



NOVA SCHOOL OF
BUSINESS & ECONOMICS

Hedge Funds

Intraday Trading

Gonçalo Sommer Ribeiro

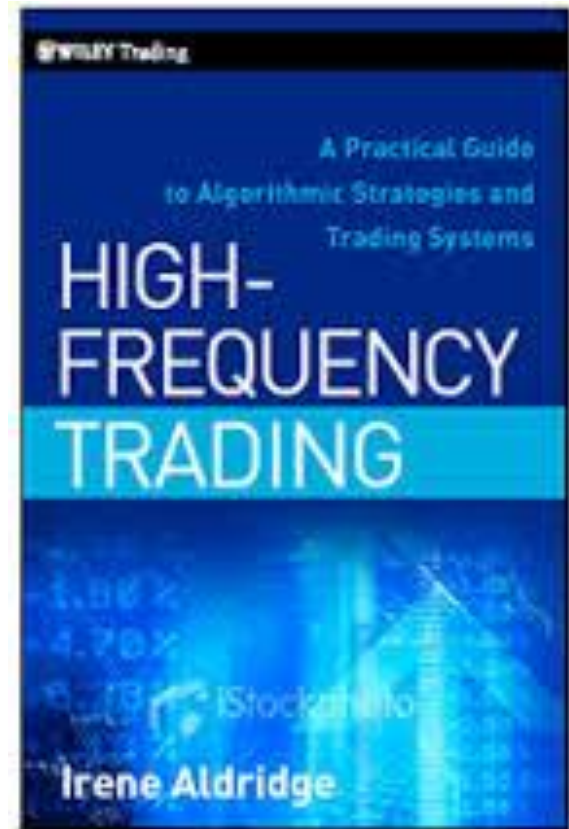
Intraday Trading

Executive Summary

- Microstructure of Financial Markets
- Intraday Data – Strategy Development
- Intraday Data – Strategy Example
- Intraday Strategies Conclusions

Intraday Trading Literature

High-Frequency Trading, Irene Aldridge



Intraday Trading

Motivation

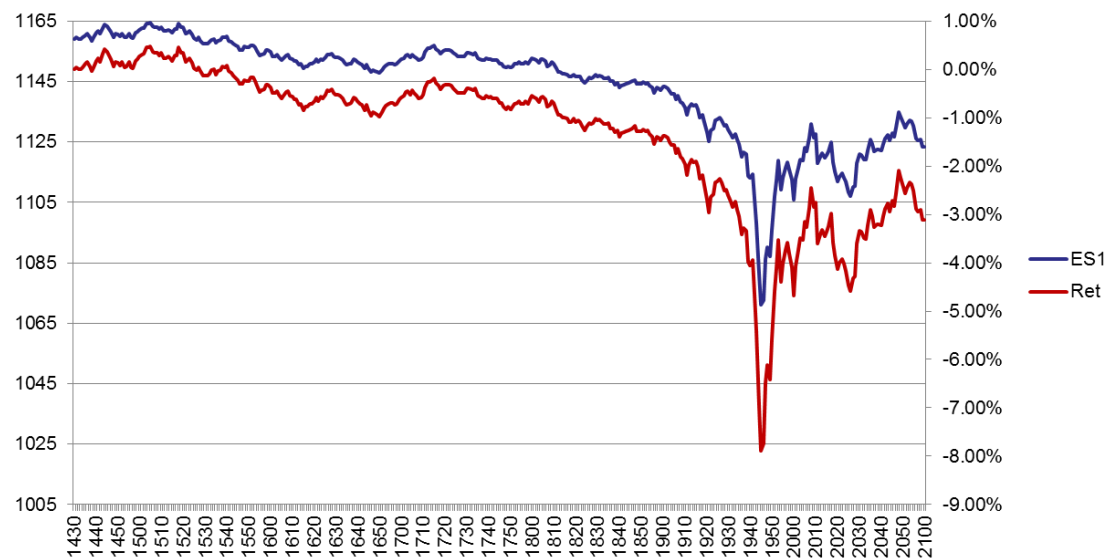
- **Intraday range** between high and low tends to be **higher** than open to close
- The objective is to **capture more volatility**
- Also the idea is to get out of a crowded place of end of day/week/month prices and capture all market movements

Intraday Trading

Motivation

Intraday Volatility

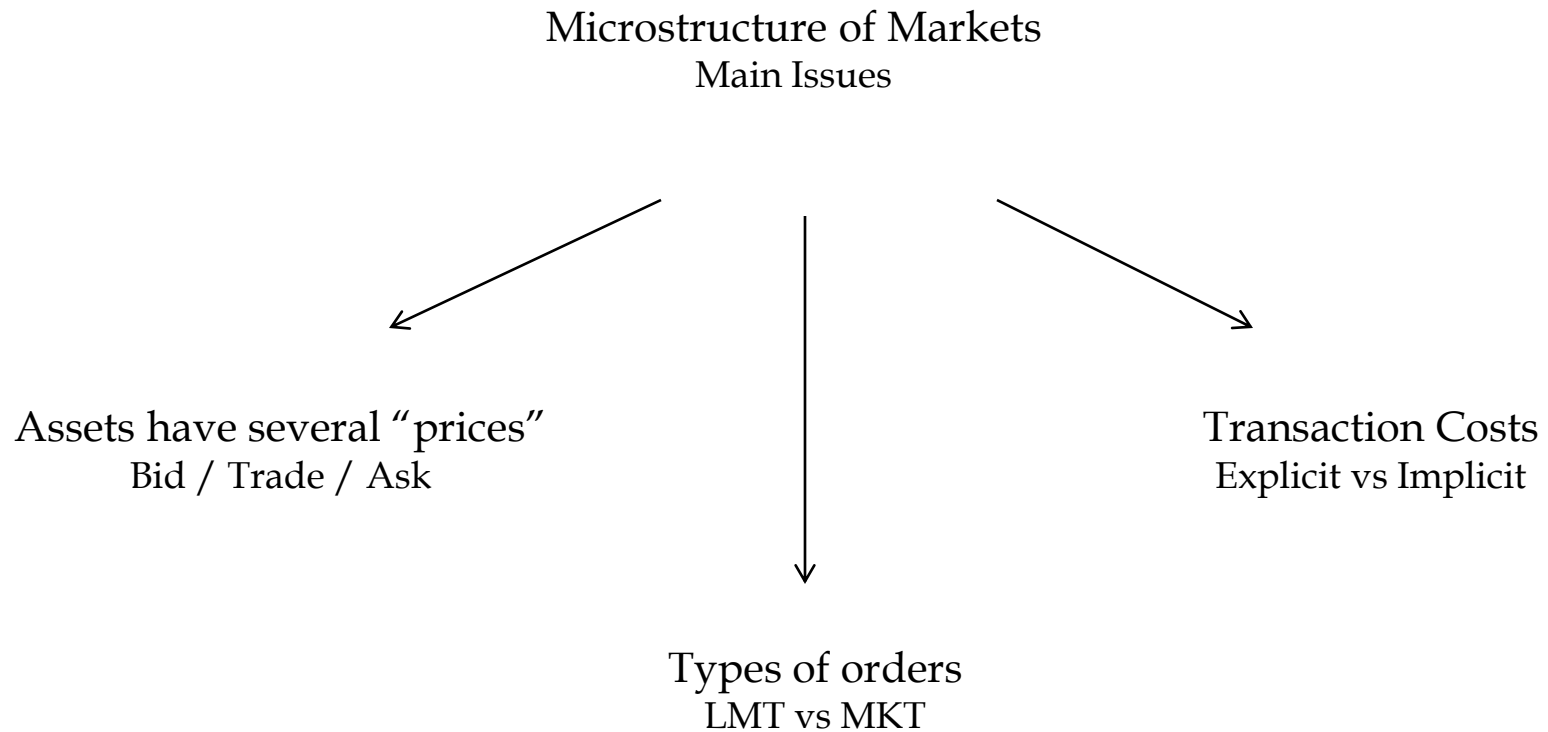
Flash Crash (6 May 2010)



S&P 500 Futures	Returns		Stdev	
	Open - Close	High - Low	Daily	Annualized
5/5/2010	0.2%	1.5%	1.2%	18.6%
5/6/2010	-3.1%	8.4%	4.1%	65.0%

Intraday Trading

Microstructure of Markets



Intraday Trading

Microstructure of Markets

Assets have several “prices”

Santander Rights “Arbitrage”



46 Rights = 1 Share

Using Trade prices	SAN/D SM		SAN SM		Difference	Arbitrage Opportunity!!!!
	Price 1 right	Price 46 rights	Price 1 share			
	€ 0.143	€ 6.578	€ 6.573	=	€ 0.005	0.08%
But using Bid/ Ask...		Bid	Ask			
	SAN/D SM	0.142 €	0.143 €	Sell 46 Rights & 1 Buy Share	-0.66%	No Arbitrage Opportunity!!!!
	46 SAN/D	6.532 €	6.578 €	Buy 46 Rights & 1 Sell Share	-0.08%	
	SAN SM	6.573 €	6.575 €			

Intraday Trading

Microstructure of Markets

Type of orders

Standard Order Lite Order

B/M Ticker INDEX STRD S/M

VGM1 INDEX

Desc: EuroStoxx 50 Jun21

Quantity:

Show Quantity:

Price:

Type: **LMT**

Account: YLNHS

TIF: ☒ DAY ☐ GTC ☐ GTD Apr-16-2021

Exec Pref: DMA

Clr Id: CREDIT-SUISSE

Submit

1 2 5 10

20 40 32 100

250 500 1,000 30

Clear

Bought: 0

Sold: 0

Last Traded: 13

Repeat RFQ

Instructions

B S

Price	Quantity
3,995	793
3,994	885
3,993	972
3,992	1,058
3,991	1,059
3,990	1,098
3,989	1,756
3,988	1,686
3,987	1,909
3,986	1,353
1,554	3,985
2,057	3,984
2,305	3,983
2,428	3,982
1,629	3,981
1,741	3,980
1,162	3,979
1,350	3,978
1,126	3,977
1,149	3,976

Standard Order Lite Order

B/M Ticker INDEX STRD S/M

VGM1 INDEX

Desc: EuroStoxx 50 Jun21

Quantity:

Show Quantity:

Price: 0

Type: MKT

Account: IOC

TIF: **MKT**

Exec Pref: STOP-LMT

STOP-LOSS

Clr Id: With Tick

Submit

1 2 5 10

20 40 32 100

250 500 1,000 30

Clear

Bought: 0

Sold: 0

Last Traded: 14

Repeat RFQ

Instructions

B S

Price	Quantity
3,995	795
3,994	894
3,993	774
3,992	1,080
3,991	1,059
3,990	1,111
3,989	1,750
3,988	1,698
3,987	2,010
3,986	1,168
1,533	3,985
2,131	3,984
2,257	3,983
2,616	3,982
1,640	3,981
1,734	3,980
1,157	3,979
1,343	3,978
1,121	3,977
1,157	3,976

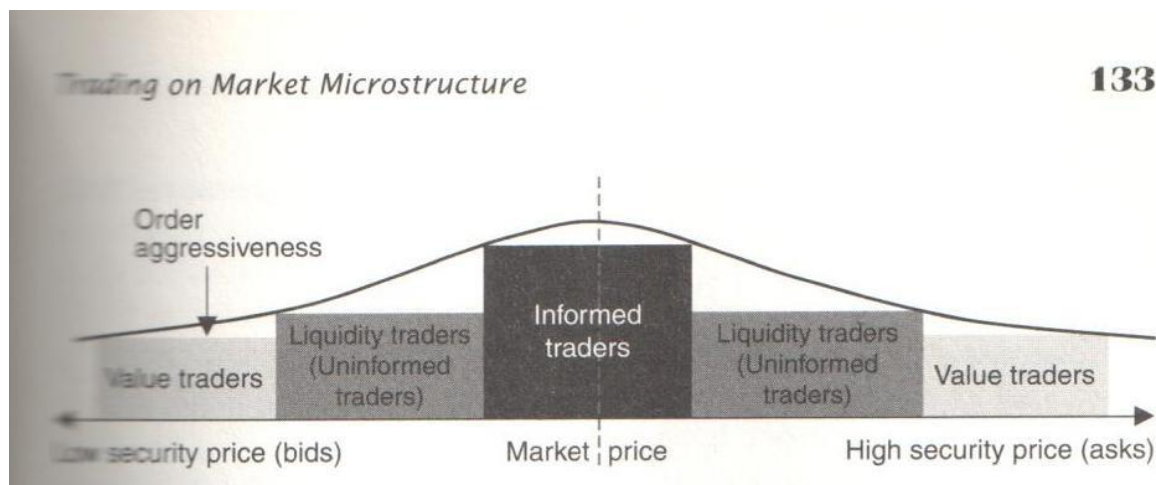
Intraday Trading

Microstructure of Markets

Type of orders

Order book

- Limit vs Market orders
 - LMT guarantees price but not execution
 - MKT guarantees execution but not price



Intraday Trading

Microstructure of Markets

Implicit Trading Costs

Bid/Ask Spread

Bid

Best price to
Sell

The screenshot shows a trading interface for the VGM1 INDEX (EuroStoxx 50 Jun21). The interface includes fields for Quantity, Price, Type (LMT), Account (YLNHS), TIF (DAY, GTC, GTD), Exec Pref (DMA), and Clr Id (CREDIT-SUISSE). A 'Submit' button is present. Below the form are buttons for 'Clear', 'Repeat', and 'RFQ'. The right side of the interface displays a list of bid and ask prices with their respective quantities. The bid prices are shown in blue and the ask prices in red.

Bid Price	Ask Price	Quantity
3,995	3,985	793
3,994	3,985	885
3,993	3,985	972
3,992	3,985	1,058
3,991	3,985	1,059
3,990	3,985	1,098
3,989	3,985	1,756
3,988	3,985	1,686
3,987	3,985	1,909
3,986	3,985	1,353
1,554	3,985	
2,057	3,984	
2,305	3,983	
2,428	3,982	
1,629	3,981	
1,741	3,980	
1,162	3,979	
1,350	3,978	
1,126	3,977	
1,149	3,976	

At the bottom right, there are fields for 'Bought: 0', 'Sold: 0', and 'Last Traded: 13'.

Ask / Offer

Best price to
Buy

Why 2 prices instead of one? Adverse Selection

Intraday Trading

Microstructure of Markets

Implicit Trading Costs

Bid/Ask Spread (de)Formation Flash Crash

- Real life example of **distortion** of Bid-Ask Spread



- 0:58 Stop Limit ES1: 1053
- 3:36 BidAsk spread ES1 1064.5 – 1065.75
- 3:40 Hit Limit @ 1064

Video: https://www.youtube.com/watch?v=E1xqSZy9_4I

Intraday Trading

Microstructure of Markets

Implicit Trading Costs

Bid/Ask Spread Factors

Factors affecting Bid/ Ask Spread :

- Market liquidity (market makers)
- Market conditions (big swings in markets)
- Value of Asset and tick size (depending on exchange rules)

Standard Order Lite Order

B/M Ticker INDEX STRD S/M

VGM1 INDEX

Desc: EuroStoxx 50 Jun21

Quantity: 1

Show Quantity: 1

Price: 3,995

Type: LMT

Account: YLNHS

TIF: DAY GTC GTD Apr-16-2021

Exec Pref: DMA

Cr Id: CREDIT-SUISSE

Submit

1 2 5 10

20 40 32 100

Clear 250 500 1,000 30

Bought: 0

Sold: 0

Last Traded: 13

Instructions B S

Eurostoxx 50 bid/ask spread is 0.025%

Standard Order Lite Order

B/M Ticker INDEX STRD S/M

NQM1 INDEX

Desc: Mini Nasdaq 100 Jun21

Quantity: 1

Show Quantity: 1

Price: 13,992.50

Type: LMT

Account: YLNHS

TIF: DAY GTC GTD Apr-16-2021

Exec Pref: DMA

Cr Id: CREDIT-SUISSE

Submit

1 2 5 10

20 40 32 100

Clear 250 500 1,000 30

Bought: 0

Sold: 0

Last Traded: 1

Instructions B S

Nasdaq bid/ask spread is 0.002% ~ 14x lower

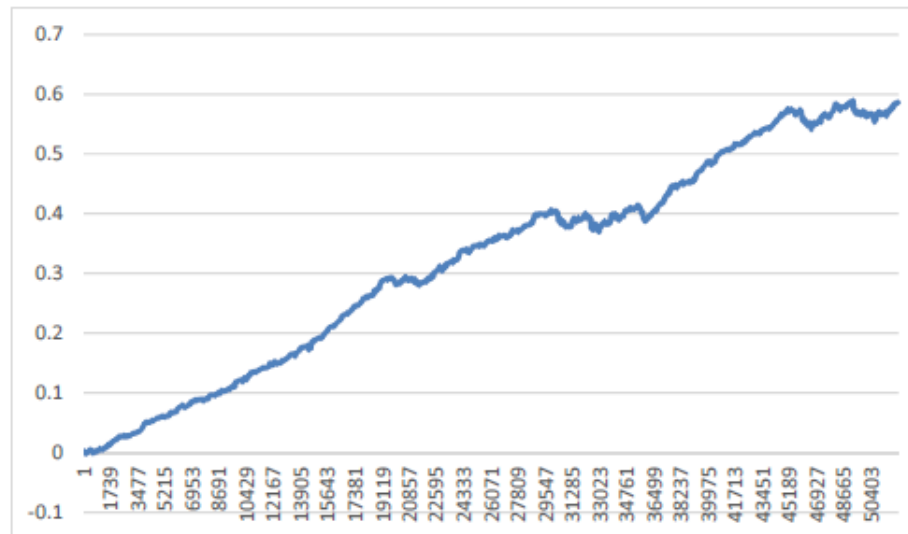
Intraday Trading

Microstructure of Markets

Illusion of Mean Reversion

Bid/Ask Bounce

- **Bid/Ask bounce:** for the same market level, as transaction orders arrive in the market the price of the asset “bounces” from the bid (selling orders) to the ask price (buying orders) creating “fake volatility” in asset TRADING prices and the illusion of mean reversion
- Cumulative profitability of a 1 min reverse strategy in VG Futures TRADING prices (January to March 2021)



Intraday Trading

Microstructure of Markets

Illusion of Mean Reversion

Bid/Ask Bounce Video

Order Entry Fields (Left):

- Quantity: []
- Price: 3675
- Type: LMT
- Account: YSXZX
- Date: Apr-21-2015 ☐ GTC
- Ref: DMA
- Id: CREDIT-SUISSE
- Submit

Order Book Table (Center):

Quantity	Price	Quantity
	3,679	1,109
	3,678	1,081
	3,677	849
	3,676	172
660	3,675	
887	3,674	
881	3,673	
980	3,672	
1,849	3,671	
942	3,670	
965	3,669	

Order Entry Summary (Bottom Center):

FESX 1506 3,675 ▼ 2

Bought: 0
Sold: 0
Last Traded: 2

Order Entry Fields (Right):

- Show Quantity: []
- Price: 160.2
- Type: LMT
- Account: YSXZ
- Date: Apr-
- Exec Pref: DMA
- Clr Id: CREI
- Subr

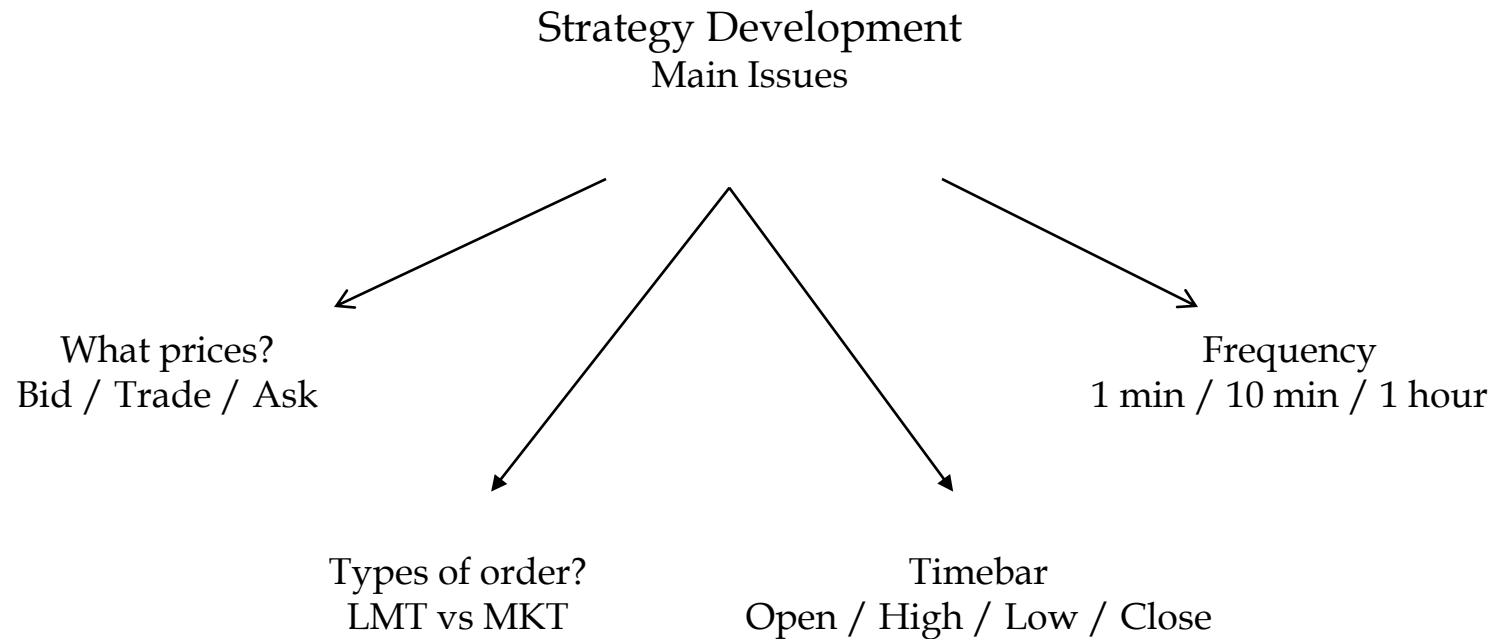
Navigation Buttons (Bottom):

1 2 3 4
5 6 8 10
20 30 40 50

Clear

Intraday Trading

Strategy Development

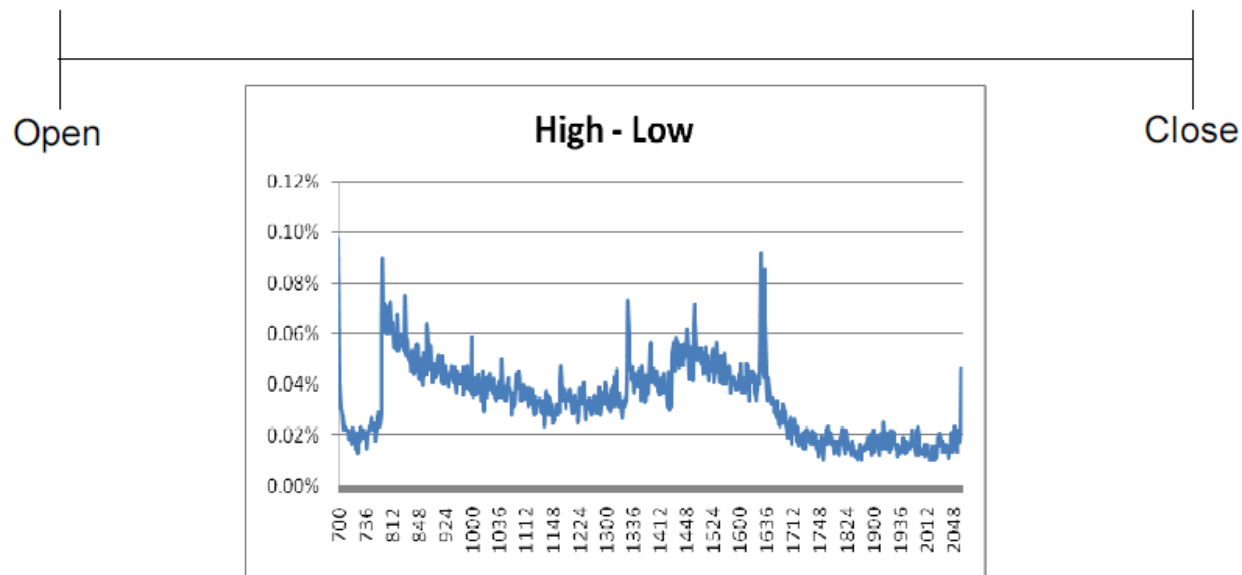


Intraday Trading

Strategy Development

Timebar

1 minute is a long time



DATE	OPEN	HIGH	LOW	CLOSE
5/6/2010 14:30	1943.25	1947	1941.75	1946.5

Intraday Trading

Strategy Development

Intraday Strategies

- Everything that you have discussed so far, **but intraday**
- Moving Averages – **Mean Reversion vs Trend Following**
- Explore “Seasonalities” / **Time Patterns**
- **Event Trading** – specific events (announcements, news trading, social media, etc)
- Machine/Deep Learning, Variables modeling using Physics theories The objective is to capture more volatility

Intraday Trading

Strategy Development

Signals for Intraday Strategies

Example

- Mean Reversion Strategy using minute data (negative autocorrelation?)
- Rule: Moving Average +/- Standard Deviation
- Information Lag, to avoid forward looking bias
- Which length of MA and Sigma? - Trial and error
- Using Trade prices

Intraday Trading

Strategy Development

Data Download

Spreadsheet Builder ? x

Intraday Layout 1 Select Securities 2 Set Date Range 3 Preview and Create

Bars | Ticks

From 01/02/2021 07 : 00 : 00 To 04/16/2021 16 : 44 : 00 ☐ Now

Bar Types (Select at least one)

☒ Trade ☒ Bid ☒ Ask

Market Events (Select at least one)

☒ Open ☐ Value
☒ Close ☒ Volume
☒ High ☐ Tick Count
☒ Low

Set Bar Size - + ☒ Minutes ☐ Seconds

OPTIONAL PARAMETERS

☐ Set Data to Recur Daily
☐ Real-time Bars (for bar type Trade only)

Fill and Alignment Settings

Fill with ⓘ

Time Zone

☒ Local Time Zone
☐ Custom Time Zone
☐ City: On DST: True
☐ Offset from GMT:

Distribution & Dividend Settings

☒ Follow Terminal Dividend Settings

Bloomberg

Previous Next Cancel

Intraday Trading Strategy Development Data Download Output

<div> <div>FileHomeInsertPage LayoutFormulasDataReviewViewDeveloperHelp</div> <div> <div> <div>CutCopyFormat Painter</div> <div>Paste</div> </div> <div>Clipboard</div> </div> <div> <div>Calibri11A⁺A⁻</div> <div> <div>BBIU</div> <div></div> <div></div> </div> <div>Font</div> </div> <div> <div></div> <div></div> <div></div> </div> <div>Alignment</div> </div> <div> <div>General</div> <div>\$%&#</div> <div>Number</div> </div> <div> <div>Conditional FormattingFormat as Table</div> <div>NormalBadGoodNeutralCalculationCheck</div> <div>Styles</div> </div>

Intraday Trading

Strategy Development

Intraday Strategies Results

Example

- Simple Strategy Mean-Reversion using 20 minutes Moving Average +/- 3 Standard Deviations

Start	730
End	2030

Sigma	3
-------	---

avg 32%

std 3%

IS 9.42

pos d 78%

Assumptions:

Trade price is always executable, which is not true

Type of order being used? Assumes market, but doesn't account for bid-ask

Fill the lock, order book priority. Assumes no order book

Check stability across the day vs time patterns

Transaction costs? Implicit and Explicit not accounted

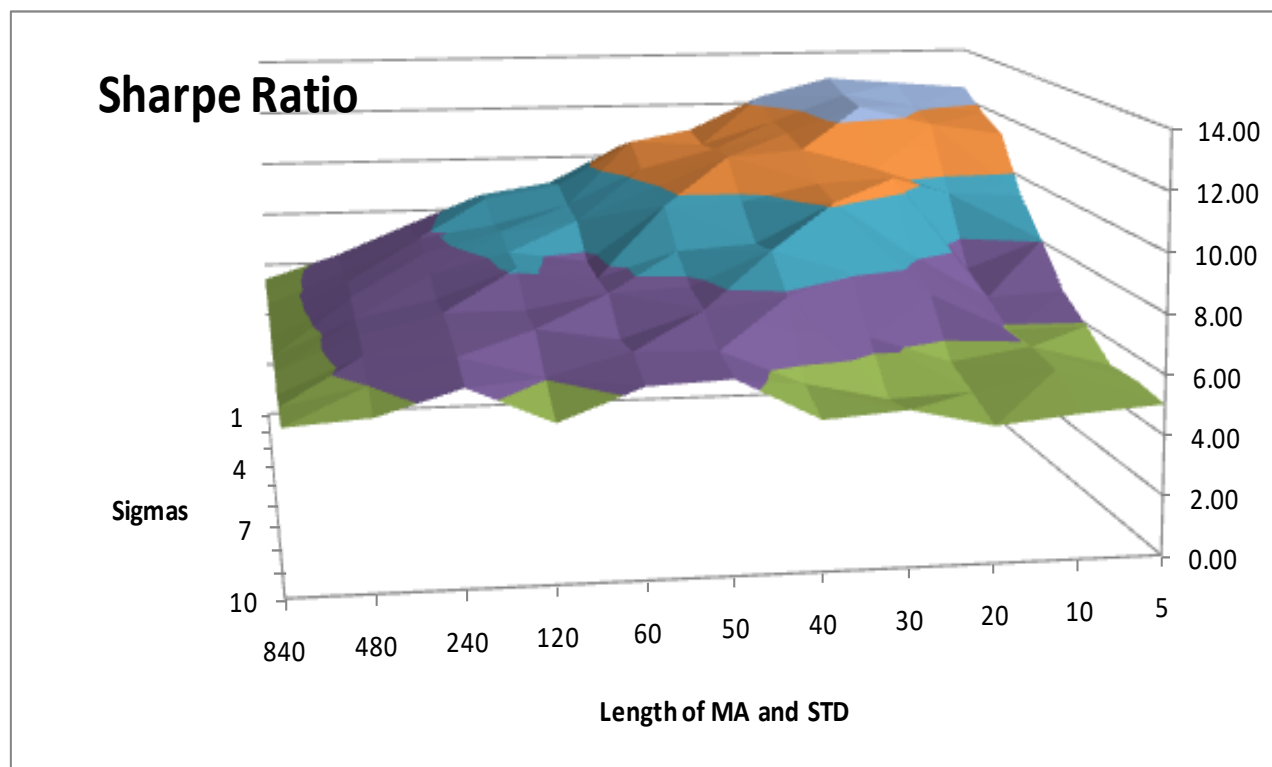
1 minute is a lot of time!! Need to use Open High Low Close

Intraday Trading

Strategy Development

Intraday Strategies Results

Sharpe Ratio Surface

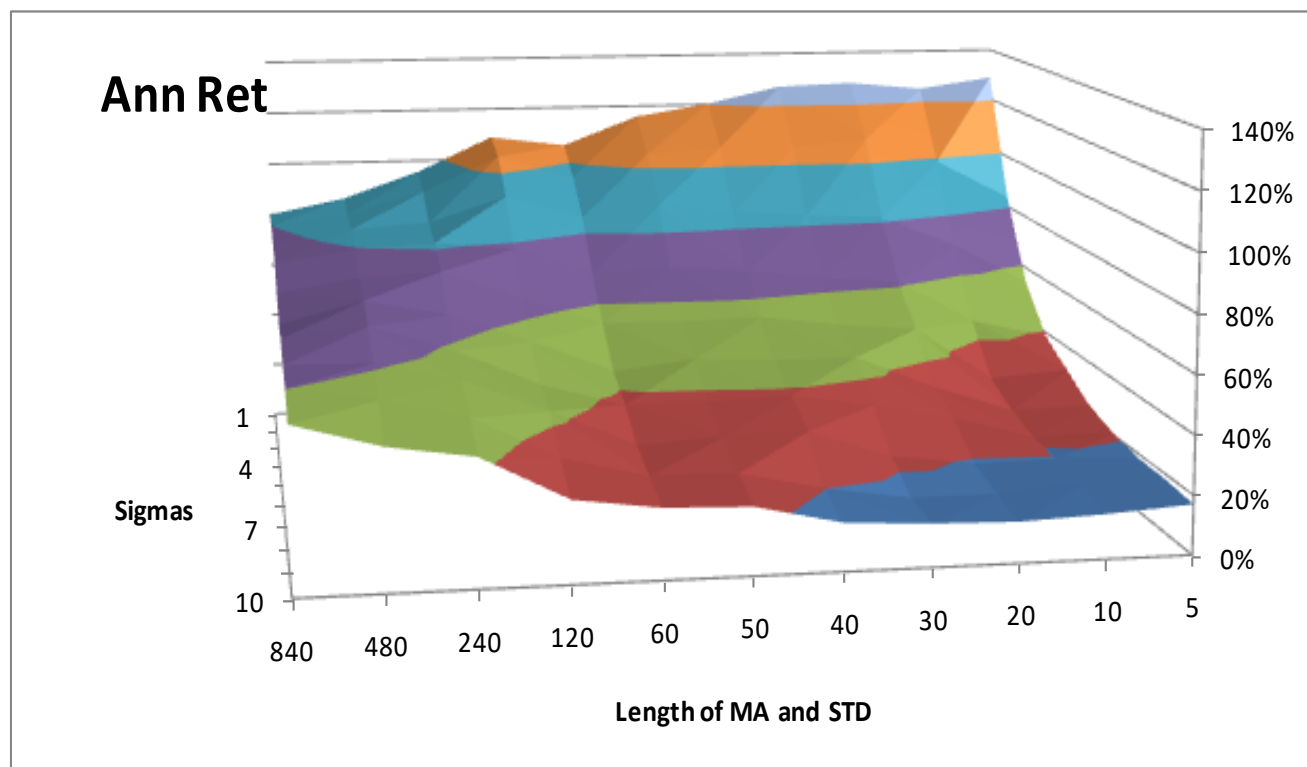


Intraday Trading

Strategy Development

Intraday Strategies Results

Sharpe Ratio Surface

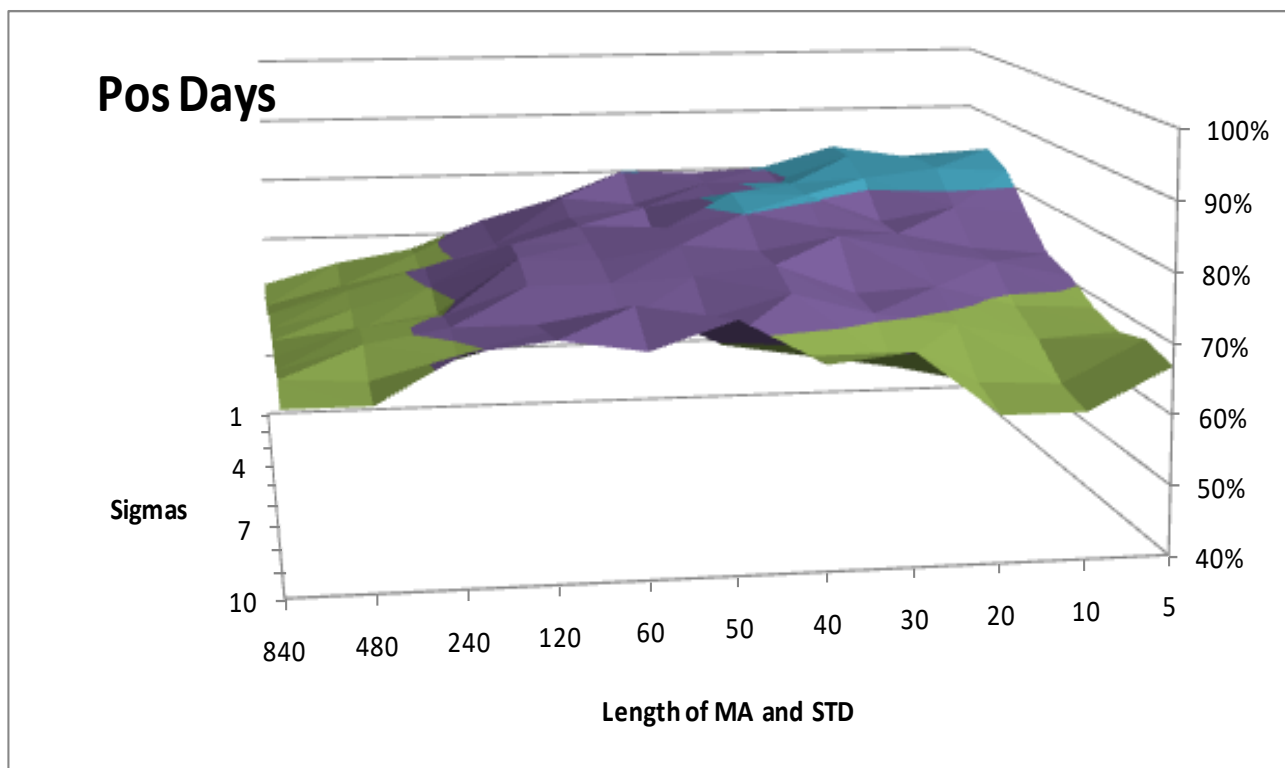


Intraday Trading

Strategy Development

Intraday Strategies Results

Positive % Surface



Intraday Trading

Strategy Development

Intraday Strategy Example

Conclusions

- Lots of trades of 1 minute – must define **entry and exit rules** accurately
- Mkt or Lmt order? – use Limit to **avoid paying the Bid/Ask spread**
- One price per minute enough? – highs and lows provide valuable info
- **In-sample bias?** – test same strategy in different data sets
- **Explicit costs** (Brokerage) and **Implicit costs** (Bid/ Ask + Bounce Illusion) not being accounted for

Can we improve our backtest? Maintaining the initial criteria MA 20 minutes and 3 sigma?

Intraday Trading

Strategy Development

Intraday Strategy accounting Implicit Costs

Bid/Ask effect

- Simple Strategy but now taking into account the Bid/Ask and Market orders

Start	730
End	2030

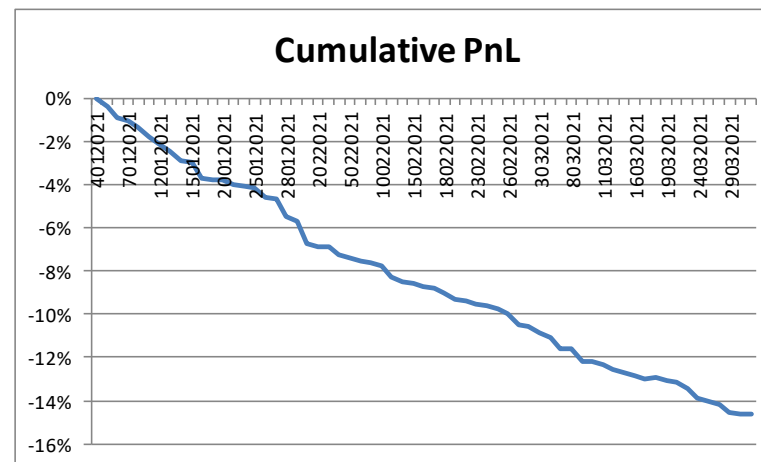
avg -61%

std 3%

Sigma	3
-------	---

IS -18.38

pos d 1.61%



Intraday Trading

Strategy Development

Intraday Strategy accounting Explicit Costs

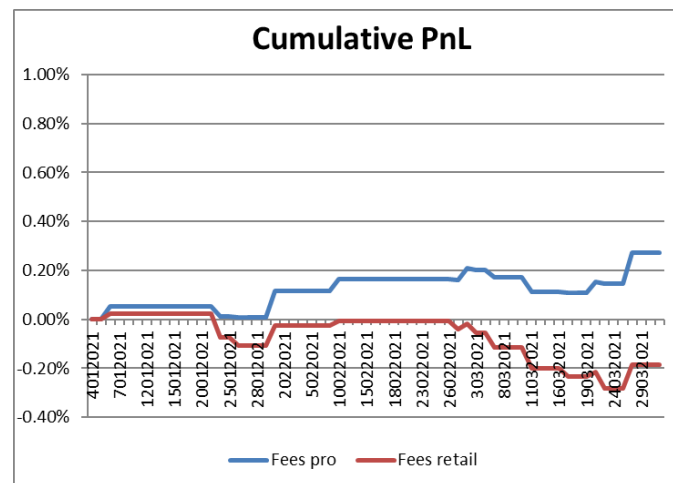
Brokerage Costs effect

- Simple Strategy but now taking into account **brokerage costs** (using $\sigma = 6$)

		Explicit Costs	
		Pro	Retail
Start	730		
End	2030		
Sigma	6		
Fees		0.003%	0.017%
avg		1.12%	-0.77%
std		0.42%	0.45%
IS		2.65	-1.73
pos d		10%	10%
n° trades		32	32

Assumptions:

Even with small explicit trading costs, these are unbearable
Retail investors are unable to do High-Frequency trading



- Fees schedule for VG
 - Professional: 1€ per transaction \Rightarrow in/out $\sim 0.003\%$
 - Retail: 6.25€ per transaction \Rightarrow in/out $\sim 0.034\%$
- Even though the strategy makes few trades, the **explicit costs kills the strategy**

Intraday Trading

Intraday Strategies

Conclusions

- Information lags are very important
- Lmt or Mkt orders? Can you replicate Mkt orders? Lmt guarantees price but face discontinuities
- Market has two prices, bid and offer. Don't consider trading prices – bid ask bounce
- Is one price per minute enough? Use Highs and Lows
- Lately has been as crowded as strategies using daily prices, but its a more time consuming and more difficult type of strategy to implement – works in nanoseconds space
- Usually performed by machines with more advanced algos – Machine Learning, Deep Learning, Quantum Physics