

# Case Studies of Data Analysis and Machine Learning for Market Microstructures

Joseph Chuang-Chieh Lin

Department of Computer Science and Engineering  
National Taiwan Ocean University

17th October, 2024

# 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

# My Career at Hedge Fund Companies

- **Quantitative Analyst (intern)** of Point72/Cubist Systematic Strategies (2018–2019).

- Hedge Fund; Fintech; Data Science
- US hedge fund (Taipei Branch in 2019)
- CEO & Chairman: Steven A. Cohen.



Billionaire investor Steve Cohen finalizes deal to buy New York Mets

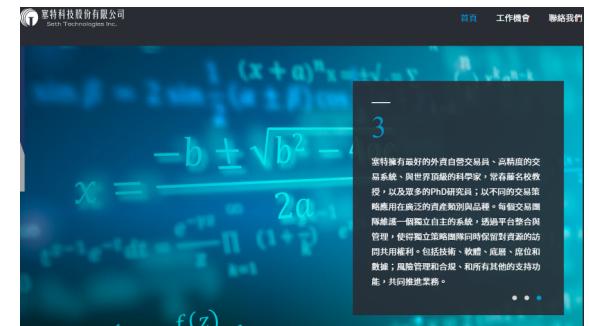
"This is different, this is a trophy investment," one sports attorney said.



Steven Cohen, Chairman and CEO of Point72 Asset Management, speaks at the Milken Institute Global Conference in Beverly Hills on May 2, 2016.  
Lucy Nicholson / Reuters file

- **Quantitative Analyst** of Seth Technologies Inc. (2020.01–2020.01).

- High-Frequency Trading; Hedge Fund; Fintech; Data Science
- Taiwan based.



# Some More Opportunities



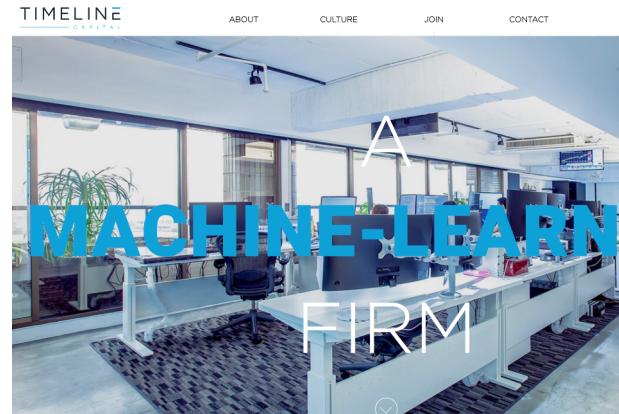
The Two Sigma website features a large, bold title "This is Financial Sciences." where the letters are composed of various financial and scientific images. Below the title are statistics: "+ 200+ PhDs", "4,500+ Person-years of R&D", and "14 Math Olympiad Medalists". The navigation bar includes links for Approach, Businesses, Insights, Careers, Contact Us, Client Login, and a search icon.

Two Sigma



The Polymer Capital Management website has a light gray hexagonal background. It features a red logo with a stylized molecular structure, the word "POLYMER" in bold capital letters, and a navigation menu with links for About, Approach, Culture, Leadership, Careers, and Contact. Below the menu, the text "ASIA-FOCUSED PLATFORM" is displayed.

Polymer Capital Management



Data Analytics & ML for Market Microstructures, CSE, NTOU, Taiwan



## THOUGHTS

"Despite the fact I was forced to comment, it's really a pretty fun place to work."

Albert E.  
DATA SCIENCE

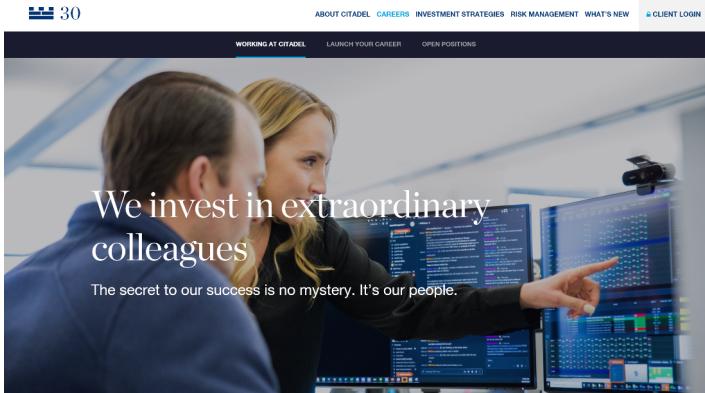


"I'm just really excited about the growth opportunity for algorithmic trading in Asia - especially in China and South-East Asia."

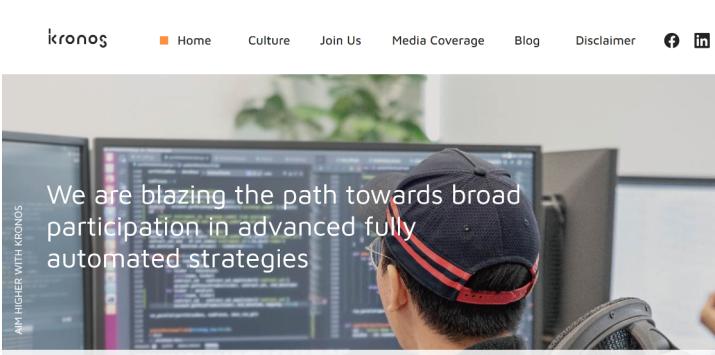
Edward W.  
BUSINESS DEV

Timeline Capital

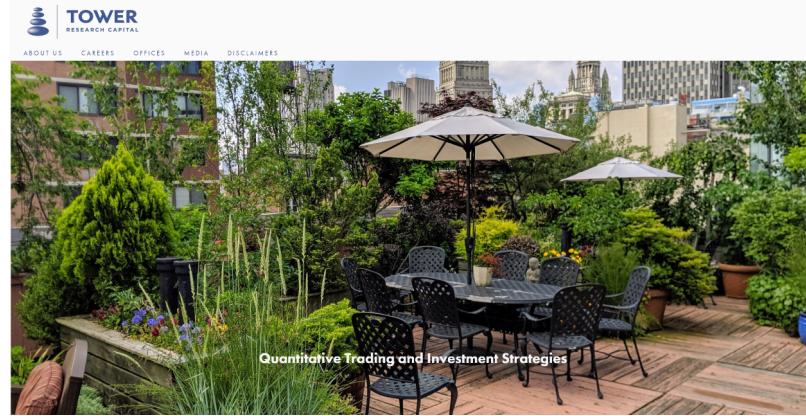
# Some More Opportunities



Citadel



Kronos Research



Tower Research Capital



WorldQuant  
Asset  
Management

*Data Analytics & ML for Market Microstructures, CSE, NTOU, Taiwan*

# 洞悉市場的人

量化交易之父吉姆·西蒙斯  
與文藝復興公司的故事

How Jim Simons Launched the Quant Revolution



# The Publicly Known Holy Grail

## Renaissance

[Home](#) [Careers](#) [Investors](#)

Renaissance Technologies is a quantitative investment management company trading in global financial markets, dedicated to producing exceptional returns for its investors by strictly adhering to mathematical and statistical methods.

**Long Island**  
 Renaissance Technologies LLC  
 600 Route 25A  
 East Setauket, New York 11733  
 USA

**New York City**  
 Renaissance Technologies LLC  
 Renaissance Institutional Management LLC  
 800 Third Avenue  
 New York, New York 10022  
 USA

Copyright © 2021 Renaissance Technologies LLC. All rights reserved. [Privacy Policy](#) | [EU GDPR Policy](#)

[www.rentec.com](http://www.rentec.com) and [www.renfund.com](http://www.renfund.com) are the only official Renaissance Technologies LLC websites. Neither Renaissance Technologies nor its affiliates operate any other website available to the public or to investors. Other websites purporting to be associated with our firm or our funds are not legitimate.

# The Publicly Known Holy Grail?

## Jim Simons (mathematician)

From Wikipedia, the free encyclopedia

For other people named James Simons, see [James Simons \(disambiguation\)](#).

**James Harris Simons** (/ˈsaɪmənz/; born 25 April 1938) is an American mathematician, billionaire hedge fund manager, and philanthropist.<sup>[4]</sup> He is the founder of Renaissance Technologies, a quantitative hedge fund based in East Setauket, New York. He and his fund are known to be quantitative investors, using mathematical models and algorithms to make investment gains from market inefficiencies. Due to the long-term aggregate investment returns of Renaissance and its Medallion Fund, Simons is described as the "greatest investor on Wall Street," and more specifically "the most successful hedge fund manager of all time."<sup>[5][6][7]</sup>

As reported by [Bloomberg Billionaires Index](#), Simons' net worth is estimated to be \$25.2 billion, making him the 66th-richest person in the World.<sup>[3]</sup>

Simons is known for his studies on pattern recognition. He developed the Chern–Simons form (with Shiing-Shen Chern), and contributed to the development of string theory by providing a theoretical framework to combine geometry and topology with quantum field theory.<sup>[8]</sup> In 1994, Simons founded the Simons Foundation with his wife to support researches in mathematics and fundamental sciences. He is one of the biggest donors to the University of California, Berkeley, establishing the Simons Institute for the Theory of Computing in 2012, and to Berkeley's Mathematical Sciences Research Institute, where he

fair101

James Simons	
	Simons in 2007
<b>Born</b>	April 25, 1938 (age 83) Newton, Massachusetts
<b>Education</b>	University of California, Berkeley (PhD) Massachusetts Institute of Technology (BS)
<b>Occupation</b>	mathematician · hedge fund manager · philanthropist
<b>Known for</b>	Founding and managing Renaissance Technologies



【明報專訊】《華爾街日報》報道，有「量化之神」之稱的知名對沖基金文藝復興科技（Renaissance Technologies）創辦人西蒙斯（James Simons，圖）向投資者透露，已於今年1月1日辭任文藝復興科技的董事會主席職務。但今年4月將慶祝83歲生辰的西蒙斯仍將留任董事。主席職位將由文藝復興科技的CEO布朗（Peter Brown）兼任。

西蒙斯原是數學家出身，23歲在加州大學伯克萊分校取得博士學位。他因與陳省身聯合創立了著名的Chern-Simons定律而享負盛名。該定律成為理論物理學的重要工具。他早年曾在麻省理工及哈佛任教。他亦曾為美國國防部進行密碼破譚工作，但因發表反戰言論而被解僱。至40多歲時他才投身金融行業，創立了文藝復興科技。

電腦運算交易著稱 數學模型推測股市

在1980至90年代，投資界都依靠閱讀年報、與商界高層聊天來決定投資策略，西蒙斯卻決定讓電腦算法進行交易。他與其他來自數學及科學領域的同事建立預測模型，以掌握市場的未來走勢。透過這些模型，西蒙斯累積超過200億美元的財富，並成為了美國民主黨的金主之一。文藝復興科技旗下的「大獎章基金」（Medallion Fund）自1988年成立以來至2018年底，年均費後收益率高達39%。當危機出現，「大獎章基金」往往有超水準表現。例如在2000年科網泡沫爆破，大獎章基金獲得98.5%的回報。在2008年金融海嘯，這基金同樣大賺80%。該基金只供職員及部分熟客投資，去年升幅達76%。不過文藝復興科技開放給外人投資的多隻基金，去年跌幅介乎20%至30%，引發客戶不滿。

（綜合報道）

# Terence Tao on Jim Simons



Terence Tao  
@tao@mathstodon.xyz

Jim Simons, who was a noted differential geometer (for instance being one of the discoverers of Chern-Simons theory), then a successful hedge fund manager, and finally a major philanthropist to mathematics and the sciences, died today, aged 86:  
[nytimes.com/2024/05/10/business/jim-simons-dead.html](https://www.nytimes.com/2024/05/10/business/jim-simons-dead.html) . . .

One can debate whether the economic model of first encouraging the concentration of wealth by billionaires, and then relying on such billionaires for philanthropy, is the most effective or just mechanism for creating public goods, but certainly Jim made some very important investments in the modern infrastructure of mathematics and science, with his foundation being a significant funder of the arXiv for instance, and of major institutes such as the SLMath institute (formerly MSRI), as well as the 2026 ICM that is to be held in Philadelphia. I was also fortunate to be supported by a Simons Investigator Award for over a decade, which in turn supported a large number of research activities of my group here at UCLA.

I only interacted with Simons a few times (we were both on the SLMath Board of Trustees, but our interactions were almost entirely via Zoom), but he came across as sincere in his support of the sciences, and I hope the Simons Foundation will continue that support in the future.

The New York Times · 5月11日

**Jim Simons, Math Genius Who Conquered...**

由 Jonathan Kandell 提供

2024年5月11日 05:21 · 編輯於 5月11日 05:25 ▾ · 🎧 · Web · 55 · ★ 92

# 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

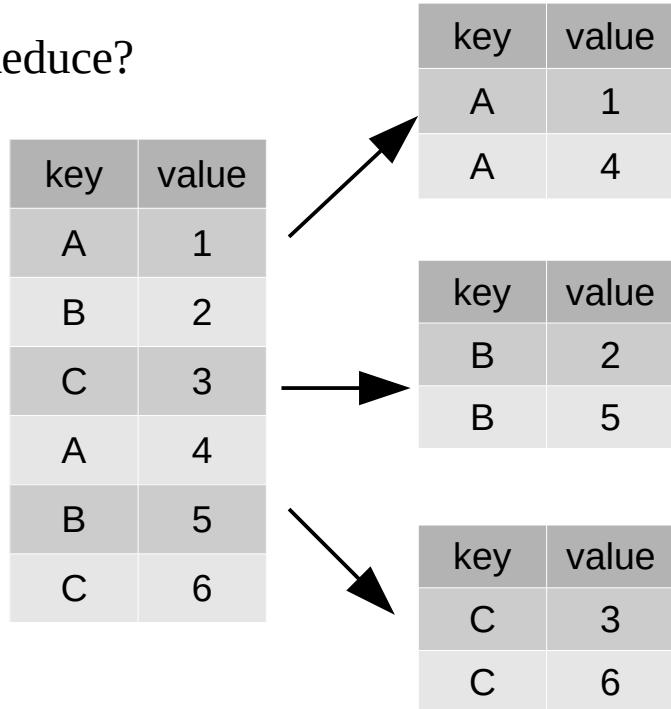
# GroupBy

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

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

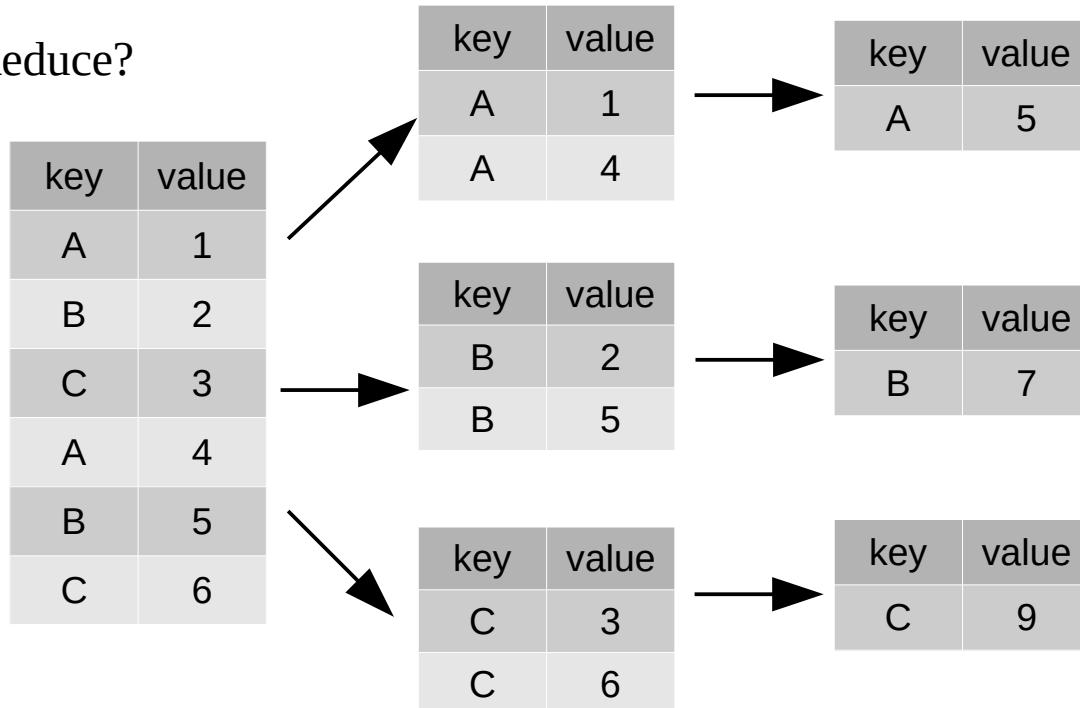
# GroupBy

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



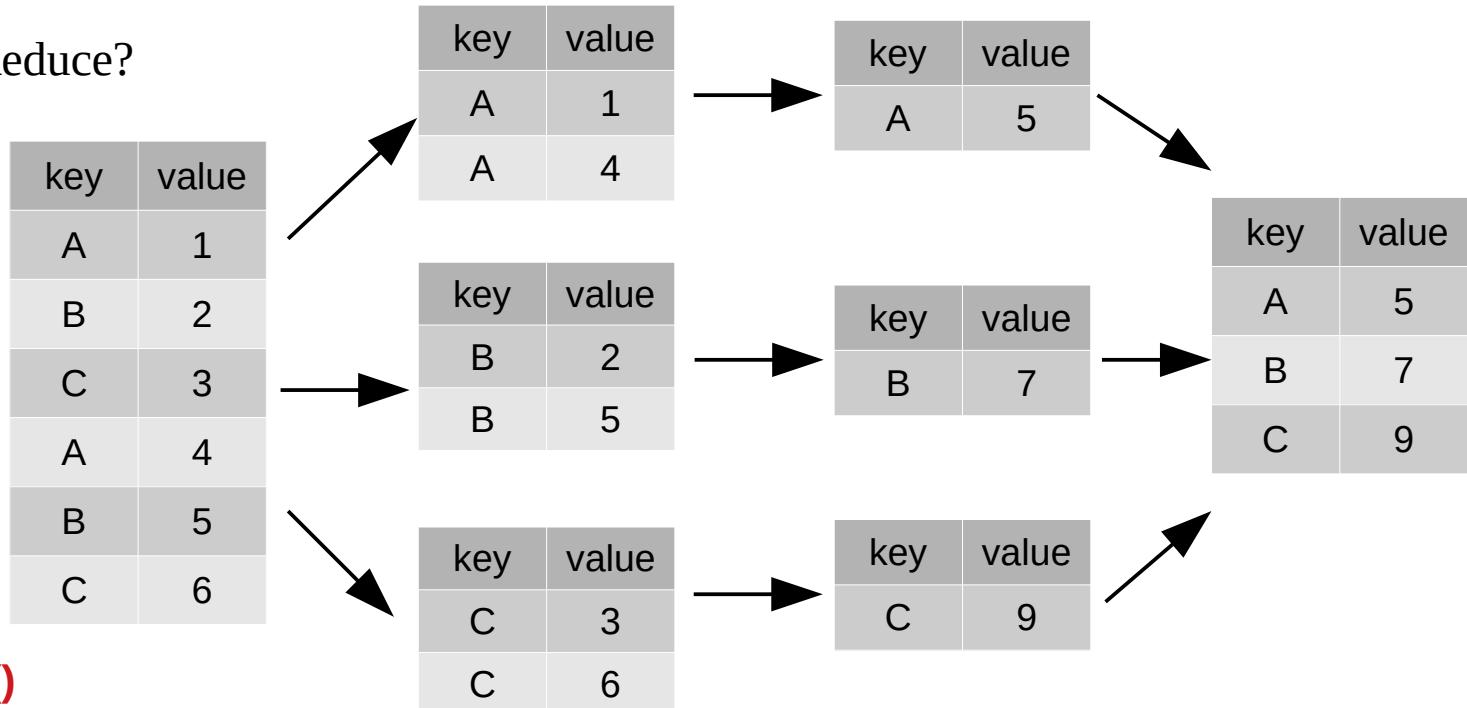
# GroupBy

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



# GroupBy

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



# 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



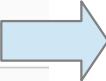
Date-Time	L1-BidPrice	L1-BidSize	L1-AskPrice	L1-AskSize	signal	position
2021-02-19 18:32:00+08:00	16402	11	16403	2	-1	-1
2021-02-19 18:33:00+08:00	16401	2	16402	10	-1	-1
2021-02-19 18:34:00+08:00	16401	1	16402	7	-1	-1
2021-02-19 18:35:00+08:00	nan	nan	nan	nan	nan	-1
2021-02-19 18:36:00+08:00	16399	16	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](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

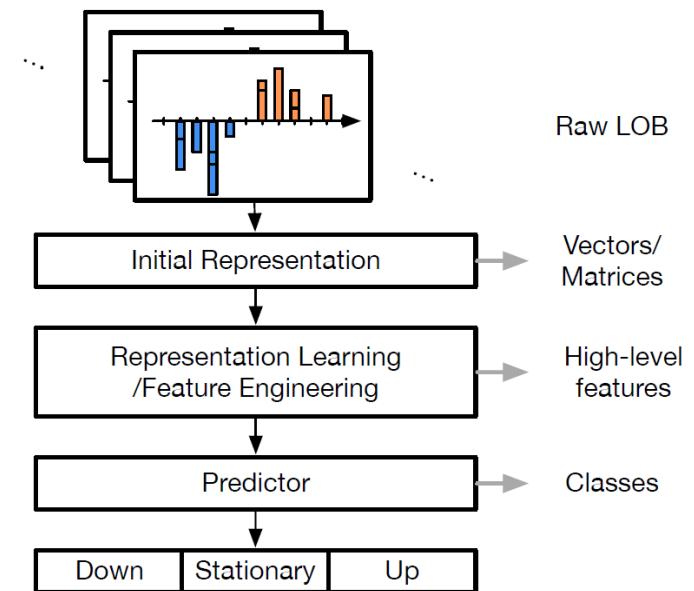
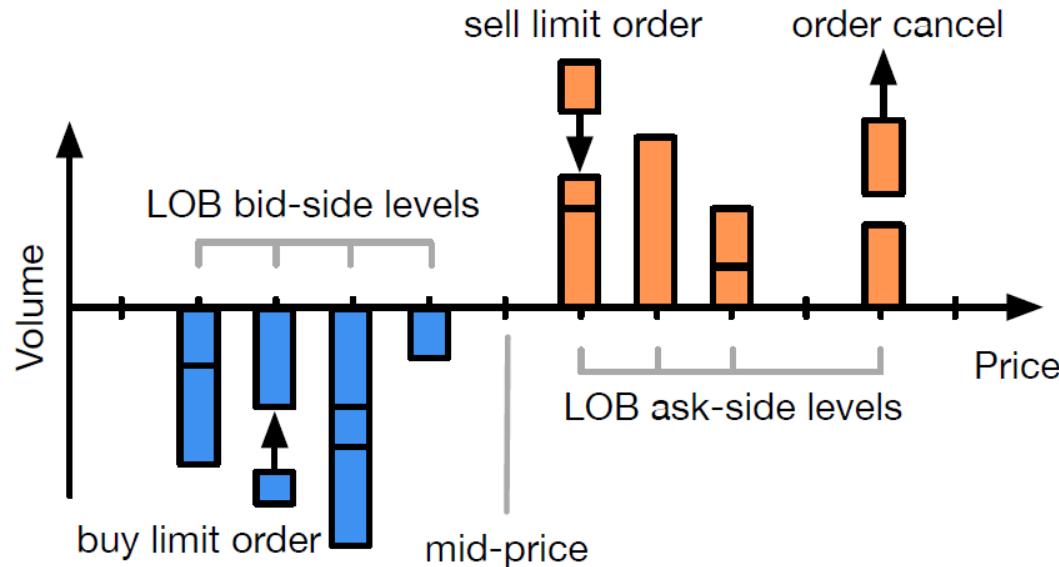
```
>>> pd.merge_asof(trades, quotes,  
...                 on='time',  
...                 by='ticker',  
...                 tolerance=pd.Timedelta('2ms'))
```

	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

# 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

# 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	<b>15</b>
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
<hr/>		
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
	<b>480</b>	<b>15</b>
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	$t+1$	$t+2$	$t+3$	$t+4$
<b>Trade price</b>				

(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
	<b>485</b>	<b>10</b>
	<b>480</b>	<b>05</b>
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	$t+1$	$t+2$	$t+3$	$t+4$
<b>Trade price</b>	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
<hr/>		
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		
	<b>475</b>	<b>10</b>
	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
<hr/>		
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
<hr/>		
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:●)與雙圈圓形(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	標準證券
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"> <li>本契約交易日同臺灣證券交易所交易日</li> <li>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</li> <li>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</li> </ul>
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"> <li>自交易當月起連續三個月份，另加上三月、六月、九月、十二月中三個接續的季月契約在市場交易</li> <li>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</li> </ul>
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之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"> <li>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</li> <li>法人機構基於避險需求得向本公司申請放寬部位限制</li> <li>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</li> </ul>

# Futures Contracts



期貨及期權產品 數據 服務 期貨教學

## AUSTRALIAN DOLLAR 期貨 - 合約規格

期貨

	期權	圖表	最後	變化	前一交易日結算價	開盤價	高	低	成交量	
合約規模	100,000澳元		0.7460	-0.00055	0.74655	0.74655	0.7509	0.7458	37	16:38:43 CT 22 Oct 2021
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 )		0.7472	+0.0006	0.7466	0.7469	0.7514	0.7455	93,623	16:39:08 CT 22 Oct 2021
最小變動價位	完全 : 0.0001美元/澳元增幅 ( 10.00美元 ) 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 )		0.75035	+0.00355	0.7468	0.7499	0.75035	0.7499	4	16:38:45 CT 22 Oct 2021
產品代碼	CME Globex電子交易: 6A CME ClearPort : AD 清算所 ( Clearing ) : AD		-	-	0.74685	-	-	-	0	16:39:13 CT 22 Oct 2021
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 )		0.7469	UNCH	0.7469	0.7473	0.75085	0.7460	42	16:39:55 CT 22 Oct 2021
結算方法	可交割		-	-	0.74695	-	-	-	0	16:38:32 CT 22 Oct 2021
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 。		-	-	0.7468	-	-	-	0	16:40:07 CT 22 Oct 2021
結算程式	實物交割 澳元/美元期貨結算程式		-	-	0.74665	-	-	-	0	16:39:13 CT 22 Oct 2021
頭寸限制	CME頭寸限制		-	-	0.74645	-	-	-	0	16:38:17 CT 22 Oct 2021
交易規則手冊	CME 255		-	-	0.74625	-	-	-	0	16:38:32 CT 22 Oct 2021
大宗最小限額	大宗交易最低門檻		-	-	0.74605	-	-	-	0	16:39:45 CT 22 Oct 2021
價格限制或熔斷	價格限制		-	-	0.7455	-	-	-	0	16:38:48 CT 22 Oct 2021
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	Agriculture	Fees
ZS Soybean	Energy	Find a Broker
CL WTI Crude Oil	Equity Index	Holiday Calendar
NG Henry Hub Natural Gas	FX	Membership
ES E-mini S&P 500	Interest Rates	Tools & Resources
NQ E-mini NASDAQ 100	Metals	Rulebooks
6E Euro FX	Options	Rule Filings
GE Eurodollar	—	Notices
ZN 10-Year T-Note	Cash Treasuries & Repo (BrokerTec)	Regulatory Guidance
SR SOFR	FX Spot & Forwards (EBS)	Position Limits
GC Gold	Cleared Swaps	Registrar's Advisories
HG Copper	Cryptocurrencies	
All Products	ESG Solutions	
	Micro Suite	

## BROWSE BY

## REFERENCE

View an Energy Product ▾

Crude Oil  
Futures and Options

GLOBEX CODE: CLZ1 LAST: 83.98 CHANGE: +1.48 (+1.79%) VOLUME: 449,253 Add to portfolio

as of October 22 2021, 04:39pm CT

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

### CRUDE OIL FUTURES - QUOTES

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	CHART	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	CHART	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，建立下一個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 contact 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.

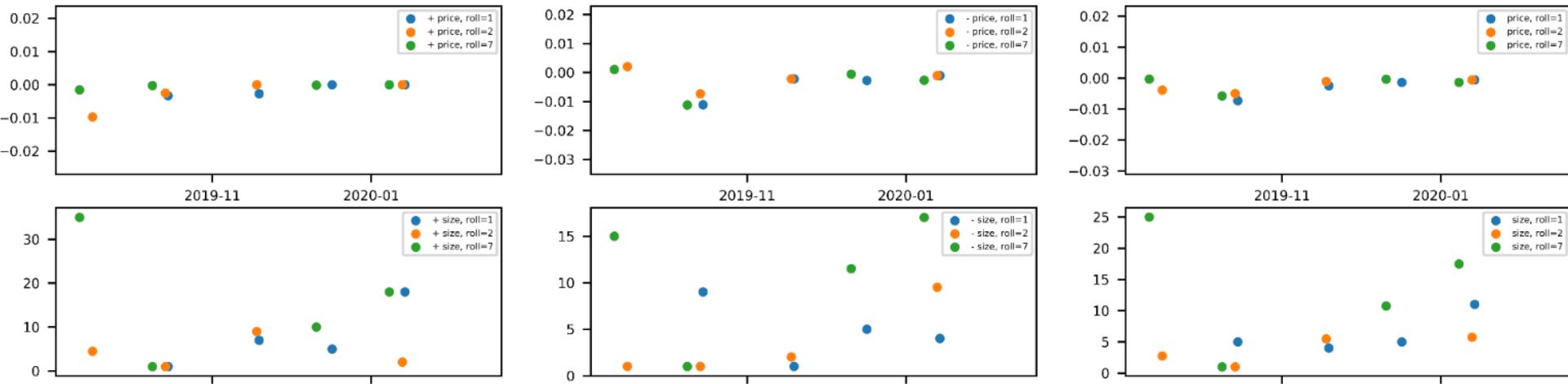
\* the same logic applies to combo orders



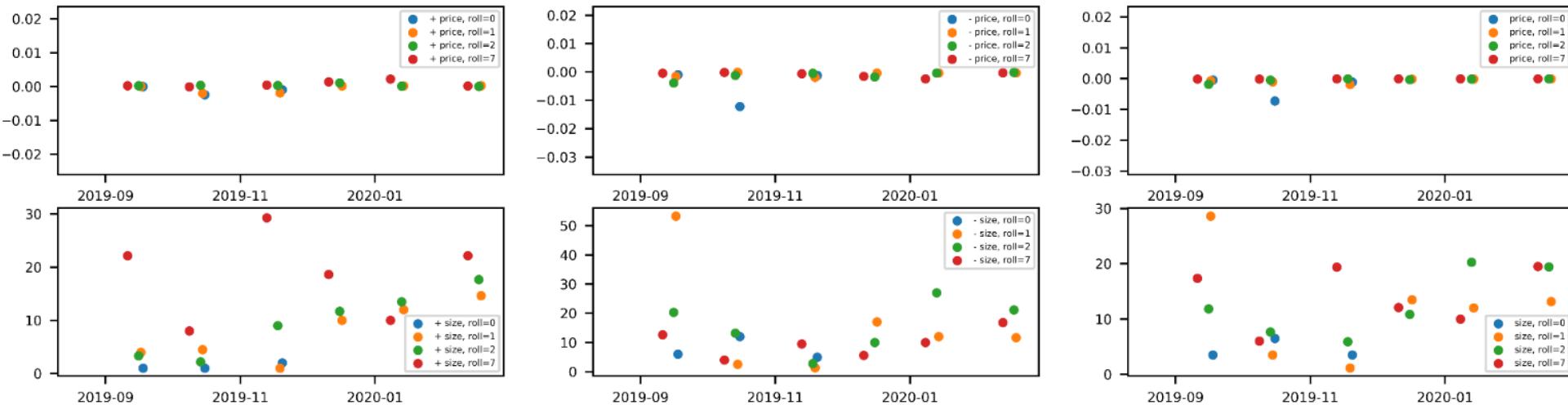
this month (A)			next month (B)		
ask	price	size	ask	price	size
	110	1		110	1
	109	1		109	1
	108	2		108	2
	107	3		107	3
	106	5		104	5
-----					
bid			bid		
	105	4		103	4
	104	3		102	3
	103	2		101	2
	102	1		100	1
	101	1		99	1

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

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

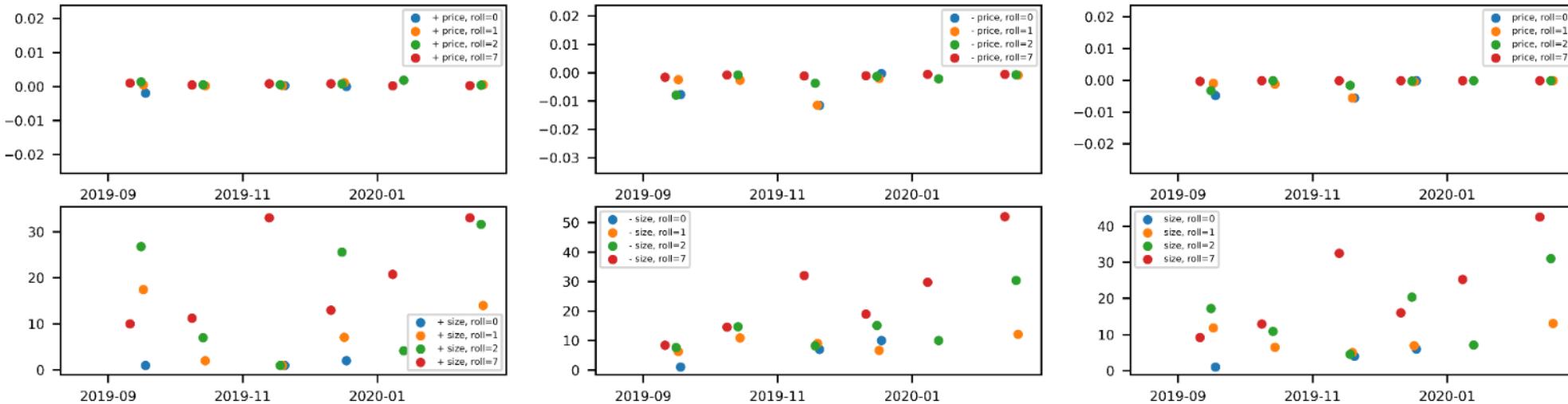


## Mean of price diff and match size in contract rolling of GHF



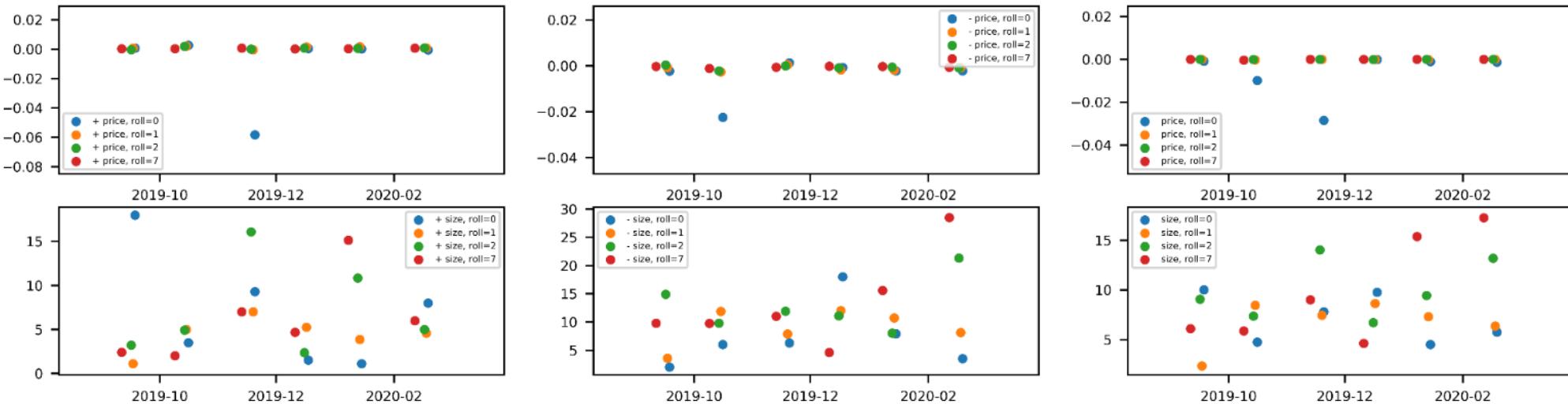
宏達電

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



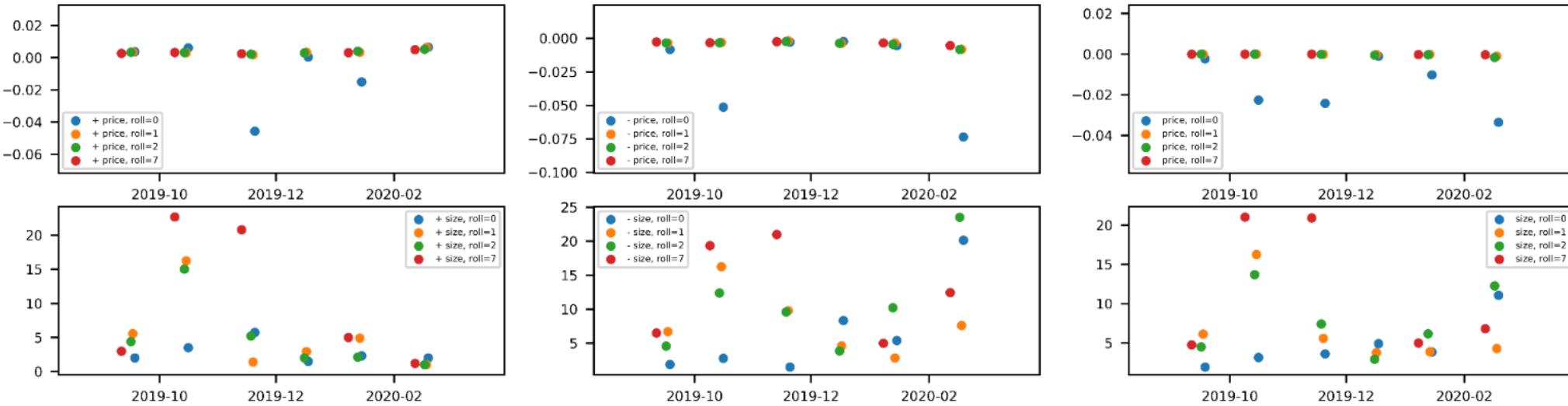
聯詠

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



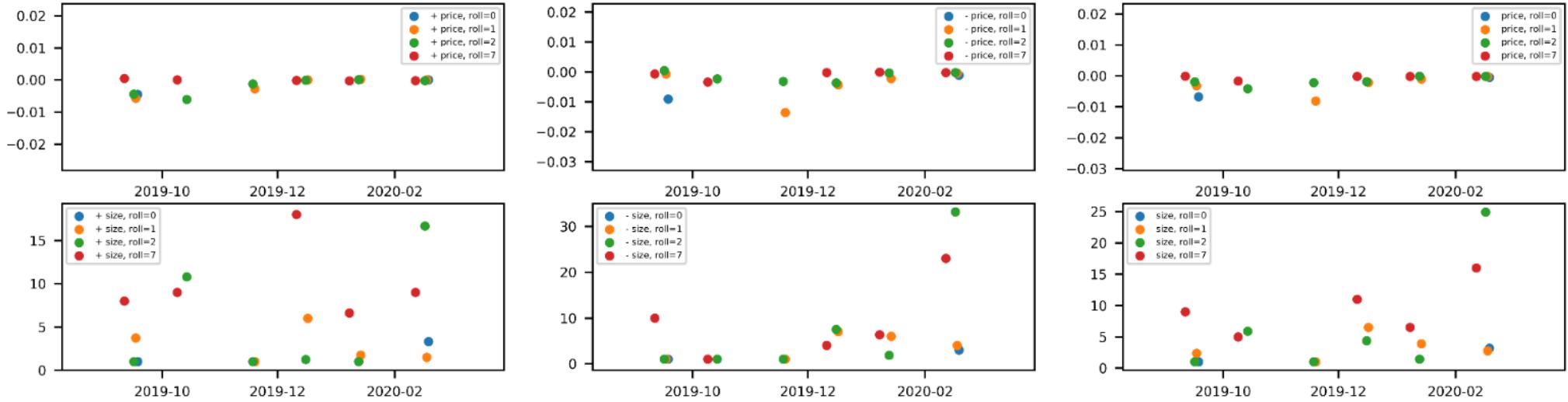
創意

### 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

- 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

# Stock Buy-Back ( 融券強制回補 )

臺灣證券交易所

字體大小 A A | 官員專區 | 報表索引 | 日本語ホームページ | English Home | Q

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日起提供停資券原因

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/BFI84U2.html>

# Data Processing

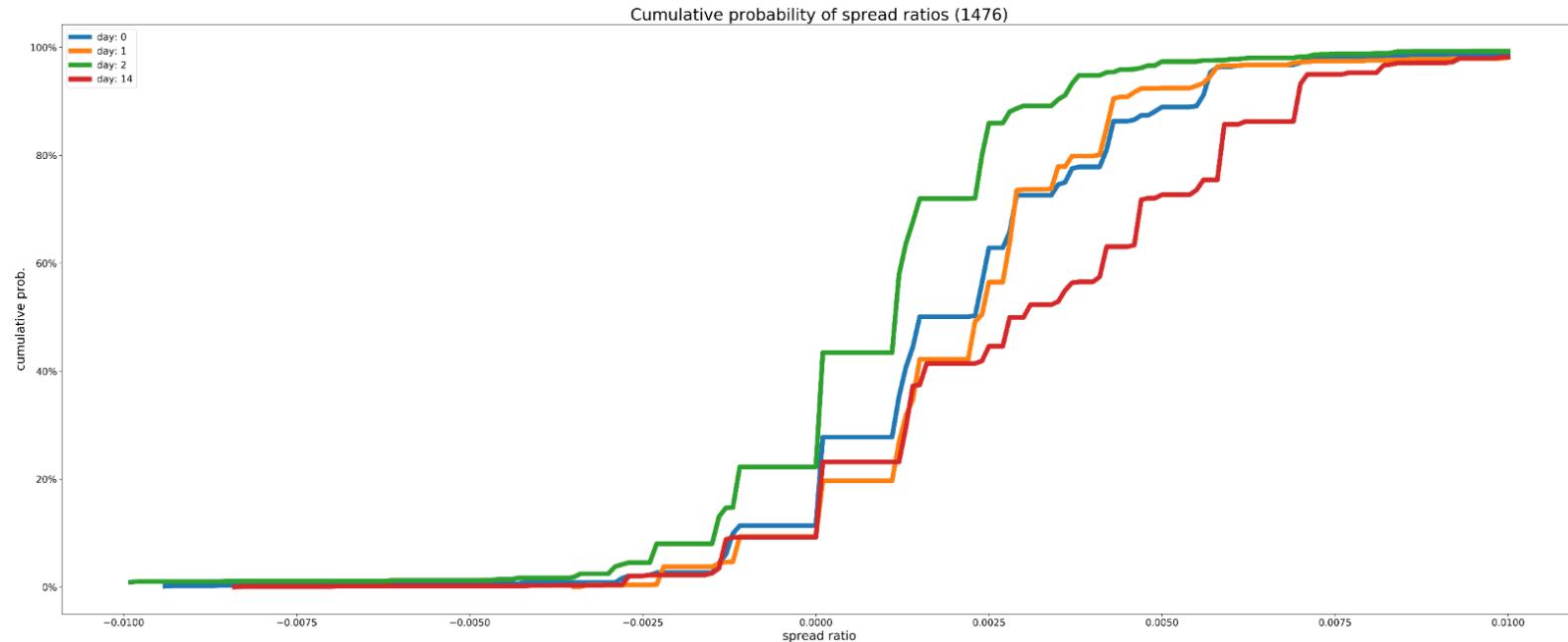
- The criteria:
  - Time range: 2018-01-01~2020-03-20.
  - Back to **14 days** before the buying-back days.
  - Snapshots of stock orderbook and future orderbook in tick-level.
  - **Concatenate** two orderbooks by aligning the time indices of future orderbook to the ones of stocks (using **pandas.merge\_asof**).
  - Tolerance **latency**:  $\leq 5$  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

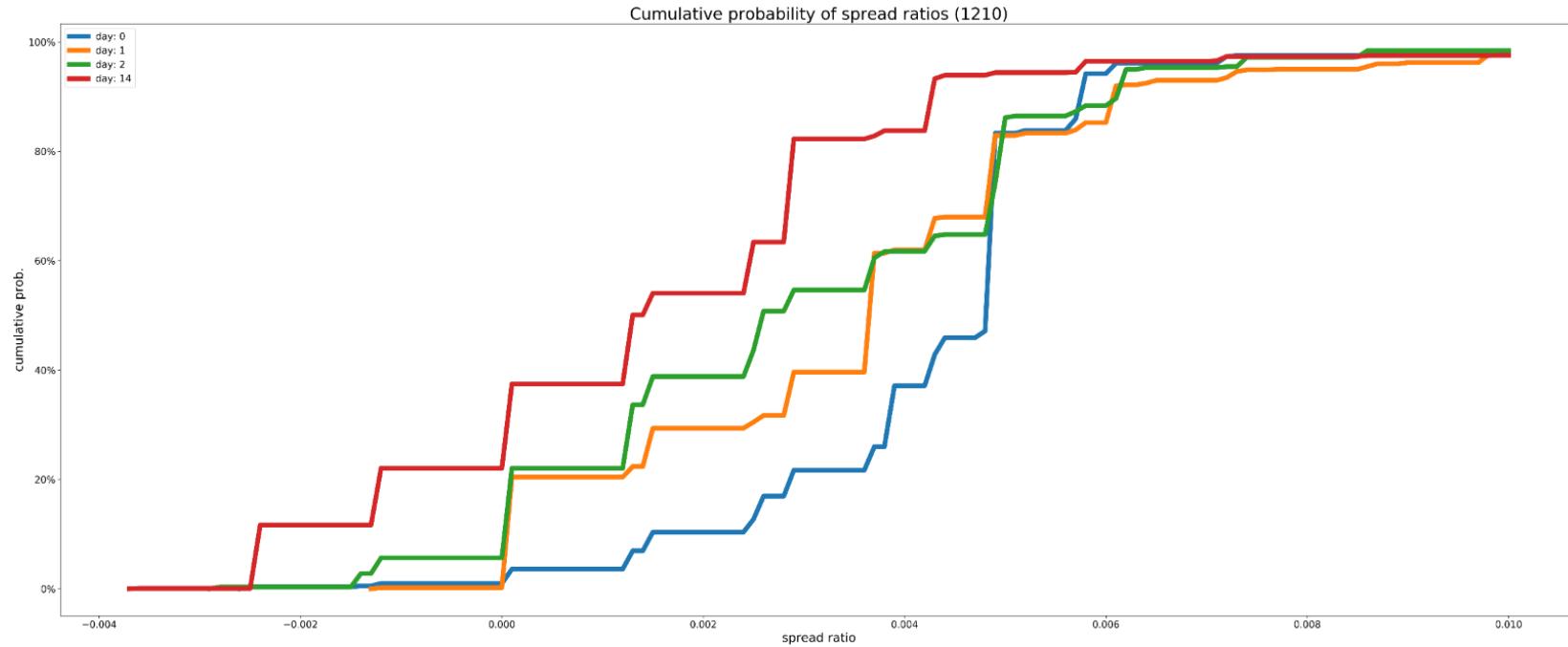
- Approx. distributions of intraday spread ratios:
  - Place spread ratios into 202 bins.

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	0.0528313824739	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	0.168952246734223	0.08775543389885	0.00054203479863	0.07442137785245
2330	0.04166210445638	0.09148144092854		0	0	0.199058359794137	0.0447279097777	0.10089784298691	0.02567611956639
2330	0.00621384186844	0.00867795157489		0	0	0.124973216198841	0.06862009856439	0.16434540389972	
2330	0.03834714255363	0.00031867431485		0	0	0.121043127257283	0.06867431485027	0.1831846186532	
2330	0.03796909492273	0.12704194260482		0	0	0.158002207505472	0.00088300220751	0.24757174392929	0.0007174392936
2330	0.0678742789369	0.08350854493507		0	0	0.148202059410271	0.00107822524125	0.1244811041027	
2330	0.09904397705541	0.08500409724117		0	0	0.14471455886379		0.18355640535384	0.00464354001639
2330	0.113524072159	0.07888084568538		0	0	0.117315868091438	0.0905434907503	0.15247615764676	0.11662645064918
2330	0.09897571642305	0.05184716307975		0	0	0.107319599493599	0.10357923811715	0.16814362987684	0.08936586488663
2330	0	0.11791938997825		0	0	0.098788126361667	0.02015250544661	0.20023148148137	0.15100762527225
2881	0	0	0	0.25012094823421	0.128043863892957		0.01967424608935		0
2881	0	0	0	0.34669249106082	0.17476162097737		0.0138557806913		0
2881	0	0	0	0.32992895204257	0.1506808762581		0.04558910597986	0.00192421551214	
2881	0	0	0	0.30466593042516	0.200303699613407		0.0926283821093	0.00096631695196	
2881	0	0	0	0.22661179698212	0.162551440329187		0.01947873799725	0.01138545953361	
2881	0	0	0	0.27126258714175	0.180015491866767		0	0.03175832687839	
2881	0	0	0	0.25997782705097	0.142738359201758		0	0.02355875831485	
2881	0	0	0	0.25504439063761	0.169357008340061		0	0.01963949421577	
2881	0	0	0	0.2512960829493	0.221342165898611		0.02289746543779	0.0426267281106	
2881	0	0	0	0.15094066570191	0.138205499276436		0.02575976845152	0.0865412445731	
2881	0	0	0	0.19878787878784	0.166212121212092		0.091212121211	0.05893939393938	
2881	0	0	0	0.06378656554712	0.285075839653277		0.05322318526543	0.0318255687974	
2881	0	0	0	0.1330575203523	0.281996530094699		0.00200186841052	0.02455625250233	
2881	0	0	0	0.16567270992365	0.252027671755707		0.04246183206107	0.00489026717557	
2881	0	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.,  $\geq 100$ ) 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  $\geq 100$ .

# 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	DCE	0.0005	0	272.00	505.50	652.50	745.00	852.00	1219.50	1487.50	1553.50	
1101	DFF	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	cou
1303	CAF	0.0005		012:30		107.5	270.5	472	730.5	1048.5	1426.5	1850
2330	CDF	0.0005		012:30	130.857142857143	322.857142857143	636.857142857143	1076.85714285714	1672.28571428571	2468.28571428571	3394.28571428571	
2881	CEF	0.0005		012:00		62	223.6	506	870	1370.4	1968	2683.6
2882	CKF	0.0005		012:30	104.6666666666667	348.6666666666667	740	1274.6666666666667	1968.333333333333	2798	3783.6666666666667	
2887	CMF	0.0005		012:00		39.6	107.2	200	320.8	490.4	706	969.6
2891	CNF	0.0005		012:30		117.6	349.6	663.2	1074	1590	2207.2	2931.6
1402	CRF	0.0005		012:00		60	184	350	555	826	1164.5	1579
1605	CSF	0.0005		012:00		60	177.5	373.5	635	925	1237.5	1593
2352	CWF	0.0005		011:30		18	51.5	104	181	288	415	568
2801	DCE	0.0005		012:00		49	118	205	323.5	473	654.5	869.5
1101	DFF	0.0005		012:00		86.4	217.2	412	678	988	1338.8	1723.2
1326	DGF	0.0005		012:00		77.5	204	354	540.5	738.5	962	1194.5
2317	DHF	0.0005		012:30		406	1189.2	2334.8	3896	5809.2	8067.6	10746.4
2357	DJF	0.0005		011:30		17	57	114.5	187	262.5	358.5	468
2382	DKF	0.0005		012:00		58	186.5	378	639.5	973	1345.5	1736.5
2885	DOF	0.0005		012:00		47.5	151.5	330.5	565.5	842.5	1139	1457.5
3481	DQF	0.0005		011:00		15.5	37.5	91.75	184.5	298.75	433.25	605.75
2448	DUF	0.0005		012:30		175.6	546.4	1048.8	1603.6	2287.6	3108	4109.6
2454	DVF	0.0005		012:30		234	680	1298.5	2017	2930.5	3973.5	5228.5
3231	DXF	0.0005		011:00		11.25	32.25	92.75	187.25	324	491.25	698.5
1102	DYF	0.0005		012:00		44.5	121.5	236.5	391	600.5	836.5	1132.5
2027	FEF	0.0005		011:30		19	52	147	264	387	517	678
2049	FFF	0.0005		012:30		163	423.5	714.5	1183	1917.5	2818	3931
2313	FTF	0.0005		012:30		132.5	341.5	715.5	1293	2052.5	3016	4150.5
2340	FYF	0.0005		012:30		118.4	345.6	646.4	995.6	1397.6	1904.8	2582.8
2344	FZF	0.0005		012:30		101.5	268	511	830.5	1257.5	1806.5	2482
2354	GCF	0.0005		011:30		22.5	59.5	113.5	190.5	297	463.5	671.5
2376	GHF	0.0005		012:00		77.6	213.2	454	756	1102.4	1498	1939.6
2377	GIF	0.0005		012:30		127.2	345.6	638	1021.2	1502	2108	2844.8
2379	GJF	0.0005		012:00		65.6	185.2	354.4	535.6	747.2	984	1245.2
2392	GLF	0.0005		011:30		30	83.5	173	325.5	556.5	877	1217.5
2449	GRF	0.0005		012:00		58	176	326	519.6	767.6	1034.8	1325.2
2474	GXF	0.0005		012:30		188	495.5	920.5	1473	2141.5	2905.5	3778.5
2485	GZF	0.0005		011:30		26	67	113	196	300	414.5	552.5

# What We Have to Notice



字體大小 A A A | 會員專區 | 報表索引 | 日本語homepage | 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
- 融資券賣出餘額
- 當日可借券賣出股數
- 借貸款項擔保品管制餘額

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  未輸入表示查詢全部股票

※ 自99年11月8日起提供停資停券查詢

**證券租賃買賣中心**  
Taipei Exchange

**戰略新板** **流動量提供者 & 證券經紀商** **交易獎勵活動**  
110/7/26~110/12/31

**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	鋐泰	110.10.04	110.10.07	除息
	5522	遠雄	110.10.07	110.10.13	除息

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

**下半年擋集**

**ENGLISH** **日本語**

關於租賃 | 清站導覽 | 公開資訊觀測站 | 新櫃板資訊公司系統  
 請輸入股票代碼、公司名稱，或網頁關鍵字

**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 > 停得券賣出預告表

**停得券賣出預告表**

資料日期：110/10/07 ~  股票代碼或關鍵字：   
  本資訊自民國104年3月起開始提供

顯示：10 筆

證券代號	證券名稱	停券起日(最後回補日)	停券迄日	原因
00687B	富邦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	元大投信級公司債	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

# Demo (Hand-Over Video)

- Demo video

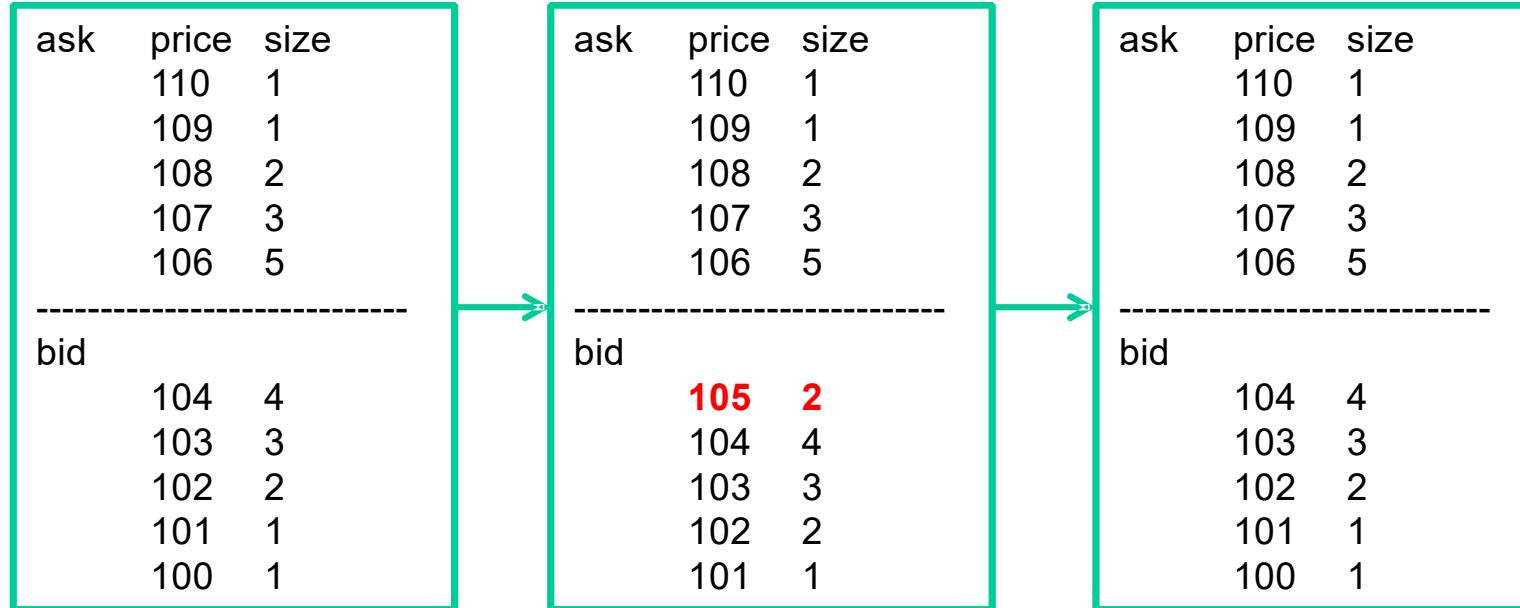
# Outline

- 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

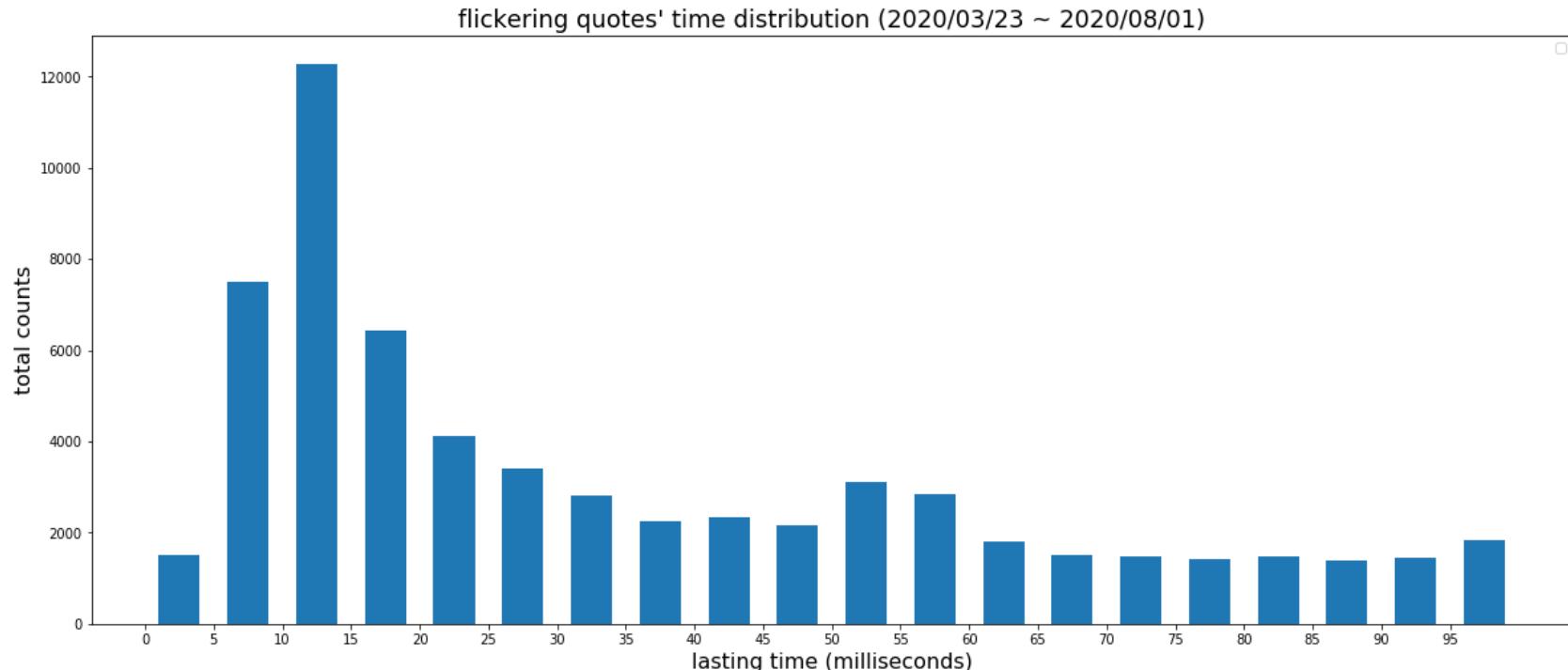
# Flickering Quotes (Flash Orders)

- 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  $\text{time}(t+1) - \text{time}(t) < \textbf{15ms}$ .
    - The order was not matched.

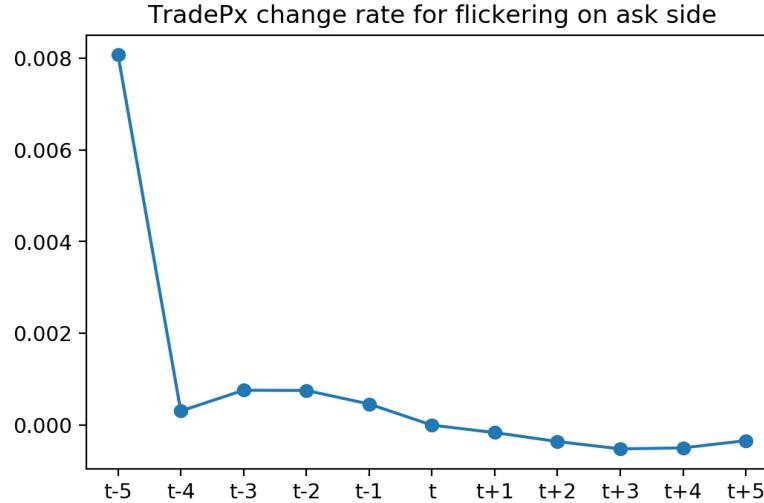
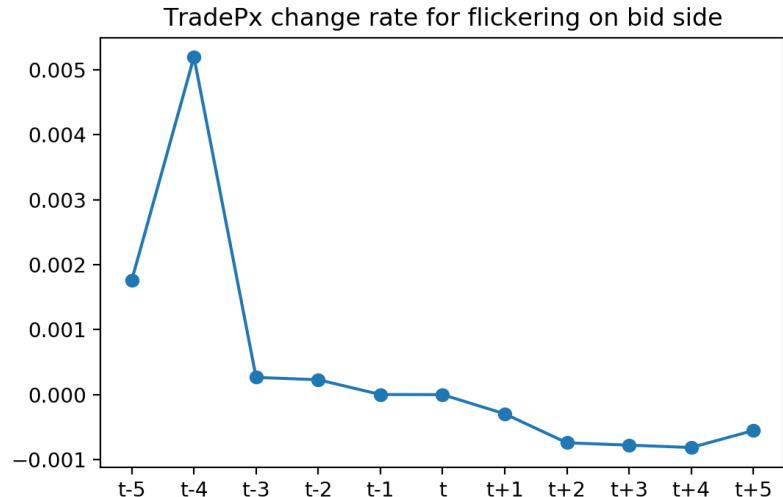
# Flickering Quotes (Flash Orders)



# Distribution Over the Lasting Time



# Price Impact Analysis



# Outline

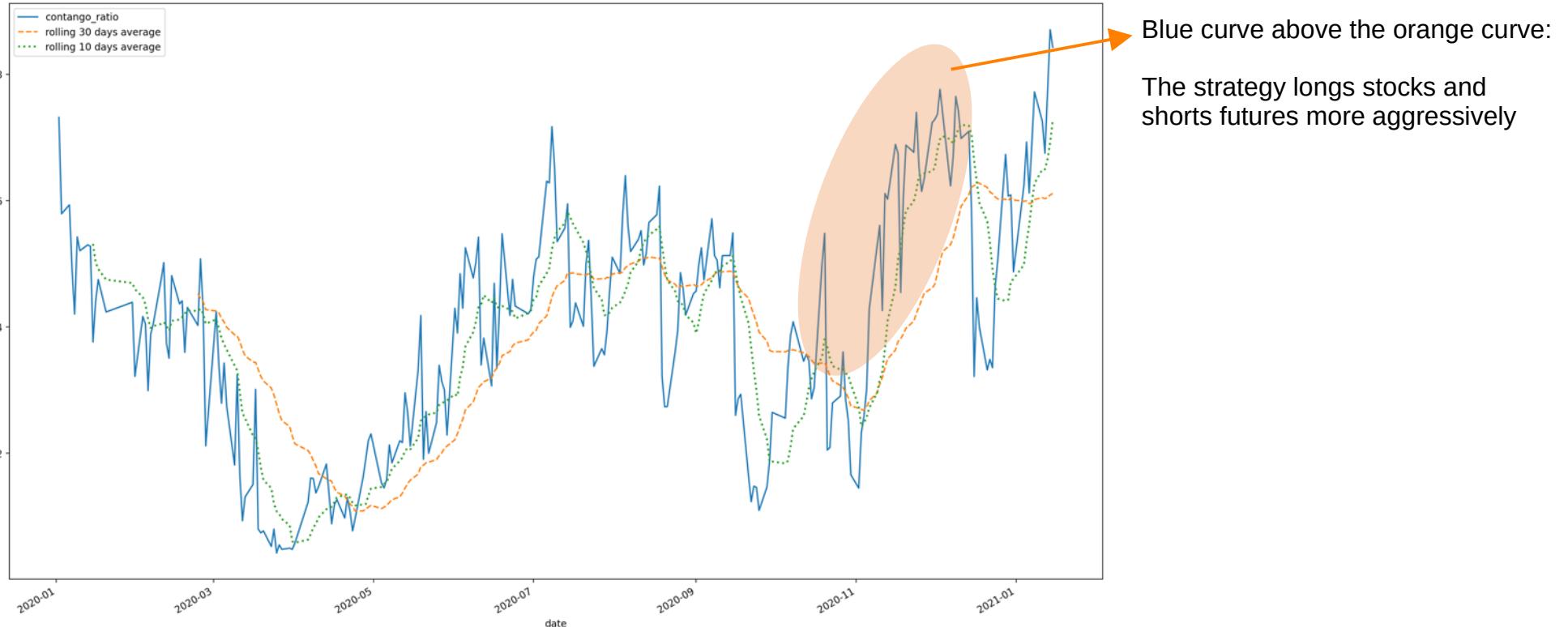
- Introduction
- Useful Techniques in Python
- Preliminaries on the Limit Order book (LOB)
- Futures Contract Rollover
- Stocks Buy-Back Analysis
- Flickering Quotes Analysis
- Forecast of Market Contango Ratio
- Strategy by LSTM/MLP Classifier

# Contango and Backwardation

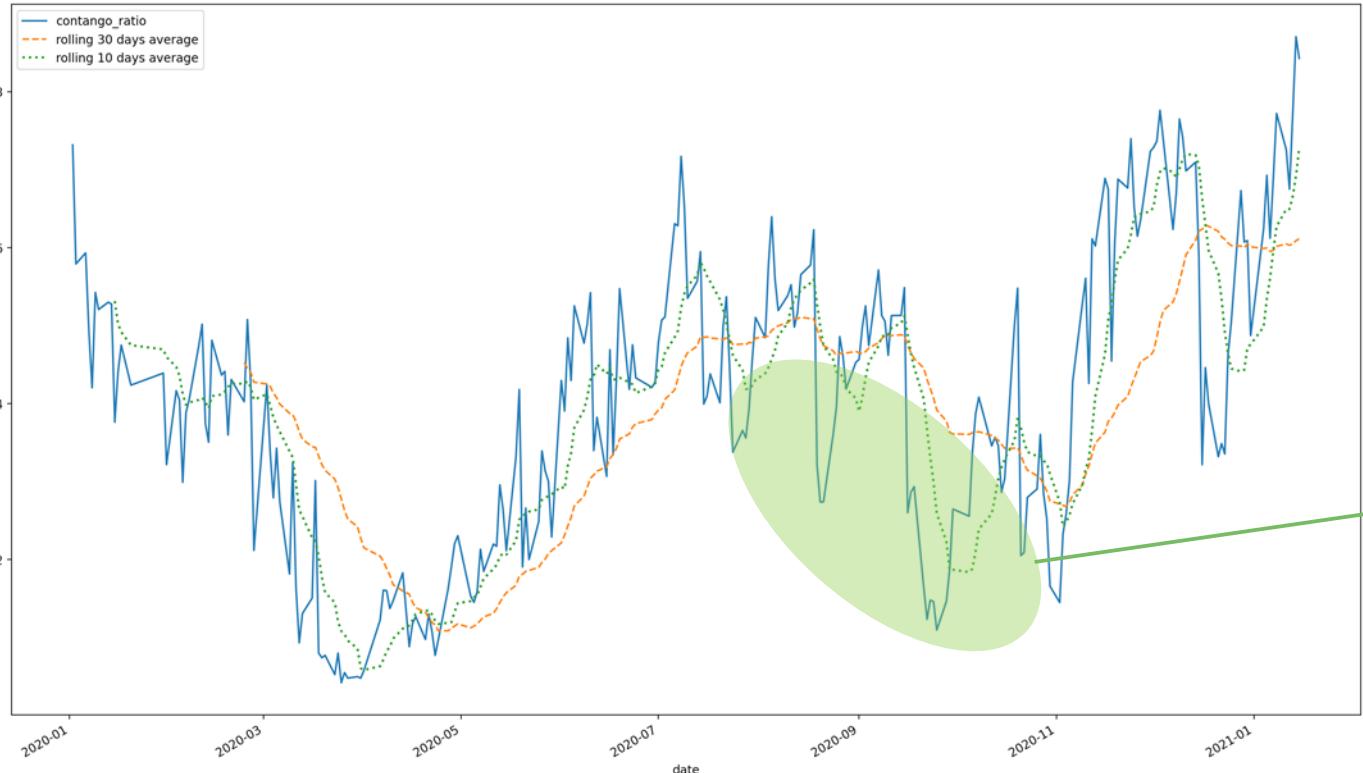
- Contango:
  - bidPrice1 of underlying futures (FUTbid1) > askPrice1 of the stock (STCask1)
    - the spread: FUTbid1 - STCask1 > max(10 bp, EMA of past spreads).
    - We accumulate the lasting time of such contango spreads per day.
- Backwardation:
  - askPrice1 of underlying futures (FUTask1) < bidPrice1 of the stock (STCbid1)
    - the spread: STCbid1 - FUTask1 > max(10 bp, 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



# 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

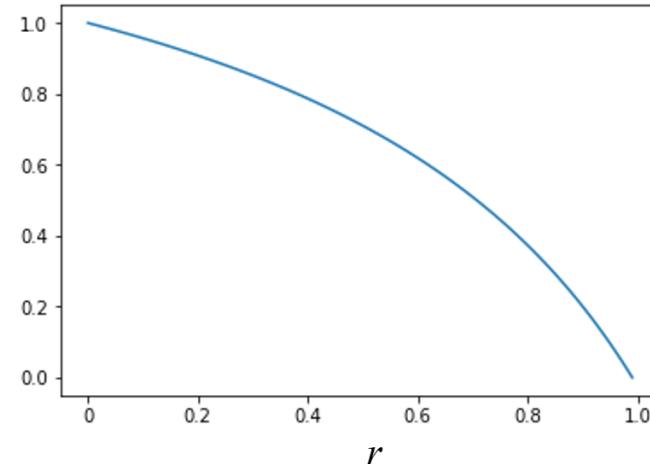
model no.	$R^2$ score
1	0.59
2	0.52
3	0.50
4	0.49
5	0.45
6	0.41
7	0.36
8	0.34
9	0.39
10	0.33

# 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:  $\theta$

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

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



# 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:  
 $\theta(r)$  for  $r \in [r'-d, r']$ .

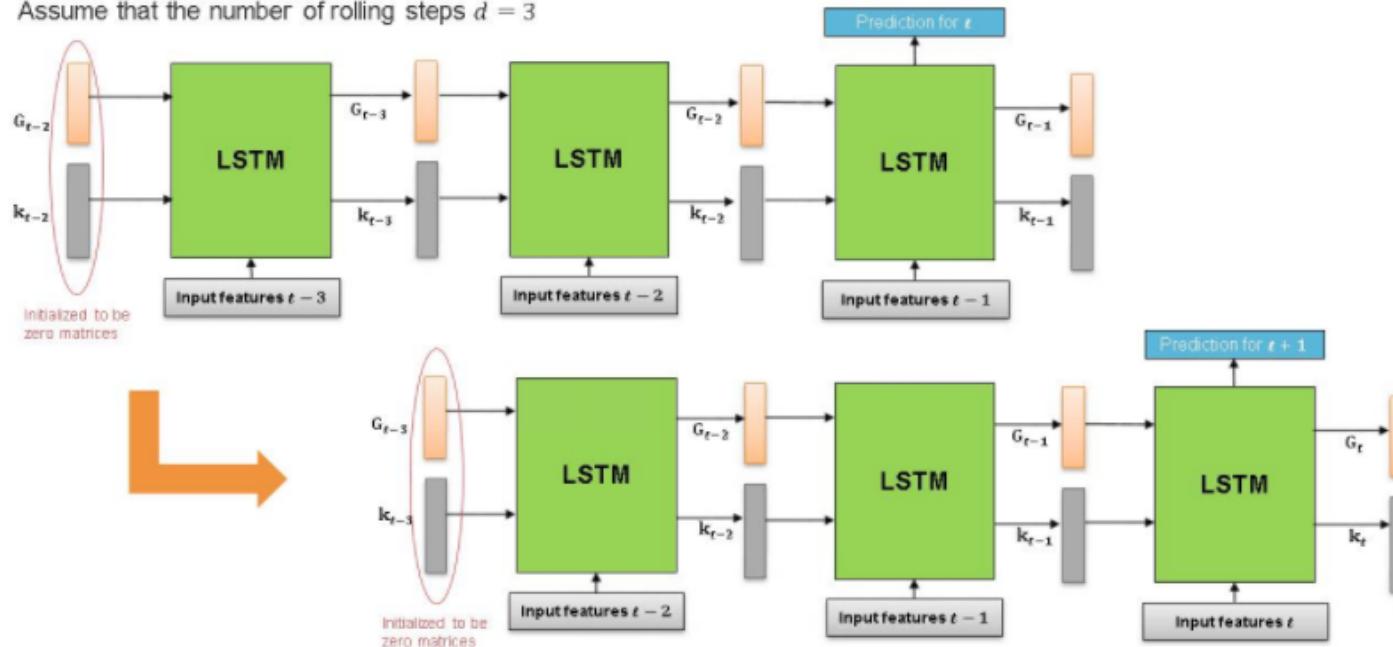
# Outline

- 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)

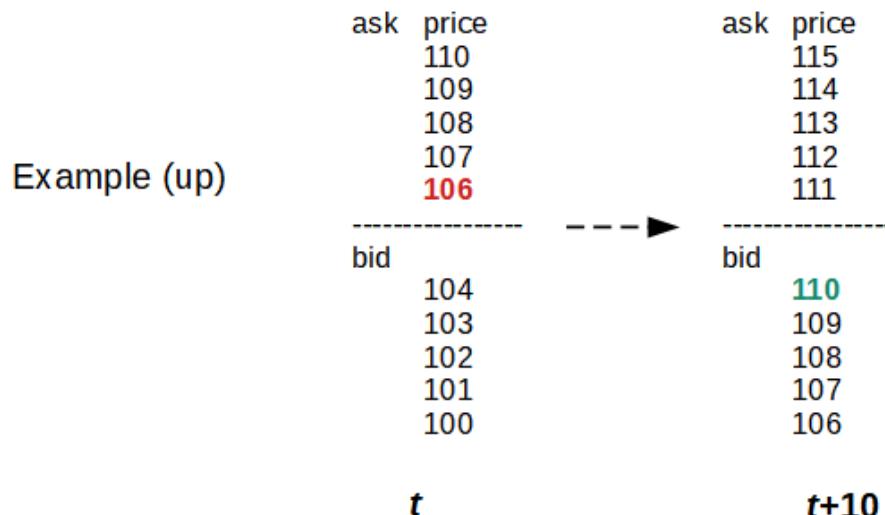
## LSTM With Rolling Steps (applied in our model)

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

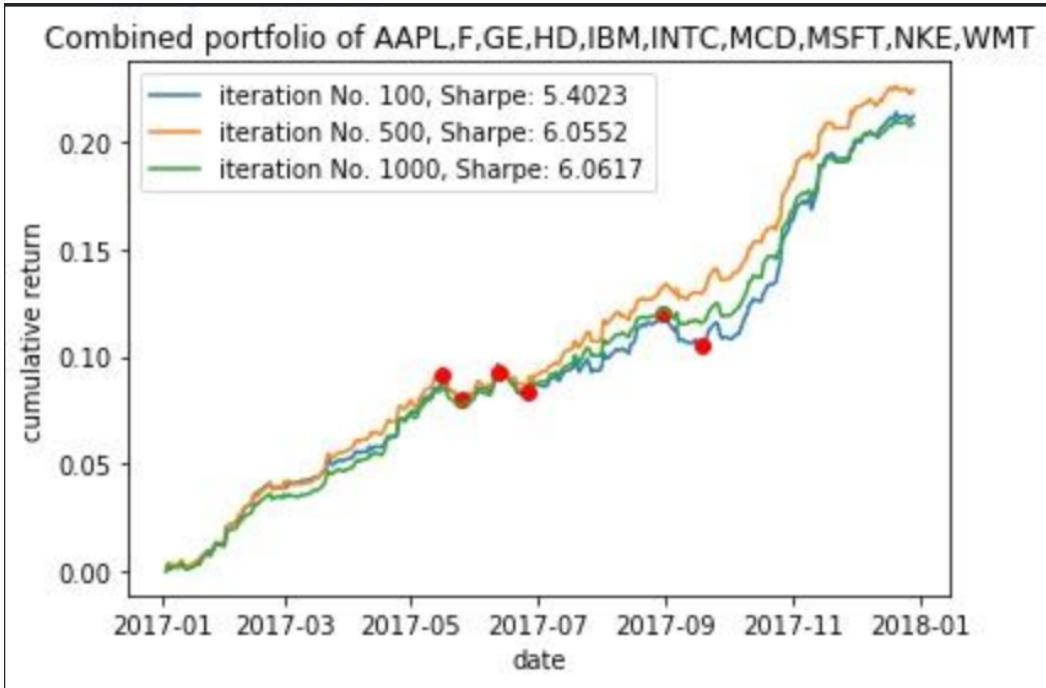


# Dealing with Data Imbalance

- 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%)



# 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

$\sigma$  : std of daily returns of our strategy

# Discussion

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