287	-0.007235	0.009133	0.009679	0.032386	0.010929	0.007244	0.106158	0.023522
trend strength_15s	0.019450	0.011224	0.020804	0.023838	0.001496	0.050904	0.018282	0.029770	0.028795	-0.201228	-0.010065
trend strength_60s	-0.002524	-0.000053	-0.006435	0.018311	-0.002733	0.000587	-0.022528	-0.000113	0.006478	-0.164409	-0.016226
net inflow ratio_15s	0.026225	0.023420	0.034146	0.023173	0.004960	0.046389	0.025215	0.032038	0.033400	-0.073251	0.013285
net inflow ratio_60s	0.008408	0.005707	0.012851	0.016485	0.001514	0.009540	0.008541	0.007014	0.010644	-0.056204	0.003372
amount flow imb_15s	0.042128	0.058762	0.042325	0.053354	0.019654	0.059615	0.014409	0.046092	0.061089	-0.057201	0.023850
amount flow imb_60s	0.011277	0.016448	0.006208	0.034499	0.021030	0.002382	-0.014561	0.002799	0.016670	-0.048346	0.016013
num flow imb_15s	0.042608	0.054782	0.040248	0.058534	0.014562	0.068370	0.016297	0.047607	0.066973	-0.089685	0.016096
num flow imb_60s	0.008510	0.013350	0.003283	0.036575	0.017941	0.004399	-0.019397	-0.002246	0.014784	-0.074001	0.007898
modeling shape feature	0.166908	0.170075	0.185616	0.174297	0.137562	0.159082	0.181216	0.171400	0.149522	0.237328	0.173405

其中，mean 的绝对值大于 0.1 的只有 modeling shape feature。

A.5 发现的特征近似重复

1. A100 和 A128 相关性高达 0.99。
2. D13 的退化版：价格不取对数，且假设 $\beta_{ask} = \beta_{bid}$，与 A118 做 15s 上的差分完全相同。