



Case Studies of Data Analysis and Machine Learning for Market Microstructures

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Outline

- Introduction
- Useful Techniques in Python
- Preliminaries on the Limit Order book (LOB)
- Futures Contract Rollover
- Stocks Buy-Back Analysis
- Flickering Quotes Analysis
- Forecast of Market Contango Ratio
- Strategy by LSTM/MLP Classifier

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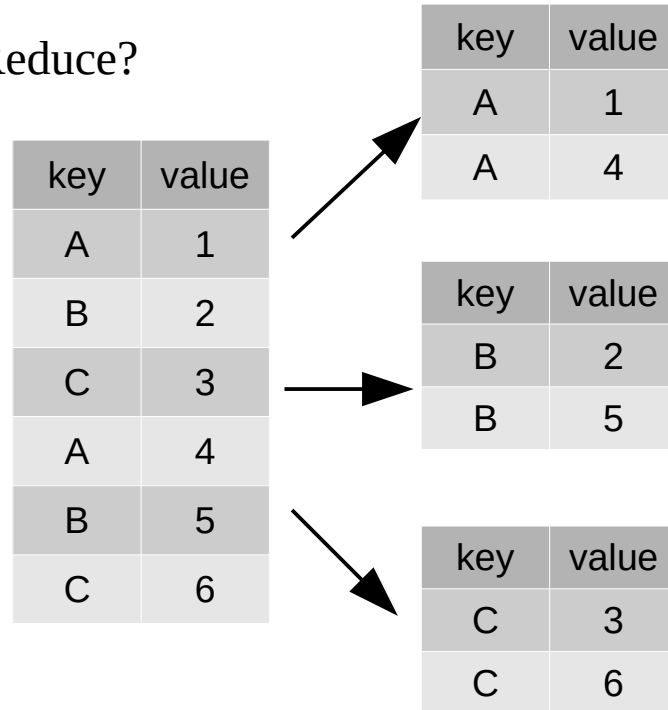
GroupBy

- Split, apply, and combine.
 - It resembles MapReduce?

| key | value |
|-----|-------|
| A | 1 |
| B | 2 |
| C | 3 |
| A | 4 |
| B | 5 |
| C | 6 |

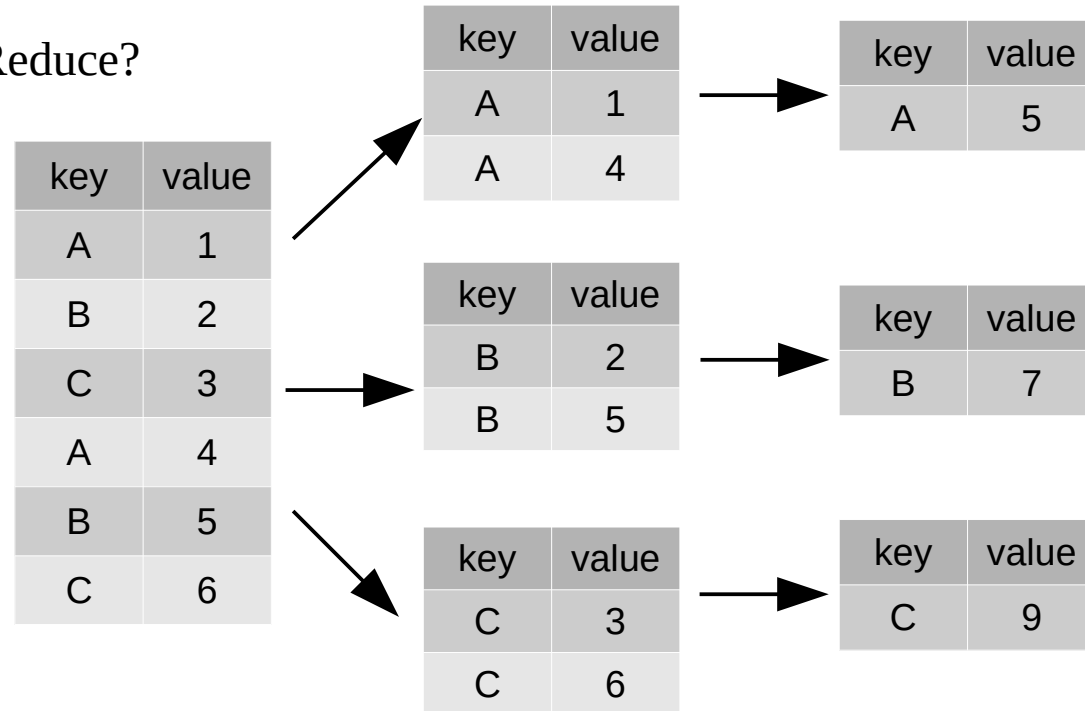
GroupBy

- **Split**, apply, and combine.
 - It resembles MapReduce?



GroupBy

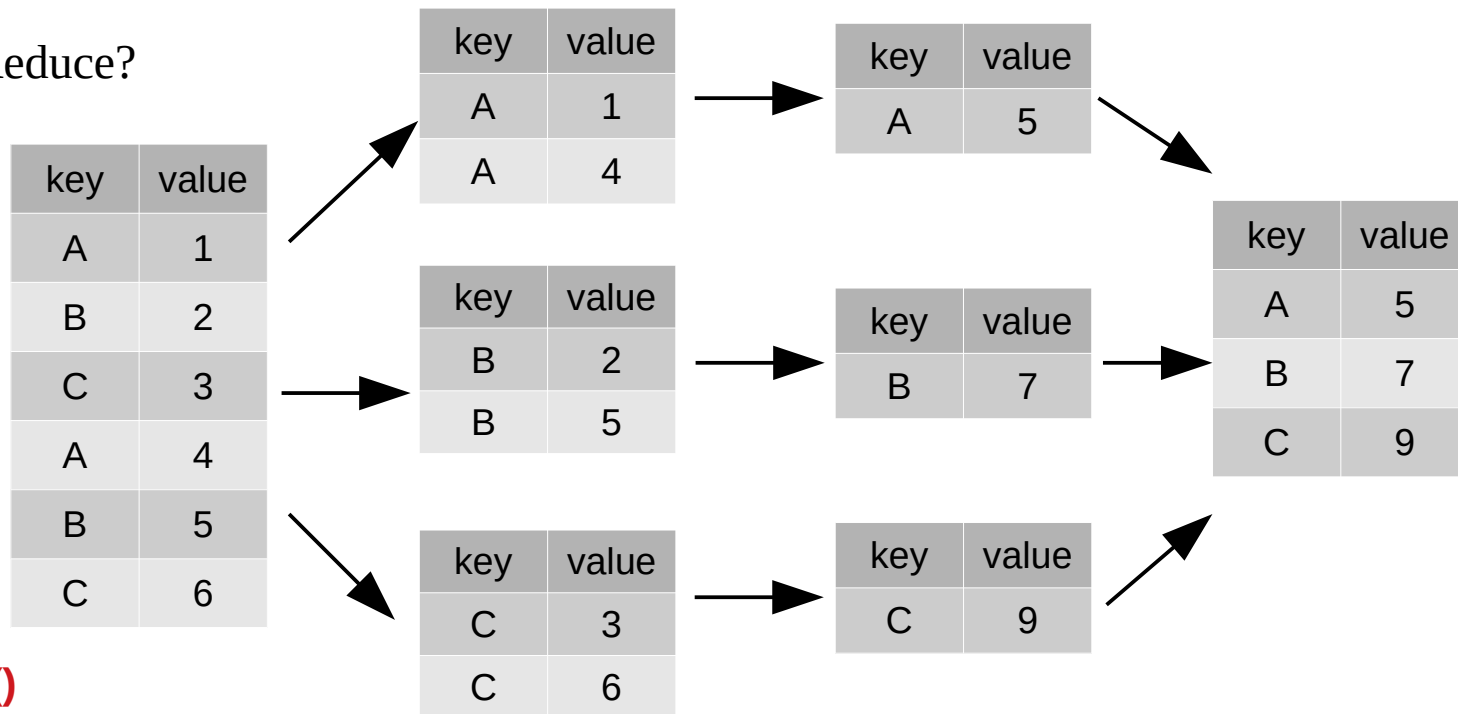
- Split, **apply**, and combine.
 - It resembles MapReduce?



GroupBy

- Split, apply, and **combine**.

- It resembles MapReduce?



`df.groupby('key').sum()`

GroupBy (aggregations)

```
df.groupby('key').aggregate(['min', np.median, max])
```

| | key | value1 | value2 |
|---|-----|--------|--------|
| 0 | A | 0 | 5 |
| 1 | B | 1 | 0 |
| 2 | C | 2 | 3 |
| 3 | A | 3 | 3 |
| 4 | B | 4 | 7 |
| 5 | C | 5 | 9 |

| | value1 | | | value2 | | |
|-----|--------|--------|-----|--------|--------|-----|
| | min | median | max | min | median | max |
| key | | | | | | |
| A | 0 | 1.5 | 3 | 3 | 4.0 | 5 |
| B | 1 | 2.5 | 4 | 0 | 3.5 | 7 |
| C | 2 | 3.5 | 5 | 3 | 6.0 | 9 |

GroupBy (self defined aggregation)

```
def filter_func(x):  
    return x['value2'].std() > 4
```

```
df.groupby('key').filter(filter_func)
```

| | key | value1 | value2 |
|---|-----|--------|--------|
| 0 | A | 0 | 5 |
| 1 | B | 1 | 0 |
| 2 | C | 2 | 3 |
| 3 | A | 3 | 3 |
| 4 | B | 4 | 7 |
| 5 | C | 5 | 9 |



| | value1 | value2 |
|---|--------|--------|
| A | 2.1213 | 1.4142 |
| B | 2.1213 | 4.9497 |
| C | 2.1213 | 4.2426 |

```
df.groupby('key').std()
```

| | key | value1 | value2 |
|---|-----|--------|--------|
| 1 | B | 1 | 0 |
| 2 | C | 2 | 3 |
| 4 | B | 4 | 7 |
| 5 | C | 5 | 9 |

df.resample

```
df = df_raw.resample('1Min').apply({'L1-BidPrice': 'last', 'L1-BidSize': lambda x: stats.mode(x)[0],  
                                   'L1-AskPrice': 'last', 'L1-AskSize': lambda x: stats.mode(x)[0]})
```

| Date-Time | L1-BidPrice | L1-AskPrice | L1-BidSize | L1-AskSize |
|-------------------------------------|-------------|-------------|------------|------------|
| 2021-02-19 15:07:15.239982417+08:00 | 16366 | 16368 | 14 | 4 |
| 2021-02-19 15:07:15.363440693+08:00 | 16366 | 16368 | 14 | 2 |
| 2021-02-19 15:07:15.615356297+08:00 | 16366 | 16369 | 15 | 13 |
| 2021-02-19 15:07:15.739785037+08:00 | 16367 | 16369 | 1 | 12 |
| 2021-02-19 15:07:15.987728899+08:00 | 16367 | 16369 | 2 | 8 |
| 2021-02-19 15:07:16.239607170+08:00 | 16367 | 16369 | 3 | 7 |
| 2021-02-19 15:07:16.364029692+08:00 | 16367 | 16369 | 2 | 7 |
| 2021-02-19 15:07:16.739406437+08:00 | 16367 | 16369 | 2 | 8 |
| 2021-02-19 15:07:16.863839355+08:00 | 16367 | 16369 | 2 | 10 |
| 2021-02-19 15:07:16.987312834+08:00 | 16367 | 16369 | 1 | 11 |
| 2021-02-19 15:07:17.739982908+08:00 | 16366 | 16368 | 16 | 4 |
| 2021-02-19 15:07:17.863457154+08:00 | 16367 | 16369 | 4 | 11 |
| 2021-02-19 15:07:17.987909162+08:00 | 16367 | 16369 | 4 | 9 |
| 2021-02-19 15:07:18.115332748+08:00 | 16367 | 16369 | 2 | 9 |
| 2021-02-19 15:07:18.239825617+08:00 | 16367 | 16369 | 2 | 10 |



| Date-Time | L1-BidPrice | L1-BidSize | L1-AskPrice | L1-AskSize |
|---------------------------|-------------|------------|-------------|------------|
| 2021-02-19 15:07:00+08:00 | 16368 | 1 | 16369 | 5 |
| 2021-02-19 15:08:00+08:00 | 16368 | 11 | 16369 | 9 |
| 2021-02-19 15:09:00+08:00 | 16368 | 11 | 16369 | 1 |
| 2021-02-19 15:10:00+08:00 | 16367 | 10 | 16368 | 1 |
| 2021-02-19 15:11:00+08:00 | 16368 | 23 | 16369 | 21 |
| 2021-02-19 15:12:00+08:00 | 16365 | 23 | 16366 | 4 |
| 2021-02-19 15:13:00+08:00 | 16370 | 1 | 16371 | 11 |
| 2021-02-19 15:14:00+08:00 | 16372 | 2 | 16374 | 4 |
| 2021-02-19 15:15:00+08:00 | 16368 | 3 | 16370 | 1 |
| 2021-02-19 15:16:00+08:00 | 16371 | 1 | 16372 | 5 |
| 2021-02-19 15:17:00+08:00 | 16372 | 5 | 16373 | 2 |
| 2021-02-19 15:18:00+08:00 | 16370 | 2 | 16371 | 1 |
| 2021-02-19 15:19:00+08:00 | 16376 | 8 | 16377 | 1 |
| 2021-02-19 15:20:00+08:00 | 16376 | 1 | 16378 | 3 |
| 2021-02-19 15:21:00+08:00 | 16373 | 4 | 16374 | 1 |

Forward Fill

```
df['position'] = df['signal'].shift(1).fillna(method='ffill')
```

| Date-Time | L1-BidPrice | L1-BidSize | L1-AskPrice | L1-AskSize | signal |
|---------------------------|-------------|------------|-------------|------------|--------|
| 2021-02-19 18:32:00+08:00 | 16402 | 11 | 16403 | 2 | -1 |
| 2021-02-19 18:33:00+08:00 | 16401 | 2 | 16402 | 10 | -1 |
| 2021-02-19 18:34:00+08:00 | 16401 | 1 | 16402 | 7 | -1 |
| 2021-02-19 18:35:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:36:00+08:00 | 16399 | 16 | 16401 | 19 | -1 |
| 2021-02-19 18:37:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:38:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:39:00+08:00 | 16403 | 1 | 16405 | 32 | 1 |
| 2021-02-19 18:40:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:41:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:42:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:43:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:44:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:45:00+08:00 | 16406 | 2 | 16407 | 2 | 1 |
| 2021-02-19 18:46:00+08:00 | 16405 | 7 | 16406 | 31 | 1 |
| 2021-02-19 18:47:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:48:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:49:00+08:00 | nan | nan | nan | nan | nan |
| 2021-02-19 18:50:00+08:00 | 16404 | 2 | 16405 | 28 | -1 |



| Date-Time | L1-BidPrice | L1-BidSize | L1-AskPrice | L1-AskSize | signal | position |
|---------------------------|-------------|------------|-------------|------------|--------|----------|
| 2021-02-19 18:32:00+08:00 | 16402 | 11 | 16403 | 2 | -1 | -1 |
| 2021-02-19 18:33:00+08:00 | 16401 | 2 | 16402 | 10 | -1 | -1 |
| 2021-02-19 18:34:00+08:00 | 16401 | 1 | 16402 | 7 | -1 | -1 |
| 2021-02-19 18:35:00+08:00 | nan | nan | nan | nan | nan | -1 |
| 2021-02-19 18:36:00+08:00 | 16399 | 16 | 16401 | 19 | -1 | -1 |
| 2021-02-19 18:37:00+08:00 | nan | nan | nan | nan | nan | -1 |
| 2021-02-19 18:38:00+08:00 | nan | nan | nan | nan | nan | -1 |
| 2021-02-19 18:39:00+08:00 | 16403 | 1 | 16405 | 32 | 1 | -1 |
| 2021-02-19 18:40:00+08:00 | nan | nan | nan | nan | nan | 1 |
| 2021-02-19 18:41:00+08:00 | nan | nan | nan | nan | nan | 1 |
| 2021-02-19 18:42:00+08:00 | nan | nan | nan | nan | nan | 1 |
| 2021-02-19 18:43:00+08:00 | nan | nan | nan | nan | nan | 1 |
| 2021-02-19 18:44:00+08:00 | nan | nan | nan | nan | nan | 1 |
| 2021-02-19 18:45:00+08:00 | 16406 | 2 | 16407 | 2 | 1 | 1 |
| 2021-02-19 18:46:00+08:00 | 16405 | 7 | 16406 | 31 | 1 | 1 |
| 2021-02-19 18:47:00+08:00 | nan | nan | nan | nan | nan | 1 |
| 2021-02-19 18:48:00+08:00 | nan | nan | nan | nan | nan | 1 |
| 2021-02-19 18:49:00+08:00 | nan | nan | nan | nan | nan | 1 |
| 2021-02-19 18:50:00+08:00 | 16404 | 2 | 16405 | 28 | -1 | 1 |

pandas.merge_asof

https://pandas.pydata.org/pandas-docs/version/0.25.0/reference/api/pandas.merge_asof.html

```
>>> quotes
```

| | time | ticker | bid | ask |
|---|-------------------------|--------|--------|--------|
| 0 | 2016-05-25 13:30:00.023 | GOOG | 720.50 | 720.93 |
| 1 | 2016-05-25 13:30:00.023 | MSFT | 51.95 | 51.96 |
| 2 | 2016-05-25 13:30:00.030 | MSFT | 51.97 | 51.98 |
| 3 | 2016-05-25 13:30:00.041 | MSFT | 51.99 | 52.00 |
| 4 | 2016-05-25 13:30:00.048 | GOOG | 720.50 | 720.93 |
| 5 | 2016-05-25 13:30:00.049 | AAPL | 97.99 | 98.01 |
| 6 | 2016-05-25 13:30:00.072 | GOOG | 720.50 | 720.88 |
| 7 | 2016-05-25 13:30:00.075 | MSFT | 52.01 | 52.03 |

```
>>> trades
```

| | time | ticker | price | quantity |
|---|-------------------------|--------|--------|----------|
| 0 | 2016-05-25 13:30:00.023 | MSFT | 51.95 | 75 |
| 1 | 2016-05-25 13:30:00.038 | MSFT | 51.95 | 155 |
| 2 | 2016-05-25 13:30:00.048 | GOOG | 720.77 | 100 |
| 3 | 2016-05-25 13:30:00.048 | GOOG | 720.92 | 100 |
| 4 | 2016-05-25 13:30:00.048 | AAPL | 98.00 | 100 |

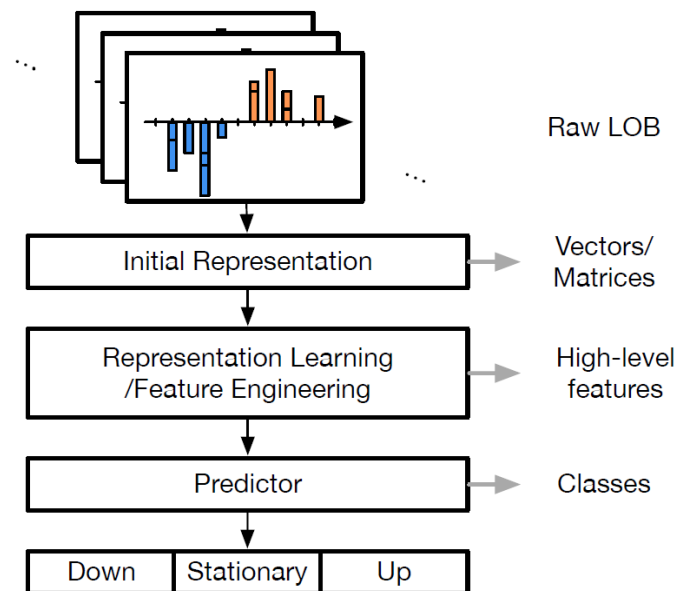
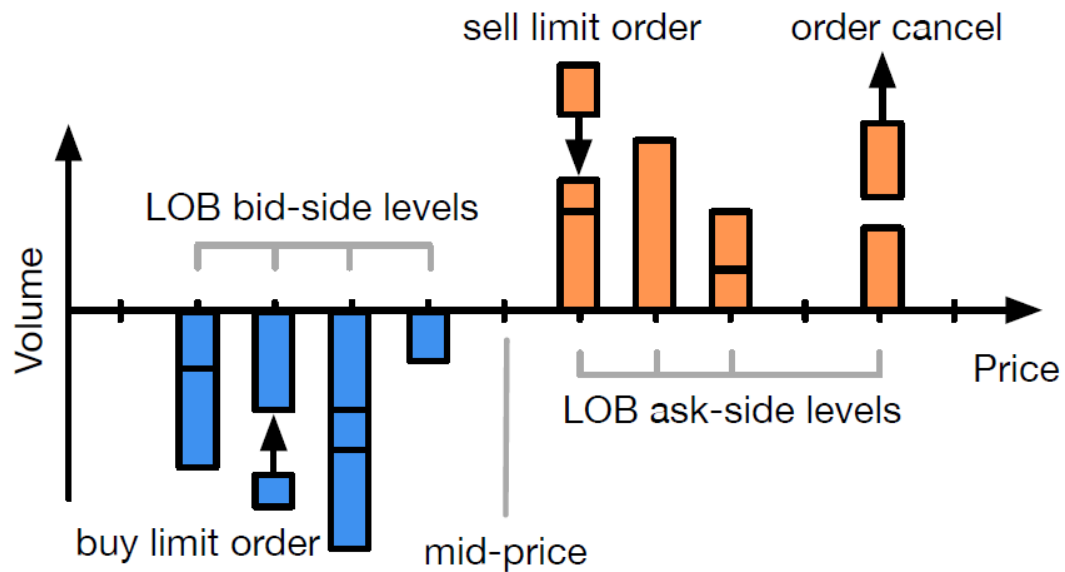
```
>>> pd.merge_asof(trades, quotes,  
...               on='time',  
...               by='ticker',  
...               tolerance=pd.Timedelta('2ms'))
```

| | time | ticker | price | quantity | bid | ask |
|---|-------------------------|--------|--------|----------|--------|--------|
| 0 | 2016-05-25 13:30:00.023 | MSFT | 51.95 | 75 | 51.95 | 51.96 |
| 1 | 2016-05-25 13:30:00.038 | MSFT | 51.95 | 155 | NaN | NaN |
| 2 | 2016-05-25 13:30:00.048 | GOOG | 720.77 | 100 | 720.50 | 720.93 |
| 3 | 2016-05-25 13:30:00.048 | GOOG | 720.92 | 100 | 720.50 | 720.93 |
| 4 | 2016-05-25 13:30:00.048 | AAPL | 98.00 | 100 | NaN | NaN |

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Limit Order Book



Reference:

Towards Robust Representation of Limit Orders Books for Deep Learning Models.

Y. Wu, M. Mahfouz, D. Magazzeni, and M. Veloso.

Limit Order Book

limit order book

| | price | volume |
|-------|-------|--------|
| Ask | | |
| | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 10 |
| | 480 | 05 |
| ----- | | |
| Bid | | |
| | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

Limit Order Book

limit order book

| | price | volume |
|-------|-------|--------|
| Ask | | |
| | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 10 |
| | 480 | 05 |
| ----- | | |
| Bid | | |
| | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

Alice wants to sell the stock
at price 480 for 2 shares (1st)

Allen wants to sell the stock
at price 480 for 8 shares (2nd)

Limit Order Book

limit order book

| | price | volume |
|-------|-------|-----------|
| Ask | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 10 |
| | 480 | 15 |
| ----- | | |
| Bid | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

Limit Order Book

limit order book

| | price | volume |
|-------|-------|--------|
| Ask | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 10 |
| | 480 | 15 |
| ----- | | |
| Bid | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

if somebody want to buy the stock at price 480, Alice's shares will be sold before Allen.

Price Formation (by Market Orders)

limit order book (t)

| | price | volume |
|-------|-------|--------|
| Ask | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 10 |
| | 480 | 15 |
| ----- | | |
| Bid | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

* Assume a series of market orders coming and no new limit orders appears in the mean time.

| Time | $t+1$ | $t+2$ | $t+3$ | $t+4$ |
|-------------|-------|-------|-------|-------|
| Trade price | | | | |

Price Formation (by Market Orders)

limit order book ($t+1$)

| | price | volume |
|-------|------------|-----------|
| Ask | | |
| | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 10 |
| | 480 | 15 |
| ----- | | |
| Bid | | |
| | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

* Assume a series of market orders coming and no new limit orders appears in the mean time.

| Time | $t+1$ | $t+2$ | $t+3$ | $t+4$ |
|-------------|-------|-------|-------|-------|
| Trade price | | | | |

(market buy, 10)

Price Formation (by Market Orders)

limit order book ($t+1$)

| | price | volume |
|-------|-------|--------|
| Ask | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 10 |
| | 480 | 05 |
| ----- | | |
| Bid | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

* Assume a series of market orders coming and no new limit orders appears in the mean time.

| Time | $t+1$ | $t+2$ | $t+3$ | $t+4$ |
|-------------|-------|-------|-------|-------|
| Trade price | 480 | | | |

Price Formation (by Market Orders)

limit order book ($t+2$)

| | price | volume |
|-------|------------|-----------|
| Ask | | |
| | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 10 |
| | 480 | 05 |
| ----- | | |
| Bid | | |
| | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

* Assume a series of market orders coming and no new limit orders appears in the mean time.

| Time | $t+1$ | $t+2$ | $t+3$ | $t+4$ |
|-------------|-------|-------|-------|-------|
| Trade price | 480 | | | |

(market buy, 10)

Price Formation (by Market Orders)

limit order book ($t+2$)

| | price | volume |
|-------|-------|--------|
| Ask | | |
| | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 05 |
| ----- | | |
| Bid | | |
| | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

* Assume a series of market orders coming and no new limit orders appears in the mean time.

| Time | $t+1$ | $t+2$ | $t+3$ | $t+4$ |
|-------------|-------|-------|-------|-------|
| Trade price | 480 | 482.5 | | |

Price Formation (by Market Orders)

limit order book ($t+3$)

| | price | volume |
|-------|------------|-----------|
| Ask | | |
| | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 05 |
| ----- | | |
| Bid | | |
| | 475 | 10 |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

* Assume a series of market orders coming and no new limit orders appears in the mean time.

| Time | $t+1$ | $t+2$ | $t+3$ | $t+4$ |
|-------------|-------|--------|-------|-------|
| Trade price | 480 | 482.50 | | |

(market sell, 10)

Price Formation (by Market Orders)

limit order book ($t+3$)

| | price | volume |
|-------|-------|--------|
| Ask | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 05 |
| ----- | | |
| Bid | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

* Assume a series of market orders coming and no new limit orders appears in the mean time.

| Time | $t+1$ | $t+2$ | $t+3$ | $t+4$ |
|-------------|-------|--------|-------|-------|
| Trade price | 480 | 482.50 | 475 | |

Price Formation (by Market Orders)

limit order book ($t+4$)

| | price | volume |
|-------|------------|-----------|
| Ask | | |
| | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 05 |
| ----- | | |
| Bid | | |
| | 470 | 20 |
| | 465 | 20 |
| | 460 | 25 |
| | 455 | 30 |

* Assume a series of market orders coming and no new limit orders appears in the mean time.

| Time | $t+1$ | $t+2$ | $t+3$ | $t+4$ |
|-------------|-------|--------|-------|-------|
| Trade price | 480 | 482.50 | 475 | |

(market sell, 30)

Price Formation (by Market Orders)

limit order book ($t+4$)

| | price | volume |
|-------|-------|--------|
| Ask | 500 | 30 |
| | 495 | 20 |
| | 490 | 10 |
| | 485 | 05 |
| ----- | | |
| Bid | 465 | 10 |
| | 460 | 25 |
| | 455 | 30 |

* Assume a series of market orders coming and no new limit orders appears in the mean time.

| Time | $t+1$ | $t+2$ | $t+3$ | $t+4$ |
|-------------|-------|--------|-------|--------|
| Trade price | 480 | 482.50 | 475 | 468.33 |

The Orderbook Snapshots

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
|----|-------------------------------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|
| 1 | Date-Time | L1-BidPrice | L1-BidSize | L1-AskPrice | L1-AskSize | L2-BidPrice | L2-BidSize | L2-AskPrice | L2-AskSize | L3-BidPrice | L3-BidSize | L3-AskPrice | L3-AskSize | L4-BidPrice | L4-BidSize |
| 2 | 2021-02-19 15:07:15.239982417+08:00 | 16366 | 14 | 16368 | 4 | 16365 | 70 | 16369 | 14 | 16364 | 61 | 16370 | 15 | 16363 | |
| 3 | 2021-02-19 15:07:15.363440693+08:00 | 16366 | 14 | 16368 | 2 | 16365 | 70 | 16369 | 14 | 16364 | 61 | 16370 | 15 | 16363 | |
| 4 | 2021-02-19 15:07:15.615356297+08:00 | 16366 | 15 | 16369 | 13 | 16365 | 71 | 16370 | 15 | 16364 | 61 | 16371 | 38 | 16363 | |
| 5 | 2021-02-19 15:07:15.739785037+08:00 | 16367 | 1 | 16369 | 12 | 16366 | 16 | 16370 | 15 | 16365 | 71 | 16371 | 38 | 16364 | |
| 6 | 2021-02-19 15:07:15.987728899+08:00 | 16367 | 2 | 16369 | 8 | 16366 | 17 | 16370 | 15 | 16365 | 71 | 16371 | 38 | 16364 | |
| 7 | 2021-02-19 15:07:16.239607170+08:00 | 16367 | 3 | 16369 | 7 | 16366 | 18 | 16370 | 15 | 16365 | 71 | 16371 | 38 | 16364 | |
| 8 | 2021-02-19 15:07:16.364029692+08:00 | 16367 | 2 | 16369 | 7 | 16366 | 18 | 16370 | 15 | 16365 | 72 | 16371 | 38 | 16364 | |
| 9 | 2021-02-19 15:07:16.739406437+08:00 | 16367 | 2 | 16369 | 8 | 16366 | 17 | 16370 | 15 | 16365 | 72 | 16371 | 38 | 16364 | |
| 10 | 2021-02-19 15:07:16.863839355+08:00 | 16367 | 2 | 16369 | 10 | 16366 | 17 | 16370 | 15 | 16365 | 72 | 16371 | 38 | 16364 | |
| 11 | 2021-02-19 15:07:16.987312834+08:00 | 16367 | 1 | 16369 | 11 | 16366 | 17 | 16370 | 15 | 16365 | 72 | 16371 | 38 | 16364 | |
| 12 | 2021-02-19 15:07:17.739982908+08:00 | 16366 | 16 | 16368 | 4 | 16365 | 71 | 16369 | 12 | 16364 | 61 | 16370 | 15 | 16363 | |
| 13 | 2021-02-19 15:07:17.863457154+08:00 | 16367 | 4 | 16369 | 11 | 16366 | 17 | 16370 | 15 | 16365 | 72 | 16371 | 38 | 16364 | |
| 14 | 2021-02-19 15:07:17.987909162+08:00 | 16367 | 4 | 16369 | 9 | 16366 | 17 | 16370 | 15 | 16365 | 72 | 16371 | 38 | 16364 | |
| 15 | 2021-02-19 15:07:18.115332748+08:00 | 16367 | 2 | 16369 | 9 | 16366 | 17 | 16370 | 15 | 16365 | 72 | 16371 | 38 | 16364 | |
| 16 | 2021-02-19 15:07:18.239825617+08:00 | 16367 | 2 | 16369 | 10 | 16366 | 17 | 16370 | 15 | 16365 | 72 | 16371 | 38 | 16364 | |
| 17 | 2021-02-19 15:07:18.363259088+08:00 | 16367 | 2 | 16368 | 1 | 16366 | 17 | 16369 | 11 | 16365 | 72 | 16370 | 15 | 16364 | |
| 18 | 2021-02-19 15:07:18.739600095+08:00 | 16367 | 1 | 16368 | 1 | 16366 | 17 | 16369 | 11 | 16365 | 72 | 16370 | 15 | 16364 | |
| 19 | 2021-02-19 15:07:18.864026638+08:00 | 16367 | 1 | 16368 | 1 | 16366 | 19 | 16369 | 11 | 16365 | 72 | 16370 | 15 | 16364 | |
| 20 | 2021-02-19 15:07:19.611751705+08:00 | 16367 | 1 | 16368 | 2 | 16366 | 19 | 16369 | 11 | 16365 | 72 | 16370 | 15 | 16364 | |
| 21 | 2021-02-19 15:07:19.863621185+08:00 | 16367 | 1 | 16368 | 5 | 16366 | 19 | 16369 | 11 | 16365 | 72 | 16370 | 15 | 16364 | |
| 22 | 2021-02-19 15:07:19.987038053+08:00 | 16367 | 1 | 16368 | 5 | 16366 | 19 | 16369 | 12 | 16365 | 71 | 16370 | 15 | 16364 | |
| 23 | 2021-02-19 15:07:20.239979501+08:00 | 16367 | 1 | 16368 | 5 | 16366 | 19 | 16369 | 12 | 16365 | 71 | 16370 | 15 | 16364 | |
| 24 | 2021-02-19 15:07:20.487909164+08:00 | 16367 | 1 | 16368 | 5 | 16366 | 21 | 16369 | 12 | 16365 | 71 | 16370 | 15 | 16364 | |
| 25 | 2021-02-19 15:07:20.987702865+08:00 | 16367 | 3 | 16368 | 5 | 16366 | 21 | 16369 | 12 | 16365 | 72 | 16370 | 15 | 16364 | |
| 26 | 2021-02-19 15:07:21.364031111+08:00 | 16367 | 4 | 16369 | 9 | 16366 | 22 | 16370 | 15 | 16365 | 72 | 16371 | 39 | 16364 | |
| 27 | 2021-02-19 15:07:21.739403070+08:00 | 16367 | 4 | 16369 | 9 | 16366 | 23 | 16370 | 15 | 16365 | 72 | 16371 | 39 | 16364 | |
| 28 | 2021-02-19 15:07:21.863846057+08:00 | 16367 | 2 | 16369 | 8 | 16366 | 22 | 16370 | 15 | 16365 | 72 | 16371 | 39 | 16364 | |

Outline

- Introduction
- Useful Techniques in Python
- Preliminaries on the Limit Order book (LOB)
- **Futures Contract Rollover**
- Stocks Buy-Back Analysis
- Flickering Quotes Analysis
- Forecast of Market Contango Ratio
- Strategy by LSTM/MLP Classifier

Futures Contracts

股票期貨/股票選擇權 交易標的

類型：全部

個股期貨報價

本頁表格內容中所有的實心圓形(如:●)與雙圈圖形(如:⊙)符號，皆代表

| 股票期貨、 選擇權 商品代碼 | 標的證券 | 證券代號 | 標的證券 簡稱 | 是否為 股票期貨 標的 | 是否為 股票選擇權 標的 | 上市普通股 標的證券 | 上櫃普通股 標的證券 | 上市ETF 標的證券 | 標準 證 股 |
|----------------------|----------------|------|------------|-------------------|--------------------|---------------|---------------|---------------|--------------|
| CA | 南亞塑膠工業股份有限公司 | 1303 | 南亞 | ● | ● | ⊙ | | | |
| CB | 中國鋼鐵股份有限公司 | 2002 | 中鋼 | ● | ● | ⊙ | | | |
| CC | 聯華電子股份有限公司 | 2303 | 聯電 | ● | ● | ⊙ | | | |
| CD | 台灣積體電路製造股份有限公司 | 2330 | 台積電 | ● | ● | ⊙ | | | |
| CE | 富邦金融控股股份有限公司 | 2881 | 富邦金 | ● | ● | ⊙ | | | |
| CF | 台灣塑膠工業股份有限公司 | 1301 | 台塑 | ● | ● | ⊙ | | | |
| CG | 仁寶電腦工業股份有限公司 | 2324 | 仁寶 | ● | ● | ⊙ | | | |
| CH | 友達光電股份有限公司 | 2409 | 友達 | ● | ● | ⊙ | | | |
| CJ | 華南金融控股股份有限公司 | 2880 | 華南金 | ● | ● | ⊙ | | | |
| CK | 國泰金融控股股份有限公司 | 2882 | 國泰金 | ● | ● | ⊙ | | | |

futures as derivatives of stocks

| 項目 | 內容 |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 交易標的 | 臺灣證券交易所發行量加權股價指數 |
| 中文簡稱 | 臺股期貨 |
| 英文代碼 | TX |
| 交易時間 | <ul style="list-style-type: none"> 本契約交易日同臺灣證券交易所交易日 一般交易時段之交易時間為營業日上午8:45~下午1:45；到期月份契約最後交易日之交易時間為上午8:45~下午1:30 盤後交易時段之交易時間為營業日下午3:00~次日上午5:00；到期月份契約最後交易日無盤後交易時段 |
| 契約價值 | 臺股期貨指數乘上新臺幣200元 |
| 契約到期交割月份 | <ul style="list-style-type: none"> 自交易當月起連續三個月份，另加上三月、六月、九月、十二月三中三個接續的季月契約在市場交易 新交割月份契約於到期月份契約最後交易日之次一營業日一般交易時段起開始交易 |
| 每日結算價 | 每日結算價原則上採當日一般交易時段收盤前1分鐘內所有交易之成交量加權平均價，若無成交價時，則依本公司「臺灣證券交易所股價指數期貨契約交易規則」訂定之 |
| 漲跌幅限制 | 各交易時段最大漲跌幅限制為前一一般交易時段每日結算價上下百分之十 |
| 最小升降單位 | 指數1點（相當於新臺幣200元） |
| 最後交易日 | 各契約的最後交易日為各該契約交割月份第三個星期三 |
| 最後結算日 | 最後結算日同最後交易日 |
| 最後結算價 | 以最後結算日臺灣證券交易所當日交易時間收盤前三十分鐘內所提供標的指數之簡單算術平均價訂之。其計算方式，由本公司另訂之 |
| 交割方式 | 以現金交割，交易人於最後結算日依最後結算價之差額，以淨額進行現金之交付或收受 |
| 部位限制 | <ul style="list-style-type: none"> 交易人於任何時間持有本契約同一方之未沖銷部位總和，不得逾本公司公告之限制標準 法人機構基於避險需求得向本公司申請放寬部位限制 綜合帳戶，除免主動揭露個別交易人者適用法人部位限制外，持有部位不受本公司公告之部位限制 |

Futures Contracts

AUSTRALIAN DOLLAR 期貨 - 合約規格

期貨 期權

| | |
|---------|--------------------------------------------------------------------------------------|
| 合約規模 | 100,000澳元 |
| 交易時間 | 周日至周五，下午5:00 至下午4:00，中部時間（每天從下午4:00，中部時間開始進入60分鐘短暫休市時間） 完全：0.0001美元/澳元增幅（10.00美元） |
| 最小變動價位 | 連續月份價差（僅Globex）：0.00001美元/澳元增幅（1.00美元） 所有其他價差合併（僅Globex）：0.00005美元/澳元增幅（5.00美元） |
| 產品代碼 | CME Globex電子交易：6A CME ClearPort：AD 清算所（Clearing）：AD |
| 上市合約 | 前3個連續月份上市合約和以3月季度周期的20個月（3月、6月、9月、12月） |
| 結算方法 | 可交割 |
| 交易終止 | 合約月份第三個週三之前的第二個營業日（通常是週一）中部時間上午 9:16。 |
| 結算程式 | 實物交割 澳元/美元期貨結算程式 |
| 頭寸限制 | CME頭寸限制 |
| 交易規則手冊 | CME 255 |
| 大宗最小限額 | 大宗交易最低門檻 |
| 價格限制或熔断 | 價格限制 |
| 供應商報價代碼 | 供應商報價符號清單 |

| | 期權 | 圖表 | 最後 | 變化 | 前一交易日結算價 | 開盤價 | 高 | 低 | 成交量 | |
|----------|-----|----|---------|----------|----------|---------|---------|--------|--------|----------------------------|
| NOV 2021 | OPT | ▲ | 0.7460 | -0.00055 | 0.74655 | 0.74655 | 0.7509 | 0.7458 | 37 | 16:38:43 CT 22 Oct 2021 |
| DEC 2021 | OPT | ▲ | 0.7472 | +0.0006 | 0.7466 | 0.7469 | 0.7514 | 0.7455 | 93,623 | 16:39:08 CT 22 Oct 2021 |
| JAN 2022 | OPT | ▲ | 0.75035 | +0.00355 | 0.7468 | 0.7499 | 0.75035 | 0.7499 | 4 | 16:38:45 CT 22 Oct 2021 |
| FEB 2022 | OPT | ▲ | - | - | 0.74685 | - | - | - | 0 | 16:39:13 CT 22 Oct 2021 |
| MAR 2022 | OPT | ▲ | 0.7469 | UNCH | 0.7469 | 0.7473 | 0.75085 | 0.7460 | 42 | 16:39:55 CT 22 Oct 2021 |
| JUN 2022 | OPT | ▲ | - | - | 0.74695 | - | - | - | 0 | 16:38:32 CT 22 Oct 2021 |
| SEP 2022 | OPT | ▲ | - | - | 0.7468 | - | - | - | 0 | 16:40:07 CT 22 Oct 2021 |
| DEC 2022 | OPT | ▲ | - | - | 0.74665 | - | - | - | 0 | 16:39:13 CT 22 Oct 2021 |
| MAR 2023 | OPT | ▲ | - | - | 0.74645 | - | - | - | 0 | 16:38:17 CT 22 Oct 2021 |
| JUN 2023 | OPT | ▲ | - | - | 0.74625 | - | - | - | 0 | 16:38:32 CT 22 Oct 2021 |
| SEP 2023 | OPT | ▲ | - | - | 0.74605 | - | - | - | 0 | 16:39:45 CT 22 Oct 2021 |
| DEC 2023 | OPT | ▲ | - | - | 0.7455 | - | - | - | 0 | 16:38:48 CT 22 Oct 2021 |

Refer to
<https://www.cmegroup.com/markets/fx/g10/australian-dollar.contractSpecs.html#>

Futures Contracts

MARKETS HOME >

FEATURED PRODUCTS

- ZC Corn
- ZS Soybean
- CL WTI Crude Oil
- NG Henry Hub Natural Gas
- ES E-mini S&P 500
- NQ E-mini NASDAQ 100
- 6E Euro FX
- GE Eurodollar
- ZN 10-Year T-Note
- SR SOFR
- GC Gold
- HG Copper
- All Products

BROWSE BY

- Agriculture
- Energy
- Equity Index
- FX
- Interest Rates
- Metals
- Options
- _____
- Cash Treasuries & Repo (BrokerTec)
- FX Spot & Forwards (EBS)
- Cleared Swaps
- Cryptocurrencies
- ESG Solutions
- Micro Suite

REFERENCE

- Fees
- Find a Broker
- Holiday Calendar
- Membership
- Tools & Resources
- Rulebooks
- Rule Filings
- Notices
- Regulatory Guidance
- Position Limits
- Registrar's Advisories

← Crude Oil
View an Energy Product ▾

Crude Oil

Futures and Options

GLOBEX CODE

LAST

CHANGE

VOLUME

Add to portfolio

CLZ1

83.98

+1.48 (+1.79%)

449,253

as of October 22 2021 04:39pm CT

OVERVIEW
QUOTES
SETTLEMENTS
VOLUME & OI
TIME & SALES
SPECS
MARGINS
CALENDAR
FUTURES
OPTIONS ▾

CRUDE OIL FUTURES - QUOTES

VENUE: GLOBEX

🔒 AUTO-REFRESH IS OFF Last Updated 24 Oct 2021 03:45:31 AM CT. Market data is delayed by at least 10 minutes.

| MONTH | OPTIONS | CHART | LAST | CHANGE | PRIOR SETTLE | OPEN | HIGH | LOW | VOLUME | UPDATED |
|------------------|---------------------------------------------------------------------------------|-------|-------|----------------|--------------|-------|-------|-------|---------|----------------------------|
| DEC 2021 CLZ1 | OPT | | 83.98 | +1.48 (+1.79%) | 82.50 | 82.61 | 84.22 | 81.76 | 449,253 | 16:39:08 CT 22 Oct 2021 |
| JAN 2022 CLF2 | OPT | | 82.69 | +1.33 (+1.63%) | 81.36 | 81.43 | 82.92 | 80.62 | 165,416 | 16:38:28 CT 22 Oct 2021 |

Data Range for the Rollover

- Data range: 2019.09 ~ 2020.02
- Resample the orderbook by '5Min' (5 minutes)
 - bid price1, ask price1: mean
 - bid size1, ask size1: max (then take minimum of them)
- Time interval for rollover:
12:30 – 13:00 (12:00 – 13:30 for combo orders) for every target date
 - target date: n th day before due date, for $n = 0, 1, 2, 5, 6, 7, 8, 9, 12, 13, 14$.

Combo Orders (跨月價差組合委託單)

跨月價差委託之優點

- 便於轉倉，降低交易風險
 - 兩月份契約可同時成交，降低轉倉時之部位及價格風險
- 便於跨月價差交易策略執行
 - 提供交易人以委託方式直接於市場反應跨月價格看法
 - 促進跨月市場價格發現
- 符合國際市場作法
 - 國際主要交易所多設有跨月價差委託功能

跨月價差委託之使用時機

- 純粹看漲或看跌價差
 - 看好兩月份價差將擴大，則買進價差；認為兩月份價差將縮小，則賣出價差
- 有留倉部位，於到期前用來轉倉
 - 由於期貨不同於現貨，期貨有到期日之限制，若近月合約到期後，交易人仍欲持有部位，可於近月合約到期前3~5天，利用一張跨月價差委託單執行轉倉，將近月份平倉的同時，建立下一月份同方向之持倉部位，不必分兩張委託執行。

Reference: <https://www.taifex.com.tw/file/taifex/CHINESE/4/doc/5.%E6%9C%9F%E8%B2%A8%E5%95%86%E5%93%81%E8%B7%A8%E6%9C%88%E5%83%B9%E5%B7%AE%E5%A7%94%E8%A8%97%E7%B0%A1%E4%BB%8B.pdf>

Long Position

- Transfer the long position from this month's contact to next month.



- Sell 4 (A) contracts at price of 105 and buy 4 (B) contracts at price of 104.
 - price diff: $+1/\text{mid-price} = 0.9$ (%)
 - match-size: 4
- Then resample the results by daily aggregation and taking the mean of them.

* the same logic applies to combo orders

| this month (A) | | | next month (B) | | |
|----------------|------------|----------|----------------|------------|----------|
| ask | price | size | ask | price | size |
| | 110 | 1 | | 110 | 1 |
| | 109 | 1 | | 109 | 1 |
| | 108 | 2 | | 108 | 2 |
| | 107 | 3 | | 107 | 3 |
| | 106 | 5 | | 104 | 5 |
| ----- | | | ----- | | |
| bid | 105 | 4 | bid | 103 | 4 |
| | 104 | 3 | | 102 | 3 |
| | 103 | 2 | | 101 | 2 |
| | 102 | 1 | | 100 | 1 |
| | 101 | 1 | | 99 | 1 |


The values are obtained by resampling (see the previous slide)

Short Position

- Transfer the short position from this month's contract to next month.

- Buy 4 (A) contracts at price of 106 and sell 4 (B) contracts at price of 105.
 - price diff: $-3/\text{mid-price} = -2.8\%$
 - match-size: 4
- Then resample the results by daily aggregation and taking the mean of them.

* the same logic applies to combo orders

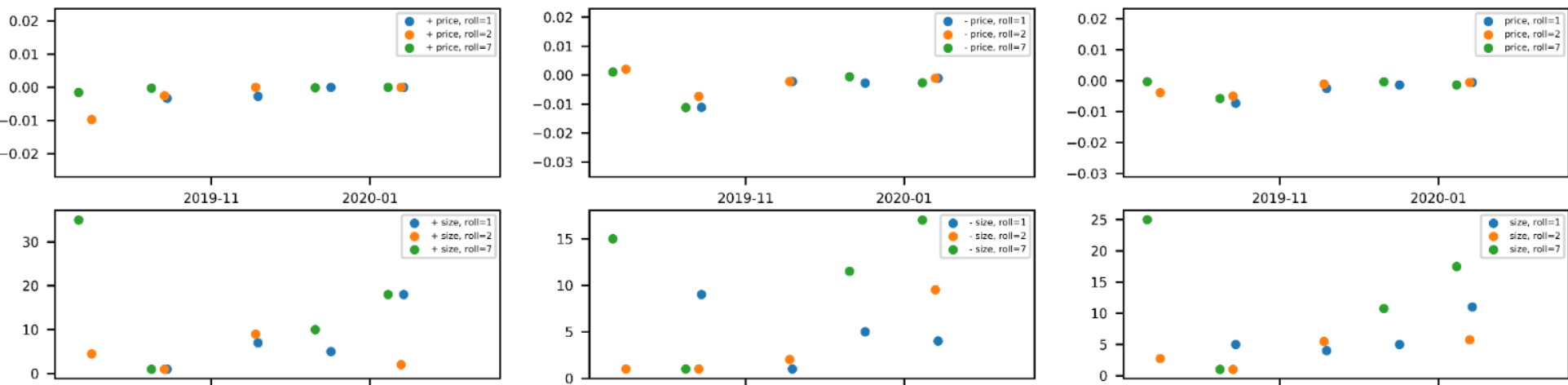


| this month (A) | | | next month (B) | | |
|----------------|------------|----------|----------------|------------|----------|
| ask | price | size | ask | price | size |
| | 110 | 1 | | 110 | 1 |
| | 109 | 1 | | 109 | 1 |
| | 108 | 2 | | 108 | 2 |
| | 107 | 3 | | 107 | 3 |
| | 106 | 5 | | 104 | 5 |
| ----- | | | ----- | | |
| bid | | | bid | | |
| | 105 | 4 | | 103 | 4 |
| | 104 | 3 | | 102 | 3 |
| | 103 | 2 | | 101 | 2 |
| | 102 | 1 | | 100 | 1 |
| | 101 | 1 | | 99 | 1 |

The values are obtained by resampling (see the previous slide)

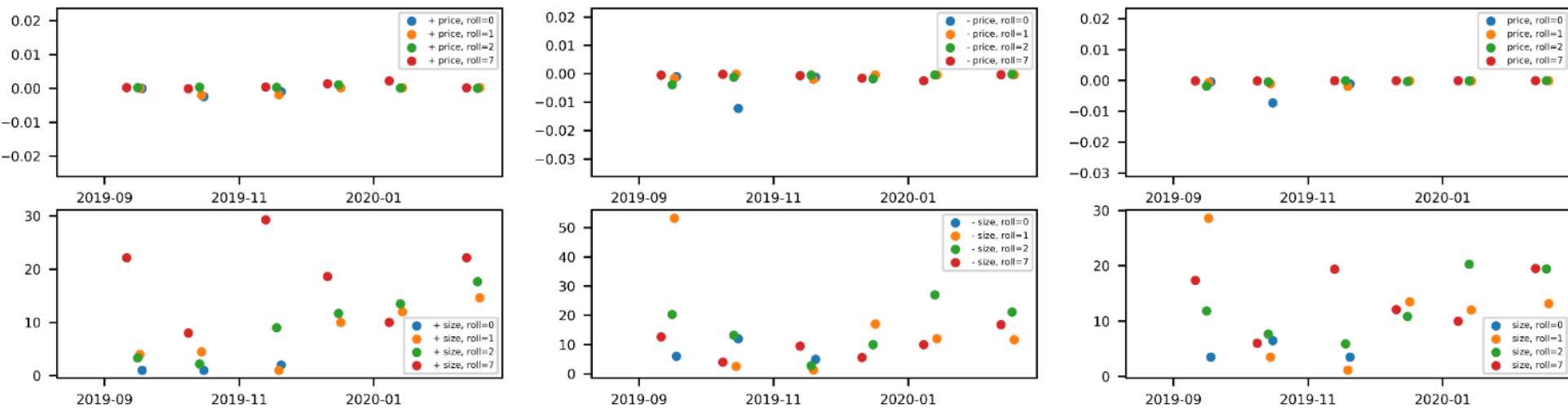
國喬

Mean of price diff and match size in contract rolling of EEF



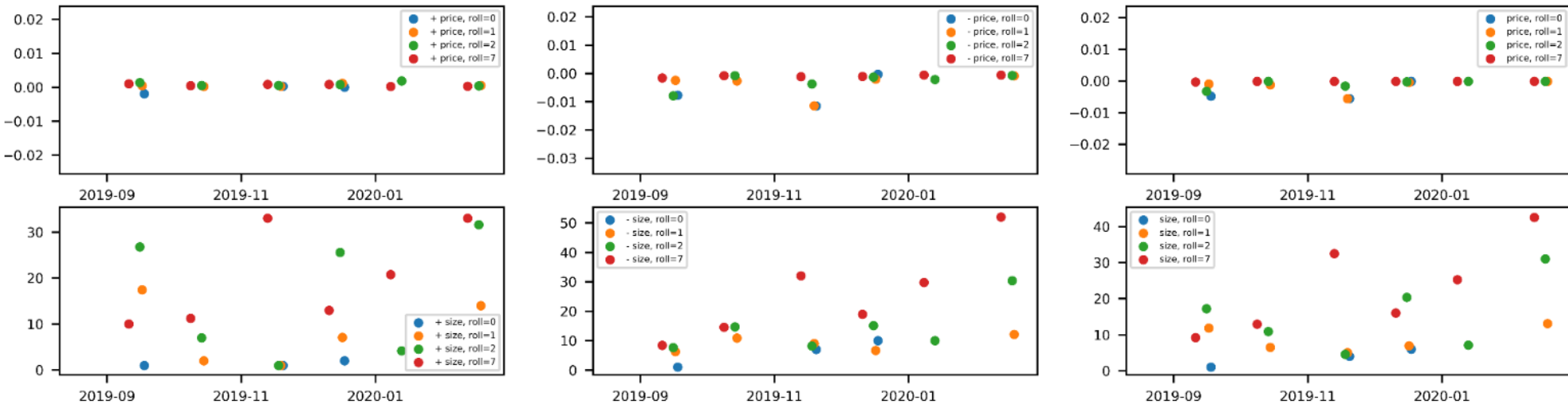
技嘉

Mean of price diff and match size in contract rolling of GHF



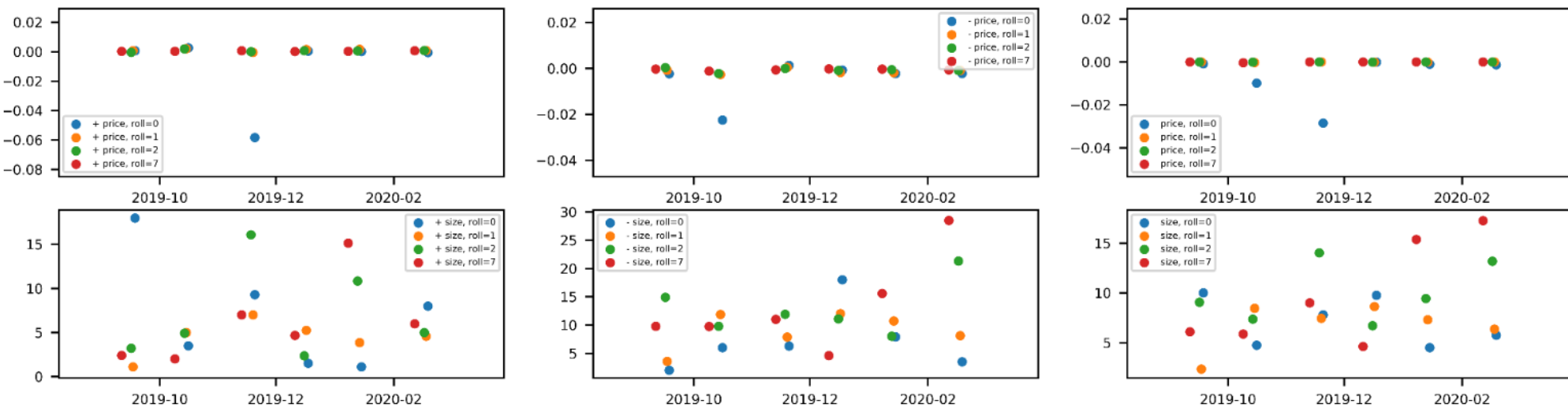
Mean of price diff and match size in contract rolling of HCF

宏達電



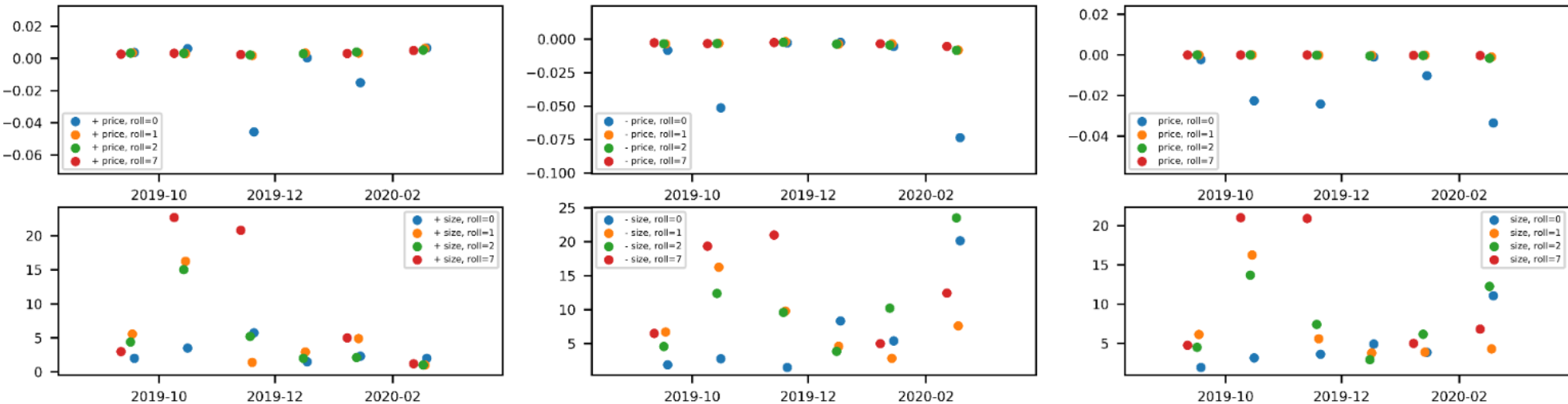
Mean of price diff and match size in contract rolling of IOF

聯詠



創意

Mean of price diff and match size in contract rolling of JBF



台虹

Mean of price diff and match size in contract rolling of KIF



Outline

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- Strategy by LSTM/MLP Classifier

Stock Buy-Back (融券強制回補)

臺灣證券交易所

字體大小 A A | 首頁導區 | 報表索引 | 日本語ホームページ | English Home | 公開資訊觀測站 | 基本市況報導 | TWSE 網站：國內業務宣導網站

關於證交所 交易資訊 指數資訊 上市公司 產品與服務 結算服務 市場公告 法令規章

交易資訊

盤後資訊
升降幅度/首五日無漲跌幅
變更交易
當日沖銷交易標的
融資融券與可借券賣出額度

- 調整成數
- 融資融券餘額
- 停券預告表
- 停券歷史查詢
- 平盤下得融(借)券賣出之證券名單
- 融券借券賣出餘額
- 當日可借券賣出股數
- 借貸款項擔保品管制餘額

標借
三大法人
中央登錄公債
鉅額交易
統計報表
市場開休市日期

首頁 > 交易資訊 > 融資融券與可借券賣出額度 > 停券歷史查詢

資料期間：民國 110 年 10 月 11 日 (一) 至 民國 110 年 10 月 24 日 (日)
股票代碼：股票名稱/代碼 (選覽) 未輸入表示查詢全部股票

查詢

※自99年11月8日起提供停券原因

列印 / HTML CSV 下載

110年10月11日至110年10月24日 得為融資融券有價證券停券歷史查詢

每頁 10 筆

| 股票代號 | 股票名稱 | 停券起日(最後回補日) | 停券迄日 | 原因 |
|--------|----------|-------------|-----------|------|
| 0056 | 元大高股息 | 110.10.18 | 110.10.21 | 分配收益 |
| 006204 | 永豐臺灣加權 | 110.10.13 | 110.10.18 | 分配收益 |
| 00714 | 群益道瓊美國地產 | 110.10.13 | 110.10.18 | 分配收益 |
| 00717 | 富邦美國特別股 | 110.10.13 | 110.10.18 | 分配收益 |
| 00730 | 富邦臺灣優質高息 | 110.10.13 | 110.10.18 | 分配收益 |
| 00733 | 富邦臺灣中小 | 110.10.13 | 110.10.18 | 分配收益 |
| 00774B | 新光中國政金綠債 | 110.10.15 | 110.10.20 | 分配收益 |
| 00851 | 台新全球AI | 110.10.15 | 110.10.20 | 分配收益 |
| 1609 | 大亞 | 110.10.06 | 110.10.12 | 現金增資 |
| 1609 | 大亞 | 110.10.06 | 110.10.12 | 除權息 |

上頁 1 2 3 下頁

https://www.twse.com.tw/zh/page/trading/exchange/BF184U2.html

Data Analytics & ML for Market Microstructures, CSIE, TKU, Taiwan

Data Processing

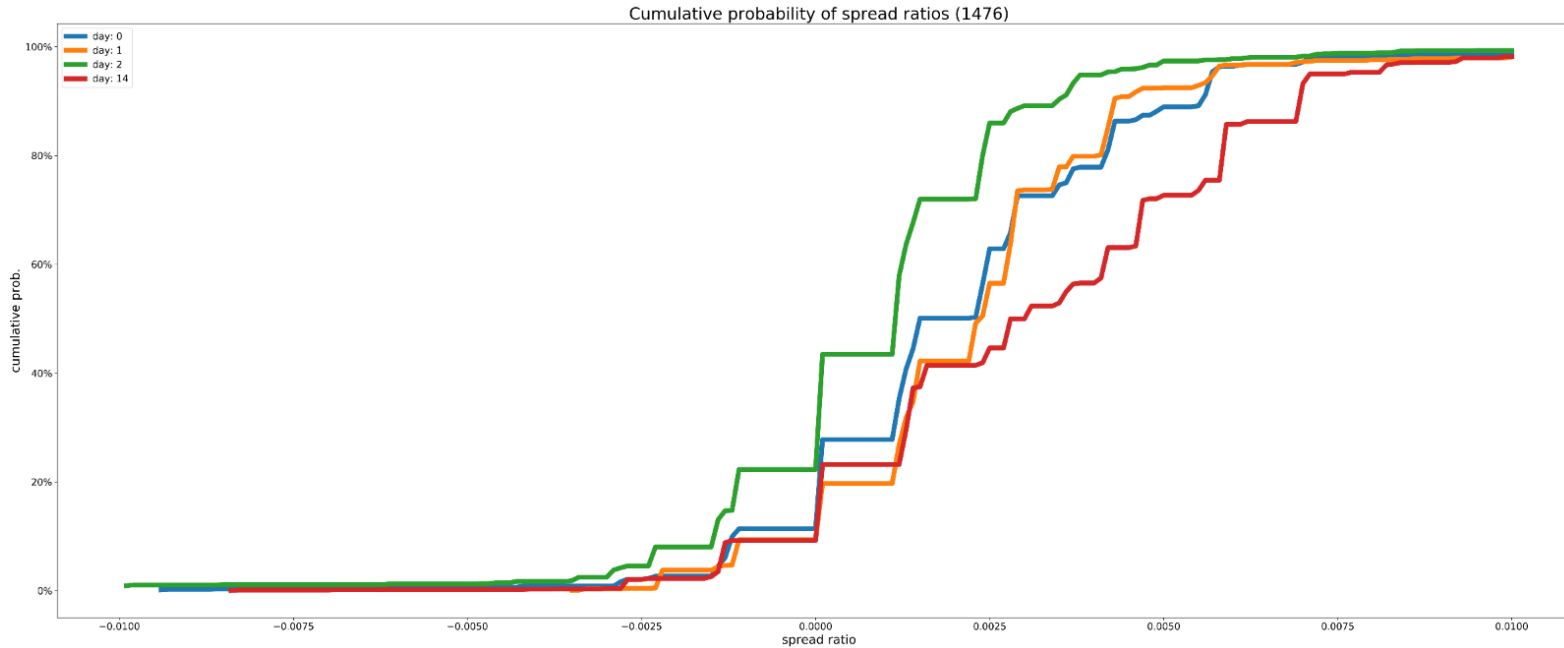
- The criteria:
 - Time range: 2018-01-01~2020-03-20.
 - Back to **14 days** before the buying-back days.
 - Snapshots of stock orderbook and future orderbook in tick-level.
 - **Concatenate** two orderbooks by aligning the time indices of future orderbook to the ones of stocks (using **pandas.merge_asof**).
 - Tolerance **latency**: ≤ 5 seconds.
- What do we want to know?
 - **Intraday chances** for closing the short position of a certain stock for each day.
 - **How early** (during which day before buying-back day) we might have to close the short position of a certain stock?

Distribution of the Spreads

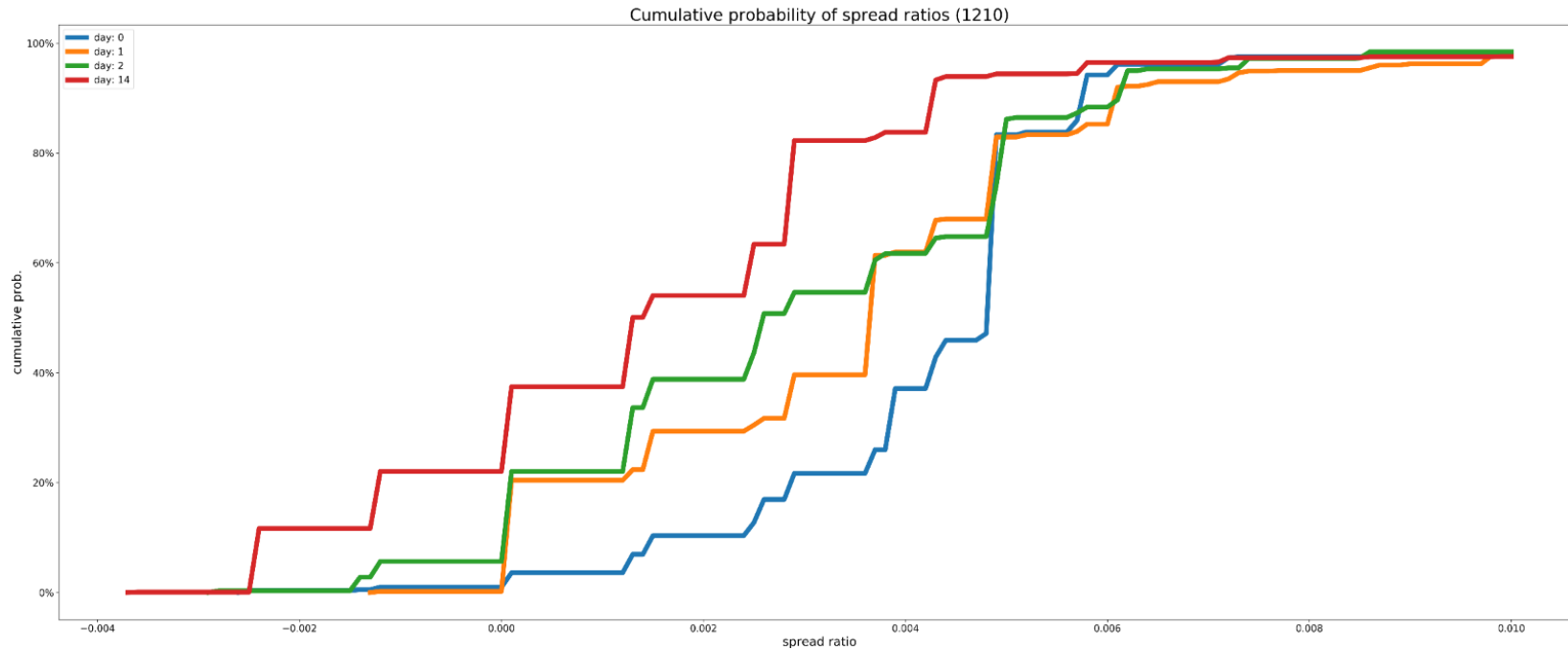
- Approx. distributions of intraday spread ratios:
 - Place spread ratios into 202 bins.

| A | DO | DP | DQ | DR | DS | DT | DU | DV | DW |
|---------|------------------|------------------|------------------|------------------|-------------------|-------------------|------------------|------------------|------------------|
| stockid | spr_0.0014 | spr_0.0015 | spr_0.0016 | spr_0.0017 | spr_0.0018 | spr_0.0019 | spr_0.002 | spr_0.0021 | spr_0.0022 |
| 2330 | 0.01887588315934 | 0 | 0 | 0.0528313824739 | 0.01613413476748 | 0.050722345249392 | 0.04539702625751 | 0.118158810503 | 0.09480122324159 |
| 2330 | | 0.03927075886017 | 0.00285976917577 | 0.00153201920131 | 0.00383004800327 | 0.02905729751812 | 0.18052292922066 | 0.04555203758552 | 0.08145235420281 |
| 2330 | | 0.05826978701027 | 0.01125427294242 | | 0.01341046542204 | 0.014041546147782 | 0.07425716539573 | 0.12095713910062 | 0.00247173284249 |
| 2330 | | 0.05791323506269 | 0.06032628652362 | | 0.08933536169539 | | 0.17536589204213 | 0.10701358652894 | 0 |
| 2330 | | 0.03666203059806 | 0.00784422809458 | | 0.02798331015299 | 0.063365785813608 | 0.08216968011119 | 0.00561891515994 | 0.04472878998605 |
| 2330 | | 0.17589029215674 | 0.00758848718088 | | 0 | 0.168952246734223 | 0.08775543389885 | 0.00054203479863 | 0.07442137785245 |
| 2330 | | 0.04166210445638 | 0.09148144092854 | | 0 | 0.199058359794137 | 0.0447279097777 | 0.10089784298691 | 0.02567611956639 |
| 2330 | | 0.00621384186844 | 0.00867795157489 | | 0 | 0.124973216198841 | 0.06862009856439 | 0.16434540389972 | 0 |
| 2330 | | 0.03834714255363 | 0.00031867431485 | | 0 | 0.121043127257283 | 0.06867431485027 | 0.1831846186532 | 0 |
| 2330 | | 0.03796909492273 | 0.12704194260482 | | 0 | 0.158002207505472 | 0.00088300220751 | 0.24757174392929 | 0.0007174392936 |
| 2330 | | 0.0678742789369 | 0.08350854493507 | | 0 | 0.148202059410271 | 0.00107822524125 | 0.1244811041027 | 0 |
| 2330 | | 0.09904397705541 | 0.08500409724117 | | 0 | 0.14471455886379 | | 0.18355640535384 | 0.00464354001639 |
| 2330 | | 0.113524072159 | 0.07888084568538 | | 0 | 0.117315868091438 | 0.0905434907503 | 0.15247615764676 | 0.11662645064918 |
| 2330 | | 0.09897571642305 | 0.05184716307975 | | 0 | 0.107319599493599 | 0.10357923811715 | 0.16814362987684 | 0.08936586488663 |
| 2330 | | 0 | 0.11791938997825 | | 0 | 0.098788126361667 | 0.02015250544661 | 0.20023148148137 | 0.15100762527225 |
| 2881 | | 0 | 0 | 0.25012094823421 | 0.128043863892957 | | 0 | 0.01967424608935 | 0 |
| 2881 | | 0 | 0 | 0.34669249106082 | 0.17476162097737 | | 0 | 0.0138557806913 | 0 |
| 2881 | | 0 | 0 | 0.32992895204257 | 0.1506808762581 | | 0 | 0.04558910597986 | 0.00192421551214 |
| 2881 | | 0 | 0 | 0.30466593042516 | 0.200303699613407 | | 0 | 0.0926283821093 | 0.00096631695196 |
| 2881 | | 0 | 0 | 0.22661179698212 | 0.162551440329187 | | 0 | 0.01947873799725 | 0.01138545953361 |
| 2881 | | 0 | 0 | 0.27126258714175 | 0.180015491866767 | | 0 | | 0.03175832687839 |
| 2881 | | 0 | 0 | 0.25997782705097 | 0.142738359201758 | | 0 | | 0.02355875831485 |
| 2881 | | 0 | 0 | 0.25504439063761 | 0.169357008340061 | | 0 | | 0.01963949421577 |
| 2881 | | 0 | 0 | 0.2512960829493 | 0.221342165898611 | | 0 | 0.02289746543779 | 0.0426267281106 |
| 2881 | | 0 | 0 | 0.15094066570191 | 0.138205499276436 | | 0 | 0.02575976845152 | 0.08654124445731 |
| 2881 | | 0 | 0 | 0.19878787878784 | 0.166212121212092 | | 0 | 0.09121212121211 | 0.05893939393938 |
| 2881 | | 0 | 0 | 0.06378656554712 | 0.285075839653277 | | 0 | 0.05322318526543 | 0.0318255687974 |
| 2881 | | 0 | 0 | 0.1330575203523 | 0.281996530094699 | | 0 | 0.00200186841052 | 0.02455625250233 |
| 2881 | | 0 | 0 | 0.16567270992365 | 0.252027671755707 | | 0 | 0.04246183206107 | 0.00489026717557 |
| 2881 | | 0 | 0 | 0.18579616943943 | 0.225359988815934 | | 0 | | 0.05829721795052 |

Intraday Spread Cumulative Distribution



Intraday Spread Cumulative Distribution



Suggestion for the boss: **Safe day indicator**

- Safe day: the day $-i$ such that it's the last day before stock buying-back to have chance (i.e., with **prob. $\geq 20\%$**) of getting small spread ratio $\leq r$ for r in $[0.05\%, 0.2\%, 0.5\%, 0.8\%]$ and sufficiently many (i.e., ≥ 100) accumulated snapshots.
- For stocks of spread $\leq 0.05\%$ in day 0, we compute the **safe 'hour'** to start buying-back so that with prob. **at least 20%** the expected spread is bounded by 0.05% and the number of accumulated snapshots ≥ 100 .

The Safe Day Indicators

| stockId | symbol | max_spread | last_safe_day | count_from_day0 | count_from_day1 | count_from_day2 | count_from_day3 | count_from_day4 | count_from_day5 | count_from_day6 | count_from_day7 |
|---------|--------|------------|---------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1303 | CAF | 0.0005 | 0 | 583.00 | 1203.00 | 1891.00 | 2396.50 | 2861.00 | 3224.00 | 3689.50 | 4207.00 |
| 2330 | CDF | 0.0005 | 0 | 1159.71 | 2554.00 | 4532.00 | 5378.86 | 7397.71 | 8595.71 | 9940.57 | 11828.29 |
| 2881 | CEF | 0.0005 | 0 | 954.40 | 1706.00 | 2718.40 | 3206.40 | 3956.00 | 4976.00 | 5723.20 | 6998.40 |
| 2880 | CJF | 0.0005 | 2 | 102.50 | 148.00 | 410.00 | 465.00 | 628.50 | 660.00 | 937.00 | 1048.50 |
| 2882 | CKF | 0.0005 | 0 | 1249.33 | 1949.67 | 2698.67 | 3304.33 | 3875.33 | 4704.67 | 5439.67 | 6316.00 |
| 2887 | CMF | 0.0005 | 0 | 321.60 | 800.00 | 1090.80 | 1445.60 | 1739.60 | 1835.20 | 1997.60 | 2223.20 |
| 2891 | CNF | 0.0005 | 0 | 832.80 | 1542.80 | 1912.40 | 2840.80 | 3158.40 | 3843.60 | 4718.00 | 5987.20 |
| 1402 | CRF | 0.0005 | 0 | 555.50 | 1156.00 | 1978.50 | 2700.00 | 3286.00 | 4153.50 | 4782.50 | 5633.00 |
| 1605 | CSF | 0.0005 | 0 | 401.50 | 1078.70 | 1708.70 | 2365.50 | 3000.70 | 3769.50 | 4532.70 | 5232.70 |
| 2323 | CUF | 0.0005 | 1 | 233.33 | 972.67 | 1314.00 | 2291.33 | 2428.00 | 2438.00 | 2558.00 | 3344.00 |
| 2352 | CWF | 0.0005 | 0 | 208.50 | 457.00 | 695.50 | 907.50 | 1045.50 | 1162.00 | 1292.50 | 1460.00 |
| 2371 | CXF | 0.0005 | 4 | 480.00 | 1412.00 | 2550.00 | 3175.00 | 4918.00 | 5987.00 | 6566.00 | 6700.00 |
| 2801 | DCF | 0.0005 | 0 | 272.00 | 505.50 | 652.50 | 745.00 | 852.00 | 1219.50 | 1487.50 | 1553.50 |
| 1101 | DFE | 0.0005 | 0 | 556.80 | 1329.20 | 2532.00 | 3270.80 | 4566.40 | 5437.20 | 6202.80 | 6874.40 |
| 1326 | DGF | 0.0005 | 0 | 244.50 | 421.00 | 706.00 | 794.50 | 836.10 | 944.50 | 990.90 | 1048.90 |
| 2317 | DHF | 0.0005 | 0 | 3586.40 | 7246.00 | 10865.20 | 13515.60 | 15816.40 | 17920.40 | 20089.20 | 22406.80 |
| 2337 | DIF | 0.0005 | 2 | 139.33 | 1161.33 | 2150.67 | 2959.33 | 3268.00 | 3732.00 | 4172.67 | 5555.33 |
| 2357 | DJF | 0.0005 | 0 | 121.50 | 189.00 | 248.00 | 268.00 | 295.50 | 339.00 | 407.50 | 449.00 |
| 2382 | DKF | 0.0005 | 0 | 434.50 | 704.00 | 1254.00 | 1400.50 | 1624.50 | 1791.00 | 1906.50 | 2109.50 |
| 2884 | DNF | 0.0005 | 1 | 246.00 | 742.00 | 1228.50 | 1381.50 | 1558.50 | 1673.50 | 1894.50 | 2044.00 |
| 2885 | DOF | 0.0005 | 0 | 322.50 | 334.50 | 334.50 | 338.00 | 377.50 | 392.00 | 438.00 | 462.50 |
| 3481 | DQF | 0.0005 | 0 | 281.75 | 625.00 | 759.00 | 801.50 | 835.25 | 894.25 | 1100.00 | 1321.00 |
| 2448 | DUF | 0.0005 | 0 | 1452.80 | 3170.40 | 4499.60 | 5892.00 | 6454.80 | 7589.20 | 8194.40 | 8981.20 |
| 2454 | DVF | 0.0005 | 0 | 1749.00 | 3752.00 | 5280.00 | 7126.00 | 8340.50 | 9579.50 | 11467.50 | 13839.50 |
| 3231 | DXF | 0.0005 | 0 | 276.75 | 479.50 | 534.50 | 624.00 | 703.50 | 761.50 | 961.75 | 1600.25 |
| 1102 | DYF | 0.0005 | 0 | 469.00 | 1038.00 | 1372.50 | 1789.00 | 2112.00 | 2659.50 | 2905.00 | 3271.50 |

Safe Hours in Day 0

| stockId | symbol | max_spread | last_safe_day | last_safe_hour | count_hour_from_12:30 | count_hour_from_12:00 | count_hour_from_11:30 | count_hour_from_11:00 | count_hour_from_10:30 | count_hour_from_10:00 | count_hour_from_09:30 | count |
|---------|--------|------------|---------------|----------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------|
| 1303 | CAF | 0.0005 | 0 | 12:30 | 107.5 | 270.5 | 472 | 730.5 | 1048.5 | 1426.5 | 1850 | |
| 2330 | CDF | 0.0005 | 0 | 12:30 | 130.857142857143 | 322.857142857143 | 636.857142857143 | 1076.85714285714 | 1672.28571428571 | 2468.28571428571 | 3394.28571428571 | |
| 2881 | CEF | 0.0005 | 0 | 12:00 | 62 | 223.6 | 506 | 870 | 1370.4 | 1968 | 2683.6 | |
| 2882 | CKF | 0.0005 | 0 | 12:30 | 104.666666666667 | 348.666666666667 | 740 | 1274.66666666667 | 1968.33333333333 | 2798 | 3783.66666666667 | |
| 2887 | CMF | 0.0005 | 0 | 12:00 | 39.6 | 107.2 | 200 | 320.8 | 490.4 | 706 | 969.6 | |
| 2891 | CNF | 0.0005 | 0 | 12:30 | 117.6 | 349.6 | 663.2 | 1074 | 1590 | 2207.2 | 2931.6 | |
| 1402 | CRF | 0.0005 | 0 | 12:00 | 60 | 184 | 350 | 555 | 826 | 1164.5 | 1579 | |
| 1605 | CSF | 0.0005 | 0 | 12:00 | 60 | 177.5 | 373.5 | 635 | 925 | 1237.5 | 1593 | |
| 2352 | CWF | 0.0005 | 0 | 11:30 | 18 | 51.5 | 104 | 181 | 288 | 415 | 568 | |
| 2801 | DCF | 0.0005 | 0 | 12:00 | 49 | 118 | 205 | 323.5 | 473 | 654.5 | 869.5 | |
| 1101 | DFE | 0.0005 | 0 | 12:00 | 86.4 | 217.2 | 412 | 678 | 988 | 1338.8 | 1723.2 | |
| 1326 | DGF | 0.0005 | 0 | 12:00 | 77.5 | 204 | 354 | 540.5 | 738.5 | 962 | 1194.5 | |
| 2317 | DHF | 0.0005 | 0 | 12:30 | 406 | 1189.2 | 2334.8 | 3896 | 5809.2 | 8067.6 | 10746.4 | |
| 2357 | DJF | 0.0005 | 0 | 11:30 | 17 | 57 | 114.5 | 187 | 262.5 | 358.5 | 468 | |
| 2382 | DKF | 0.0005 | 0 | 12:00 | 58 | 186.5 | 378 | 639.5 | 973 | 1345.5 | 1736.5 | |
| 2885 | DOF | 0.0005 | 0 | 12:00 | 47.5 | 151.5 | 330.5 | 565.5 | 842.5 | 1139 | 1457.5 | |
| 3481 | DOF | 0.0005 | 0 | 11:00 | 15.5 | 37.5 | 91.75 | 184.5 | 298.75 | 433.25 | 605.75 | |
| 2448 | DUF | 0.0005 | 0 | 12:30 | 175.6 | 546.4 | 1048.8 | 1603.6 | 2287.6 | 3108 | 4109.6 | |
| 2454 | DVF | 0.0005 | 0 | 12:30 | 234 | 680 | 1298.5 | 2017 | 2930.5 | 3973.5 | 5228.5 | |
| 3231 | DXF | 0.0005 | 0 | 11:00 | 11.25 | 32.25 | 92.75 | 187.25 | 324 | 491.25 | 698.5 | |
| 1102 | DYF | 0.0005 | 0 | 12:00 | 44.5 | 121.5 | 236.5 | 391 | 600.5 | 836.5 | 1132.5 | |
| 2027 | FEF | 0.0005 | 0 | 11:30 | 19 | 52 | 147 | 264 | 387 | 517 | 678 | |
| 2049 | FFF | 0.0005 | 0 | 12:30 | 163 | 423.5 | 714.5 | 1183 | 1917.5 | 2818 | 3931 | |
| 2313 | FTF | 0.0005 | 0 | 12:30 | 132.5 | 341.5 | 715.5 | 1293 | 2052.5 | 3016 | 4150.5 | |
| 2340 | FYF | 0.0005 | 0 | 12:30 | 118.4 | 345.6 | 646.4 | 995.6 | 1397.6 | 1904.8 | 2582.8 | |
| 2344 | FZF | 0.0005 | 0 | 12:30 | 101.5 | 268 | 511 | 830.5 | 1257.5 | 1806.5 | 2482 | |
| 2354 | GCF | 0.0005 | 0 | 11:30 | 22.5 | 59.5 | 113.5 | 190.5 | 297 | 463.5 | 671.5 | |
| 2376 | GHF | 0.0005 | 0 | 12:00 | 77.6 | 213.2 | 454 | 756 | 1102.4 | 1498 | 1939.6 | |
| 2377 | GIF | 0.0005 | 0 | 12:30 | 127.2 | 345.6 | 638 | 1021.2 | 1502 | 2108 | 2844.8 | |
| 2379 | GJF | 0.0005 | 0 | 12:00 | 65.6 | 185.2 | 354.4 | 535.6 | 747.2 | 984 | 1245.2 | |
| 2392 | GLF | 0.0005 | 0 | 11:30 | 30 | 83.5 | 173 | 325.5 | 556.5 | 877 | 1217.5 | |
| 2449 | GRF | 0.0005 | 0 | 12:00 | 58 | 176 | 326 | 519.6 | 767.6 | 1034.8 | 1325.2 | |
| 2474 | GXF | 0.0005 | 0 | 12:30 | 188 | 495.5 | 920.5 | 1473 | 2141.5 | 2905.5 | 3778.5 | |
| 2485 | GZF | 0.0005 | 0 | 11:30 | 26 | 67 | 113 | 196 | 300 | 414.5 | 552.5 | |

What We Have to Notice



字體大小 | 會員專區 | 報表索引 | 日本語ホームページ | English Home | 查詢

公開資訊觀測站 | 基本市況報導 | TWSE 網站: 國內業務宣導網站

關於證交所 | 交易資訊 | 指數資訊 | 上市公司 | 產品與服務 | 結算服務 | 市場公告 | 法令規章

交易資訊

盤後資訊

升降幅度/首五日無漲跌幅

變更交易

當日沖銷交易標的

融資融券與可借券賣出額度

- 調整成數
- 融資融券餘額
- 停券預告表
- 停券歷史查詢
- 平盤下得融(借)券賣出之證券名單
- 融券借券賣出餘額
- 當日可借券賣出股數
- 借貸款項擔保品管制餘額

首頁 | 交易資訊 | 融資融券與可借券賣出額度 | 停券歷史查詢

English

資料期間: 民國 110 年 10 月 07 日 (四) 至 民國 110 年 10 月 07 日 (四)

股票代碼: 股票名稱/代碼 (瀏覽) 未輸入表示查詢全部股票

查詢

※自99年11月8日起提供停券券

列印 / HTML | CSV 下載

110年10月07日至110年10月07日得為融資融券有價證券停券歷史查詢

每頁 10 筆

| 股票代號 | 股票名稱 | 停券起日(最後回補日) | 停券迄日 | 原因 |
|------|------|-------------|-----------|----|
| 1541 | 鎢泰 | 110.10.04 | 110.10.07 | 除息 |
| 5522 | 遠雄 | 110.10.07 | 110.10.13 | 除息 |

證券櫃檯買賣中心
Taipei Exchange

策略新板
成交量提供者 & 證券經紀商
110/7/26-110/12/31
交易獎勵活動

下半年權重

ENGLISH | 日本語

關於櫃買 | 網站導覽 | 公開資訊觀測站 | 創櫃板資訊公開系統

請輸入股票代碼、公司名稱,或網頁關鍵字

搜尋

上櫃 | 興櫃 | 創櫃 | 開放式基金 | 黃金現貨 | ETF | ETN | 指數系列 | 債券 | 衍生商品 | 公告及法規

首頁 > 上櫃 > 融資融券 > 暫停融券賣出預告表

● 暫停融券賣出預告表

查詢上櫃公司股票分派頻率(每年、每半年或每季配發)

資料日期: 110/10/07 股票代碼或關鍵字: 列印/匯出HTML 另存CSV

本資訊自民國104年3月起開始提供

| 證券代號 | 證券名稱 | 停券起日(最後回補日) | 停券迄日 | 原因 |
|--------|------------|-------------|-----------|------|
| 00687B | 國泰20年美債 | 110/10/13 | 110/10/18 | 分配收益 |
| 00694B | 富邦美債1-3 | 110/10/13 | 110/10/18 | 分配收益 |
| 00695B | 富邦美債7-10 | 110/10/13 | 110/10/18 | 分配收益 |
| 00696B | 富邦美債20年 | 110/10/13 | 110/10/18 | 分配收益 |
| 00719B | 元大美債1-3 | 110/10/13 | 110/10/18 | 分配收益 |
| 00720B | 元大投資級公司債 | 110/10/13 | 110/10/18 | 分配收益 |
| 00722B | 群益15年IG電信債 | 110/10/13 | 110/10/18 | 分配收益 |
| 00723B | 群益15年IG科技債 | 110/10/13 | 110/10/18 | 分配收益 |
| 00724B | 群益10年IG金融債 | 110/10/13 | 110/10/18 | 分配收益 |

<https://www.twse.com.tw/zh/page/trading/exchange/BFI84U2.html>

https://www.tpex.org.tw/web/stock/margin_trading/term/term.php?l=zh-tw

Demo (Hand-Over Video)

- Demo video

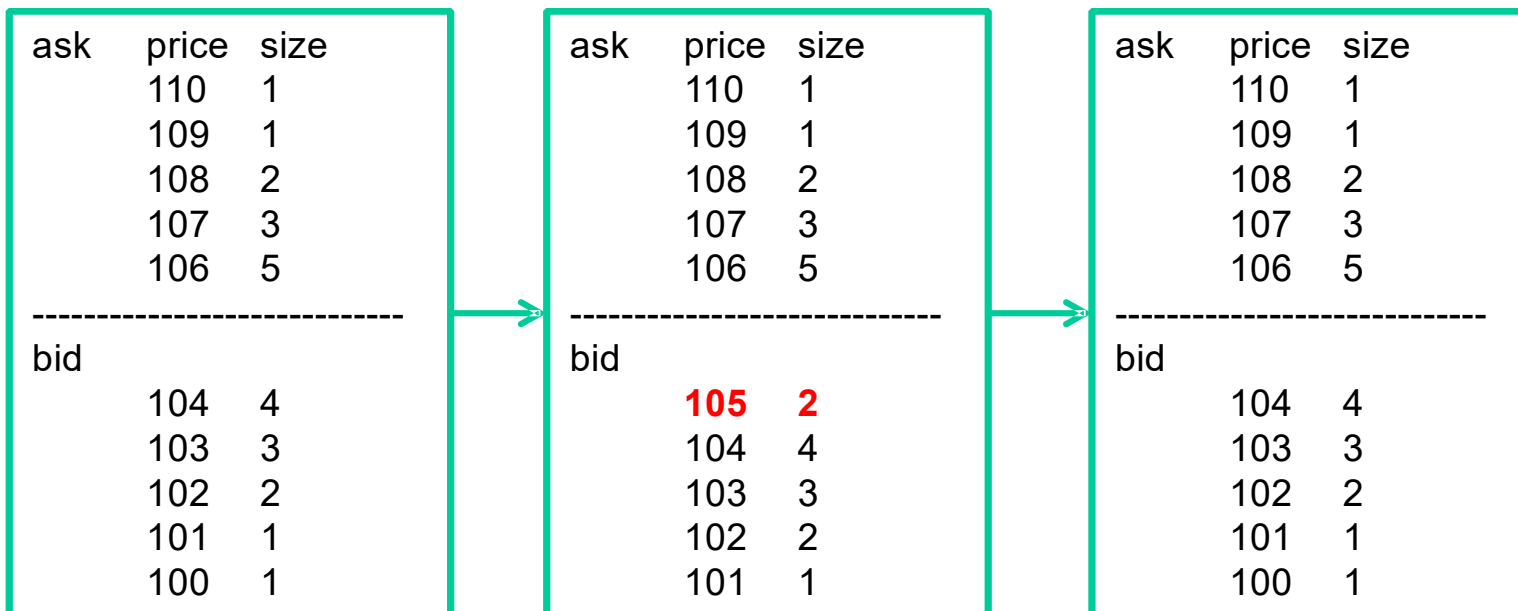
Outline

- Introduction
- Useful Techniques in Python
- Preliminaries on the Limit Order book (LOB)
- Futures Contract Rollover
- Stocks Buy-Back Analysis
- **Flickering Quotes Analysis**
- Forecast of Market Contango Ratio
- Strategy by LSTM/MLP Classifier

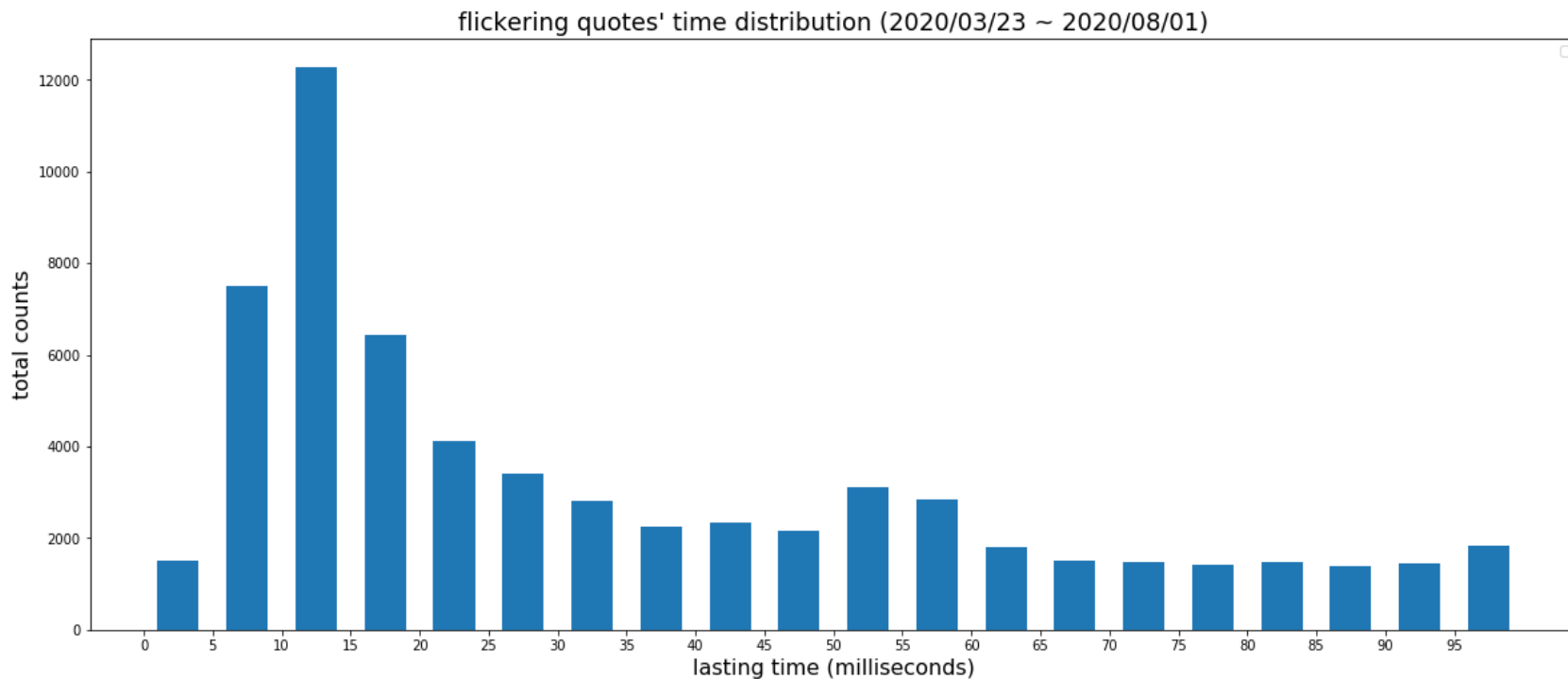
Flickering Quotes (Flash Orders)

- At time t ,
 - $\text{bidPrice1}(t-1) = \text{bidPrice1}(t+1)$ and $\text{askPrice1}(t-1) = \text{askPrice1}(t+1)$, and
 - $\text{bidPrice1}(t) \neq \text{bidPrice1}(t-1)$ or $\text{askPrice1}(t) \neq \text{askPrice1}(t-1)$.
 - $\text{time}(t+1) - \text{time}(t) < 125\text{ms}$.
 - We aim at $\text{time}(t+1) - \text{time}(t) < \mathbf{15\text{ms}}$.
 - The order was not matched.

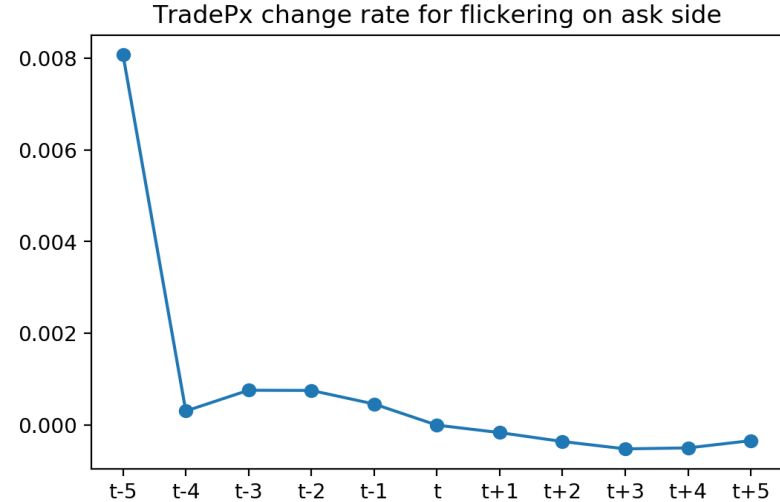
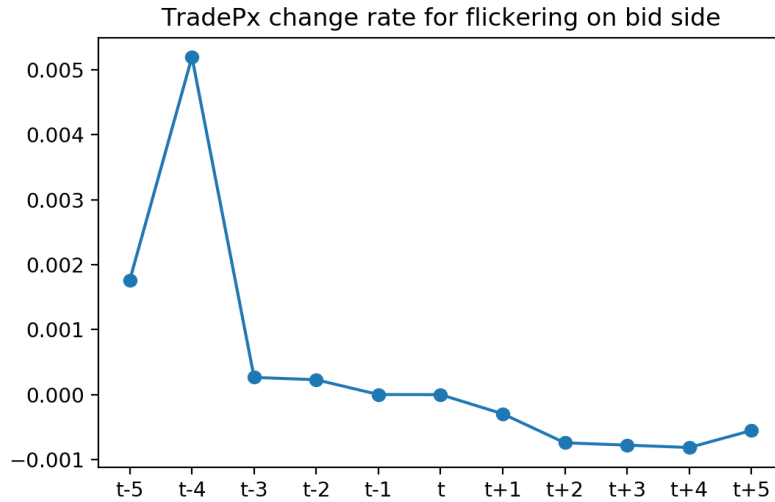
Flickering Quotes (Flash Orders)



Distribution Over the Lasting Time



Price Impact Analysis



Outline

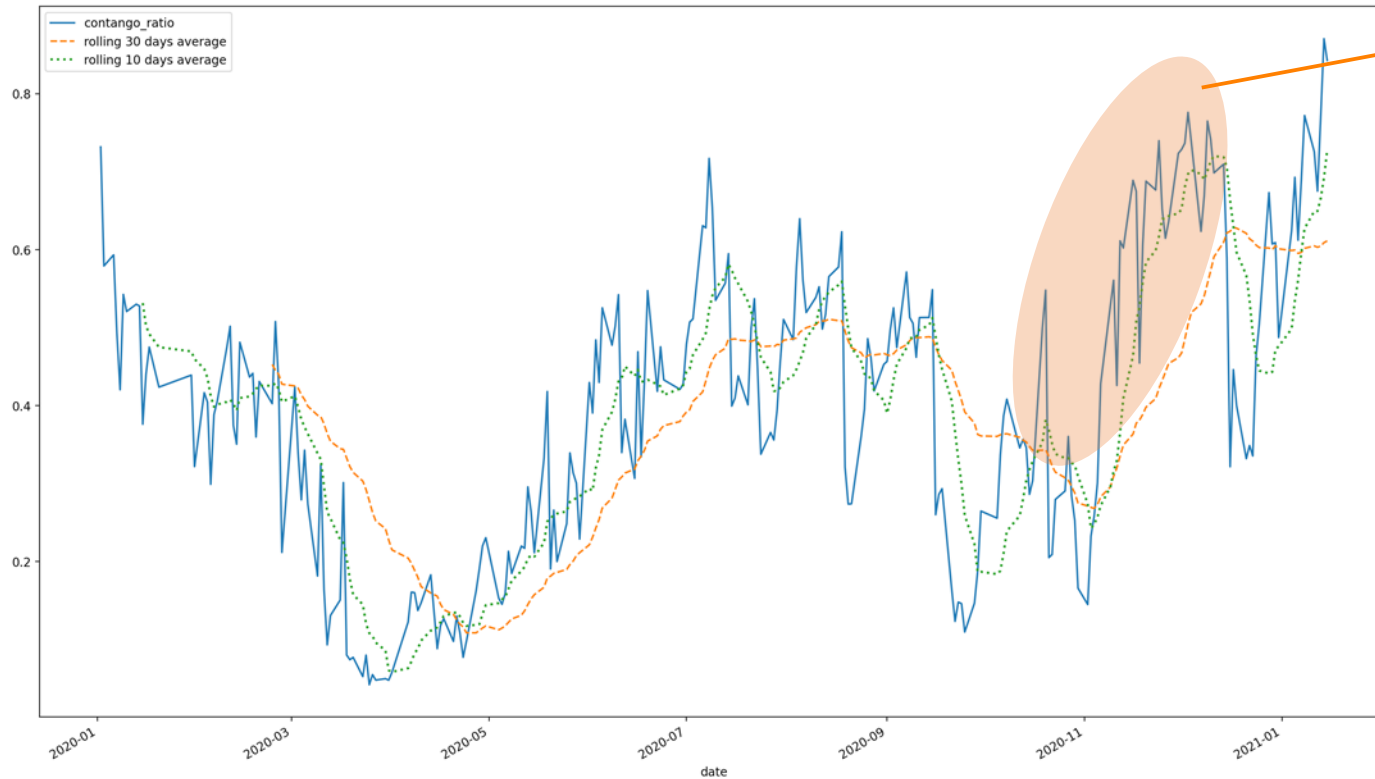
- Introduction
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- **Forecast of Market Contango Ratio**
- Strategy by LSTM/MLP Classifier

Contango and Backwardation

- Contango:
 - bidPrice1 of underlying futures (FUTbid1) > askPrice1 of the stock (STCask1)
 - the spread: $FUTbid1 - STCask1 > \max(10 \text{ bp}, \text{EMA of past spreads})$.
 - We accumulate the lasting time of such contango spreads per day.
- Backwardation:
 - askPrice1 of underlying futures (FUTask1) < bidPrice1 of the stock (STCbid1)
 - the spread: $STCbid1 - FUTask1 > \max(10 \text{ bp}, \text{EMA of past spreads})$.
 - We accumulate the lasting time of such backwardation spreads per day.
- Contango ratio per day:
 - the total lasting time of contango spreads in day d : $t_{ct}(d)$.
 - the total lasting time of backwardation spreads in day d : $t_{bw}(d)$.
 - the contango ratio of day d :

$$t_{ct}(d) / (t_{ct}(d) + t_{bw}(d)).$$

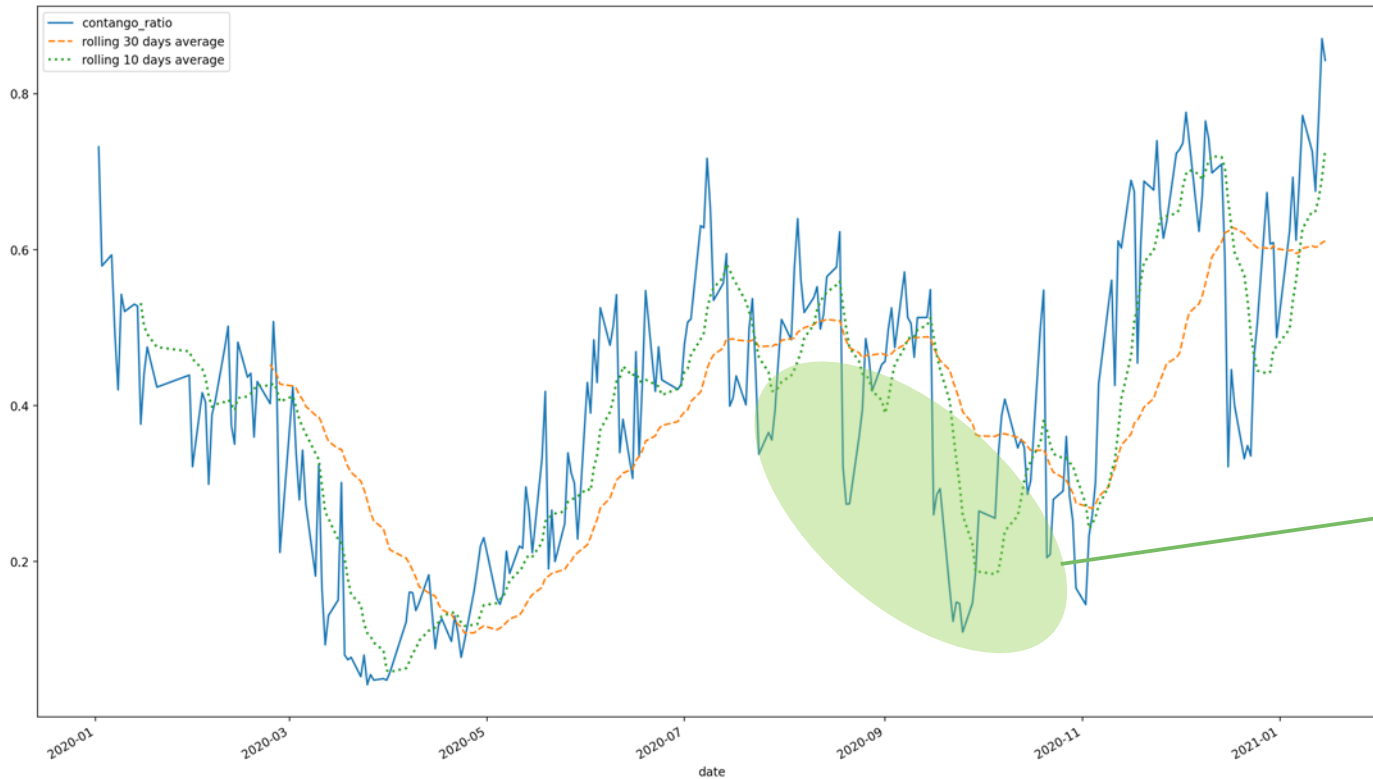
Contango and Backwardation



Blue curve above the orange curve:

The strategy longs stocks and shorts futures more aggressively

Contango and Backwardation



Blue curve under the orange curve:
The strategy longs futures and shorts
stocks more aggressively

The ML Model for the Forecast

- Support Vector Machine (SVM)
 - Used kernel functions: linear, poly, rbf
 - Package: SVR from scikit-learn.
- Multilayer Perceptron Regressor
 - Package: MLPRegressor from scikit-learn.
 - `hidden_layer_sizes=(64,64,64,64)`, `batch_size=32`, `activation='tanh'`
- Feeding data dimensions $7 \times r$ (rolling back r days; $r \in \{1, 2, 4, 8, 16, 32\}$) with normalization:
 - stock trading sizes
 - futures trading sizes
 - contango time
 - backwardation time
 - average contango spread
 - average backwardation spread
 - days to contract rollover
- Running 20 iterations and compute the weighted average of predicted contango ratios (with the weights being proportional to each model's R^2 score on the validation set).

Validation Result (2020/06/03~2020/06/16)

- Prediction using moving average of past k days:
- Prediction using our best 10 trained ML models:

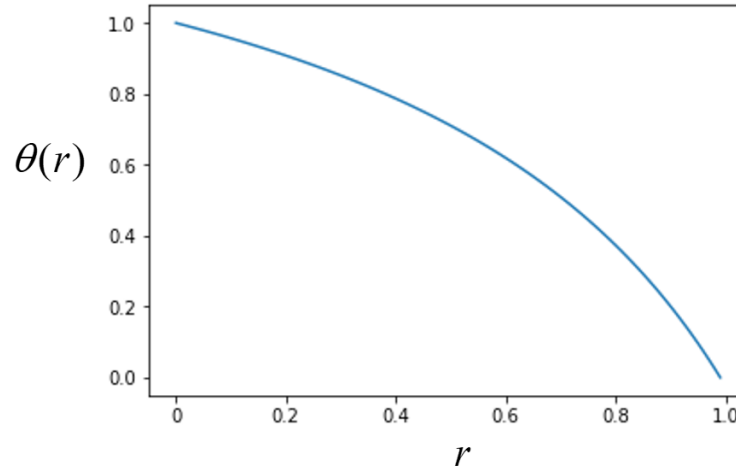
| k | R^2 score |
|-----|-------------|
| 1 | -0.61 |
| 2 | -0.19 |
| 3 | -0.56 |
| 4 | -0.69 |
| 5 | -0.88 |
| 6 | -1.08 |
| 7 | -1.19 |
| 8 | -1.45 |
| 9 | -1.57 |
| 10 | -1.79 |

| model no. | R^2 score |
|-----------|-------------|
| 1 | 0.59 |
| 2 | 0.52 |
| 3 | 0.50 |
| 4 | 0.49 |
| 5 | 0.45 |
| 6 | 0.41 |
| 7 | 0.36 |
| 8 | 0.34 |
| 9 | 0.39 |
| 10 | 0.33 |

Aids For Capital Usage

- Short-selling stocks requires more capital at hand.
 - Capital for long stocks: x
 - Capital for short stocks: y
 - Market contango ratio: r
 - Capital ratio for short stocks: θ

$$r = \frac{\frac{5}{2}x}{\frac{5}{2}x + y} \Rightarrow y = \frac{5}{2r}(1-r)x$$
$$\therefore \theta(r) = \frac{y}{x + y} = \frac{\frac{5}{2r}(1-r)x}{x + \frac{5}{2r}(1-r)x} = \frac{5(1-r)}{5-3r}.$$



Be More “Flexible”

- Every day we have the predicted market contango ratio r' .
- Also we can calculate the standard deviation d of the past 20 days.
- Then we can come out an r in $[r'-d, r'+d]$ with high probability.
- As suggested by our trader, we focus on $r \in [r'-d, r']$ for safety of position management.
- Eventually, we can give the trading desk:

$$\theta(r) \text{ for } r \in [r'-d, r'].$$

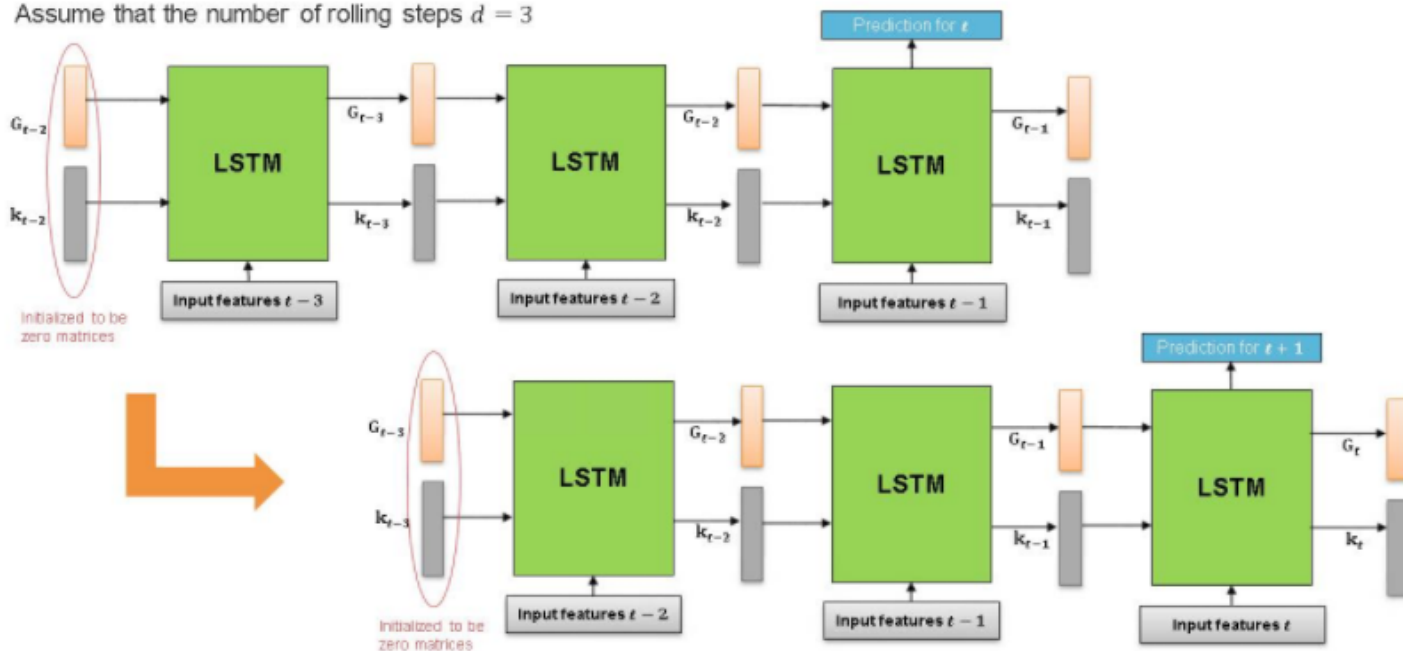
Outline

- Introduction
- Useful Techniques in Python
- Preliminaries on the Limit Order book (LOB)
- Futures Contract Rollover
- Stocks Buy-Back Analysis
- Flickering Quotes Analysis
- Forecast of Market Contango Ratio
- **Strategy by LSTM/MLP Classifier**

Long Short Term Memory Network (LSTM)

LSTM With Rolling Steps (applied in our model)

Assume that the number of rolling steps $d = 3$



Dealing with Data Imbalance

- The price goes Up, down, or flat?
 - Up: $\text{BidPrice1}[t+10] > \text{AskPrice1}[t]$ (21.5%)
 - Down: $\text{AskPrice1}[t+10] < \text{BidPrice1}[t]$ (21.2%)
 - Flat: else (57.3%)

Example (up)

| ask | price | ask | price |
|--------|------------|-----|-------------|
| | 110 | | 115 |
| | 109 | | 114 |
| | 108 | | 113 |
| | 107 | | 112 |
| | 106 | | 111 |
| -----> | | | |
| bid | | bid | |
| | 104 | | 110 |
| | 103 | | 109 |
| | 102 | | 108 |
| | 101 | | 107 |
| | 100 | | 106 |
| | t | | t+10 |

MLPClassifier Is Also An Option

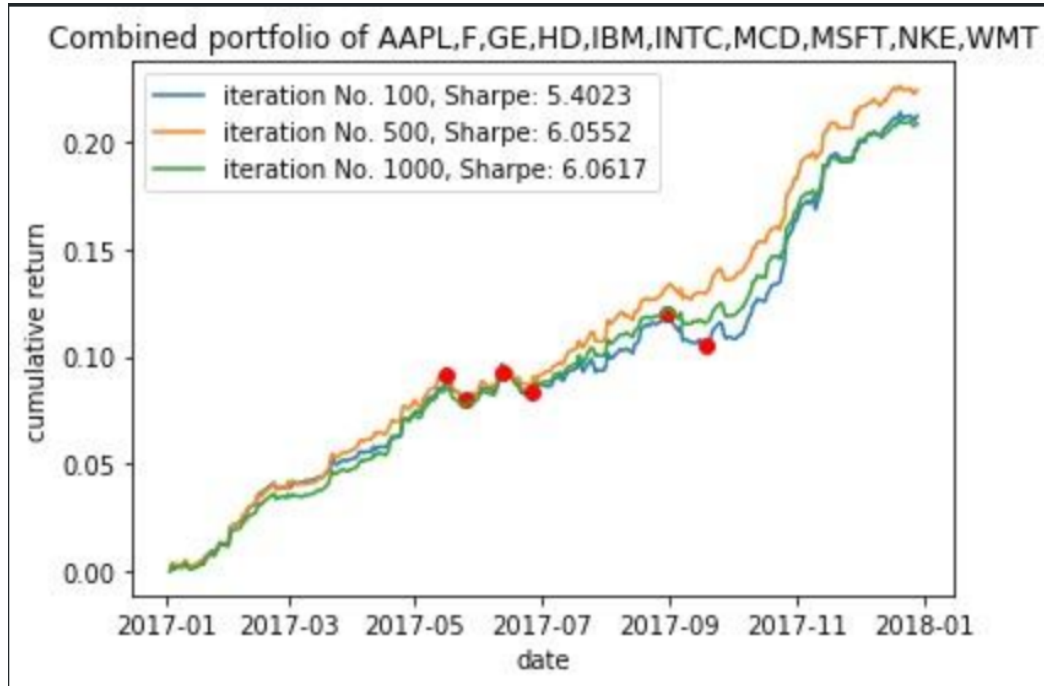
Walk-forward model building

- Data time-range: 2019-01-01~ 2020-05-31; 08:45 ~ 18:00
- Used features: (dim 200 = 20 features x 20 tick bars):

| | | | | | | |
|-----------------|-----------------|----------------|----------------|---------------------------------|---------------------------------|-------------|
| combo askPrice1 | combo bidPrice1 | combo askSize1 | combo bidSize1 | pseudo bidPrice1 | pseudo askPrice1 | far spread |
| pseudo bidSize1 | pseudo askSize1 | near askPrice1 | near bidPrice1 | far askPrice1 | far bidPrice1 | near spread |
| near askSize1 | near bidSize1 | far askSize1 | far bidSize1 | spread longCombo shortPseudo | spread longPseudo shortCombo | |

- Training and test data: 60 days for training (including ~4 days for additional validation for choosing the best model among the 3 trained ones) and 5 days for out-sample testing (total 66 models and test datasets).
- Handling data imbalance: RandomUnderSampler (ratio='not minority')
- Model used: MLPClassifier in sklearn.neural_network (+ dropout)
 - hidden layers: 128 x 8 layers
 - batch size: 128
 - solver: adam
 - activatin: relu
 - dropout ratio: 0.1
 - max iteration: 200
- Model saving: using joblib package (size each model: ~ 4.4MB)

PnL (Applied to US 12 Stocks)



$$\text{Sharpe Ratio} = \frac{\bar{r} - \tilde{r}}{\sigma} \cdot \sqrt{250}$$

\bar{r} : average daily return of our strategy

\tilde{r} : average daily return of US Treasury

σ : std of daily returns of our strategy

Discussion

- Thanks for your attention.
- Any question or feedback?