Algorithmic Trading in India

By:

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Session I:
Introduction to algorithmic trading

The buzz-words

Prop Trading

- Statistical, Volatility & Index Arbitrage
- High/Ultra High Frequency Trading
- Trend Following Systems
- Factor Models

Agency Trading

- VWAP, TWAP
- Inline, Aggressive, Passive
- Dark Pool Execution
- Smart Order Routing

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What is Algorithmic Trading?

- **al·go·rithm [noun]**
- A set of rules for solving a problem in a finite number of steps

- **Trade [**n**oun, verb,** trad·ed, trad·ing, **adjective]**
- The act or process of buying, selling, or exchanging

- Algorithmic Trading: Set of rules for buying, selling or exchanging

- Rules are best followed by machines and not humans

- Humans have IQ and EQ

- Hence we let computers do the job

The myths and reality

Myths	Reality
Oh! It is complex!	Set of simple rules, to make computers do the dirty job!
It's a Black Box!	Traders in India have been doing the same thing manually for decades
It's for PhD grads!	It's for everyone, who is competitive and future looking
It is expensive and pay-off is uncertain!	It is inexpensive, if priorities are right. Requires right approach and clear know-how of what you want!
It is for big boys!	Its for everyone from single traders to large houses

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Why algorithmic trading?

- **Simple note**
  - Trading is a mechanical job!
  - Everyone around us is doing it / thinking about it!
  - Hear more and more in the future!
  - Don't want to miss the next bus!
  - Don't want to feel left-out!

- **Serious note**
  - Build new revenue stream
  - Build competitive advantage
  - Solidify existing business and not lose it to others
  - Add value to existing clients
  - Attract new clients and investors

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Prop Trading

- Prop: Proprietary Trading

- Development of strategy for in-house trading and profitability

BSE-NSE Arb	Pair Trading Technical
Cash-Future Arb	Trend Following – Technical
Index Arb - Pure	Fundamentals on Equity Research

Agency Trading

- Agency: Execution and brokerage services for the clients

- Development of strategy for superior client executions
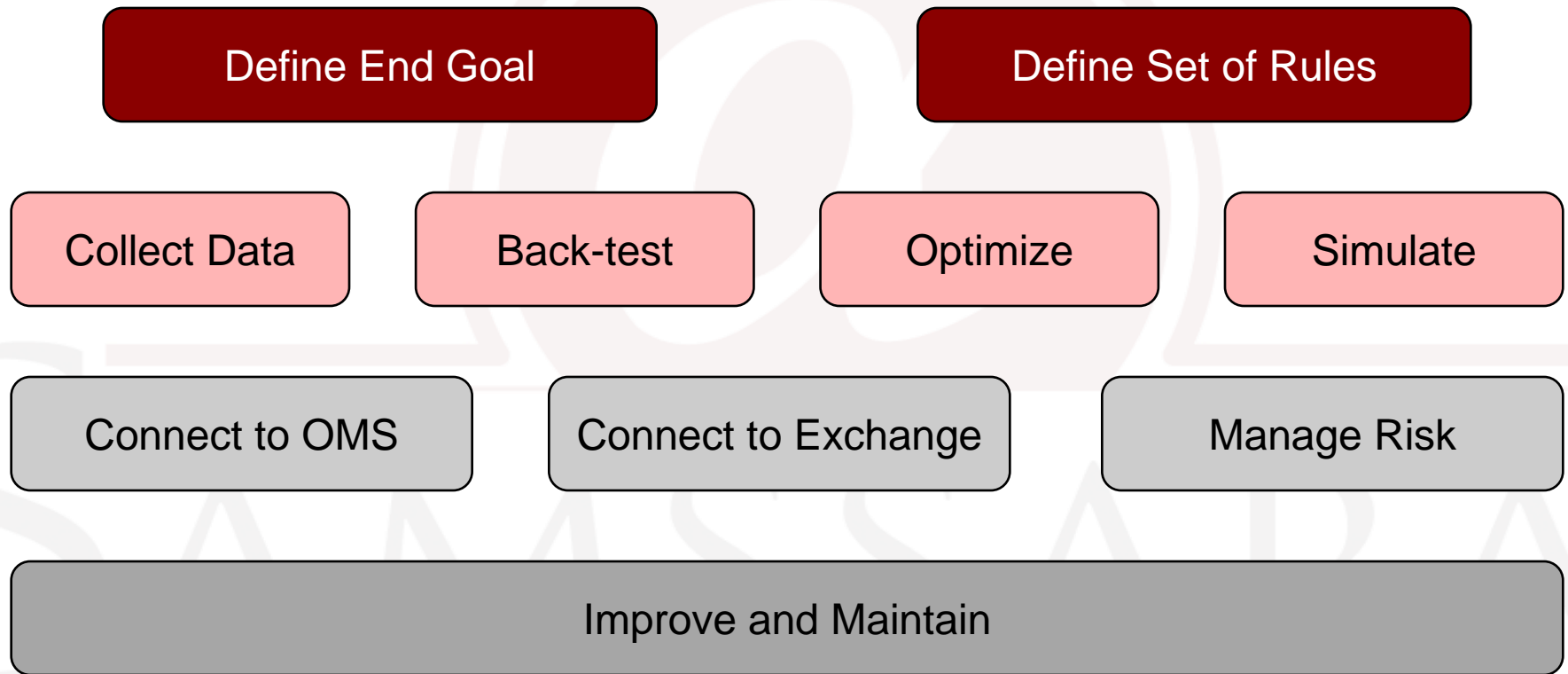
Manual Order Slicing

Manual Directional Calls

Manual Market Making

Basic VWAP and Inline Engines

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The building blocks

Define End Goal

Define Set of Rules

Collect Data

Back-test

Optimize

Simulate

Connect to OMS

Connect to Exchange

Manage Risk

Improve and Maintain

CAPITAL TECHNOLOGIES

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Defining the end goal

Nature
- Proprietary Trading
- Agency Trading
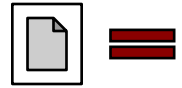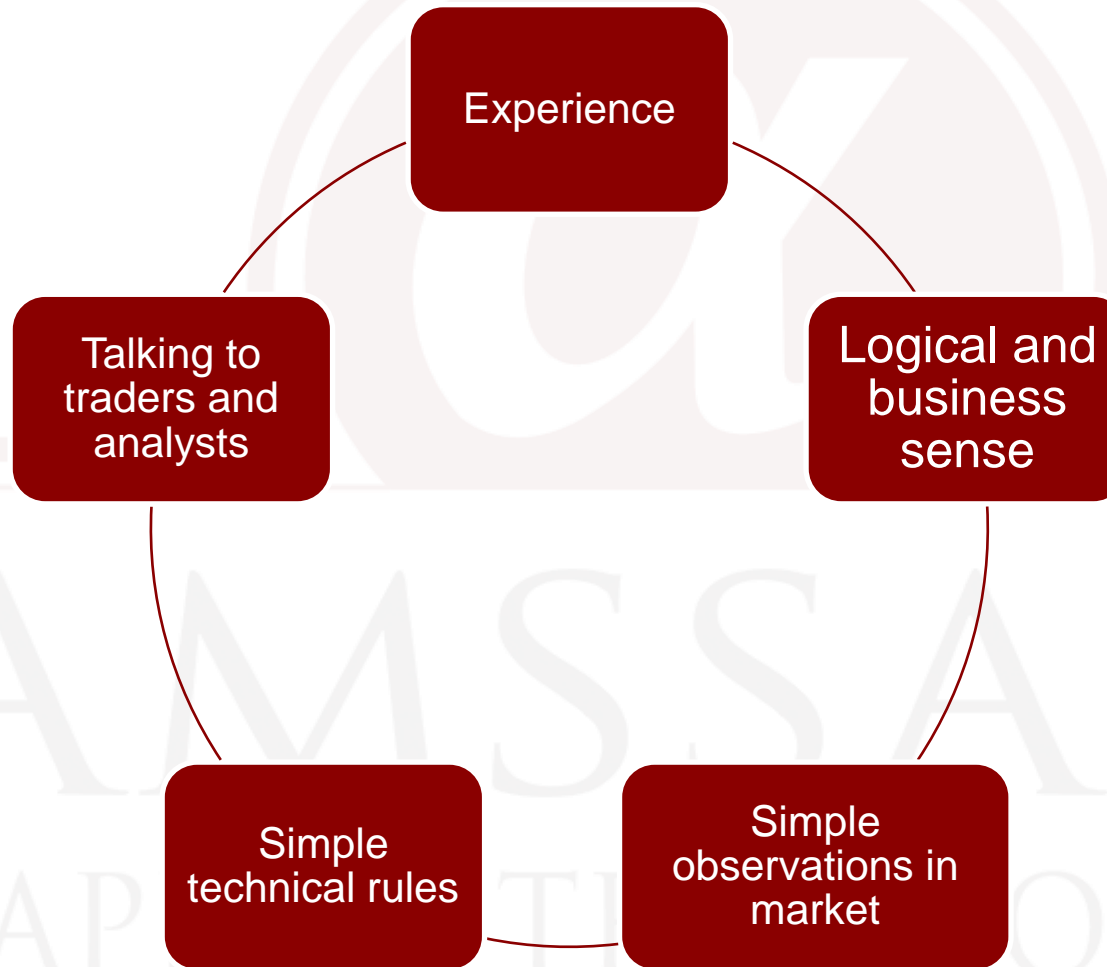- Clients Trading (Wealth Management)

Frequency
- Low
- Medium
- High

AUM & Strategy
- Higher AUM, Long term return
- Lower AUM, Daily profits
- Non-correlated fresh strategy / Refine old ones

Defining the set of rules

Session II:
The mathematics of algorithmic trading

Why Mathematics & Statistics?

Pure Technical Models	Technical & Statistical Models
Moderate ROI when model is working	Superior ROI when model is working
Large draw-downs when model stops	Flattish ROI when model stops
Long stretch of continuous bleeding in returns	Shorter stretch of continuous flattish period
User might lose confidence	User can diversify and make multi-models

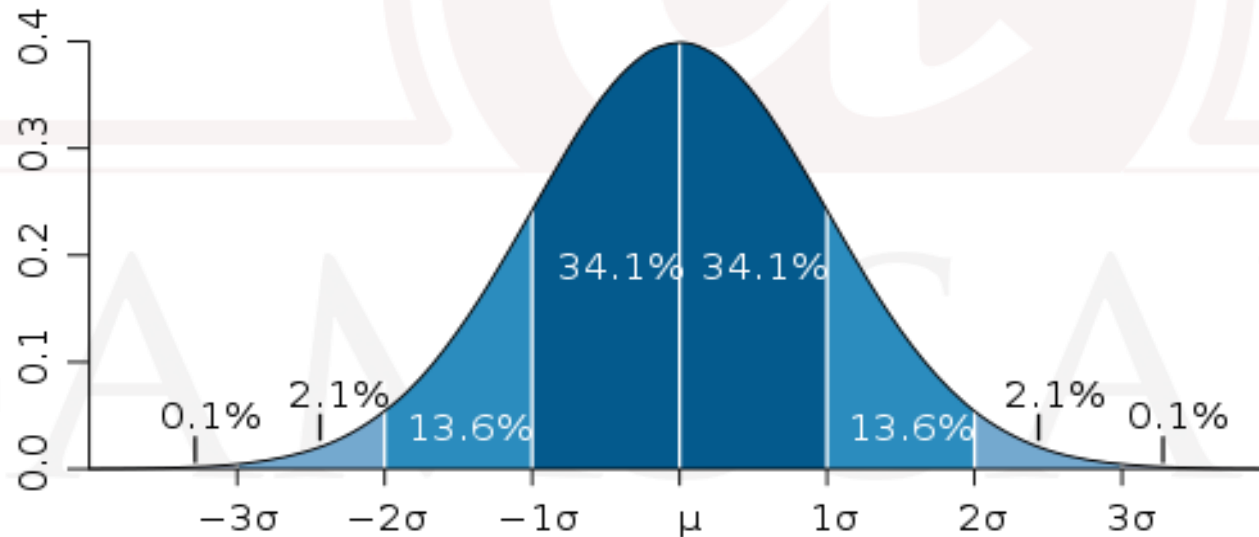SAMSSARA

The Mathematics

Data Distributions

Time Series Modeling

Market Microstructure

The normal distribution

- Most popular data distribution

- Standard normal distribution curve

Source: Wikipedia

The normal distribution

- Mean

$$\mu = \frac{\sum x_i}{n}$$

- Standard deviation

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \mu)^2}$$

- Variance

$$\sigma^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i - \mu)^2$$

- Correlation

$$r = \frac{Cov(x, y)}{\sigma_x \sigma_y}$$

- Beta

$$\beta_s = \frac{Cov(r_s, r_p)}{Var(r_p)}$$

Normal vs. other distributions

- Cauchy distribution

- Binomial Distribution

- Poisson Distribution

- Beta Distribution

- Chi-square Distribution

- Exponential Distribution

- Laplace Distribution
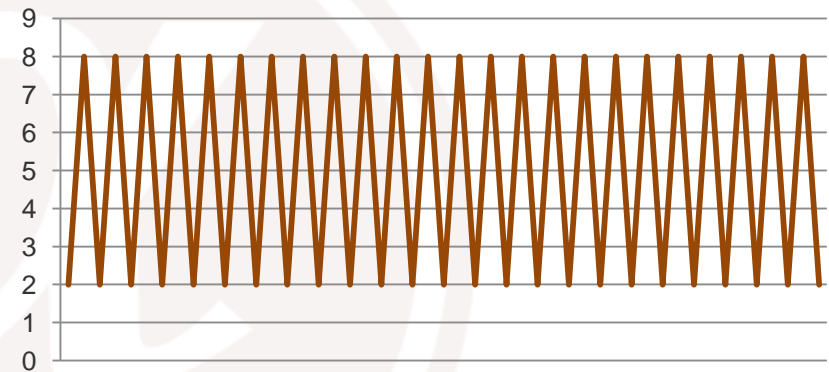
Time series modeling

- Behavior of the time-series of data
  - Mean reverting, Trending or Random Walk
  - 50-60% time series is random walk
  - Focus should be on the other 40%

- Key elements: Mean and Variance

- Different behaviors
  - Mean reverting (E.g.: Pairs Trading)
  - Non-mean reverting (E.g.: Trend)
  - Constant variance (E.g.: Pairs Trading)
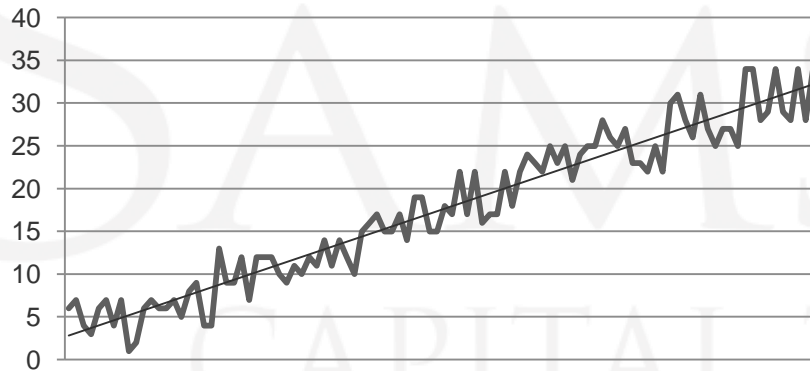 - Increasing variance (E.g.: Trend)

Mean and Variance

Constant Mean
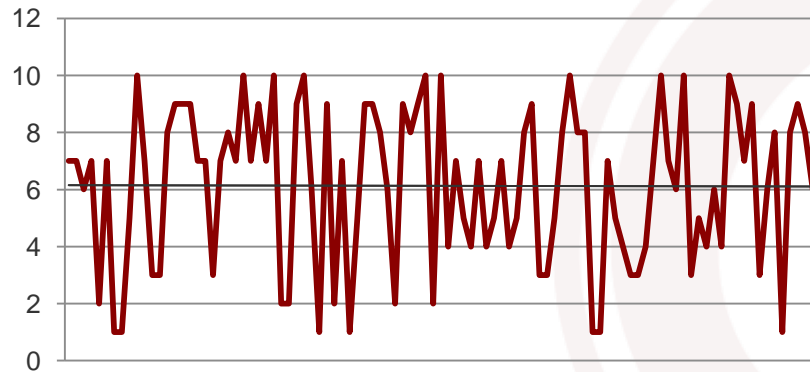
Constant Variance

Increasing Mean

Increasing Variance

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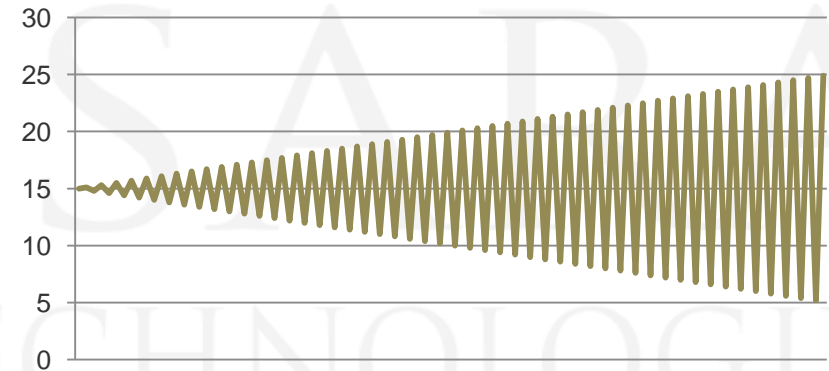
Mean reversion modeling

- Co-integration: Stationary mean and variance

- Time series is stationary when
  - The mean is constant
  - The variance is constant

- Test for co-integration
  - If |r| < 1, the series is stationary
  - If |r| = 1, it is non-stationary (Random walk)

$$y_t = ry_{t-1} + e_t$$

- Most popular test: ADF (Augmented Dickey Fuller)

- If ADF < -3.2 (95% probability of co-integrated series)

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Generic time series modeling

- Variance Ratio Test: Test for variance alone

- Useful when mean is varying w.r.t to the time
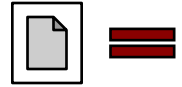
$$VR(k) = \frac{Variance(r_{k\Delta t})}{k \times Variance(r_{\Delta t})}$$

- Ornstein-Uhlenbeck Process: Test for mean reversion alone

- Useful when only mean reversion rate matters

$$dx_t = \theta(\mu - x_t)dt + \sigma dW_t$$

Cluster analysis and PCA

- Grouping of similar data and pattern

- Useful in factor modeling

- PCA: To identify principal component
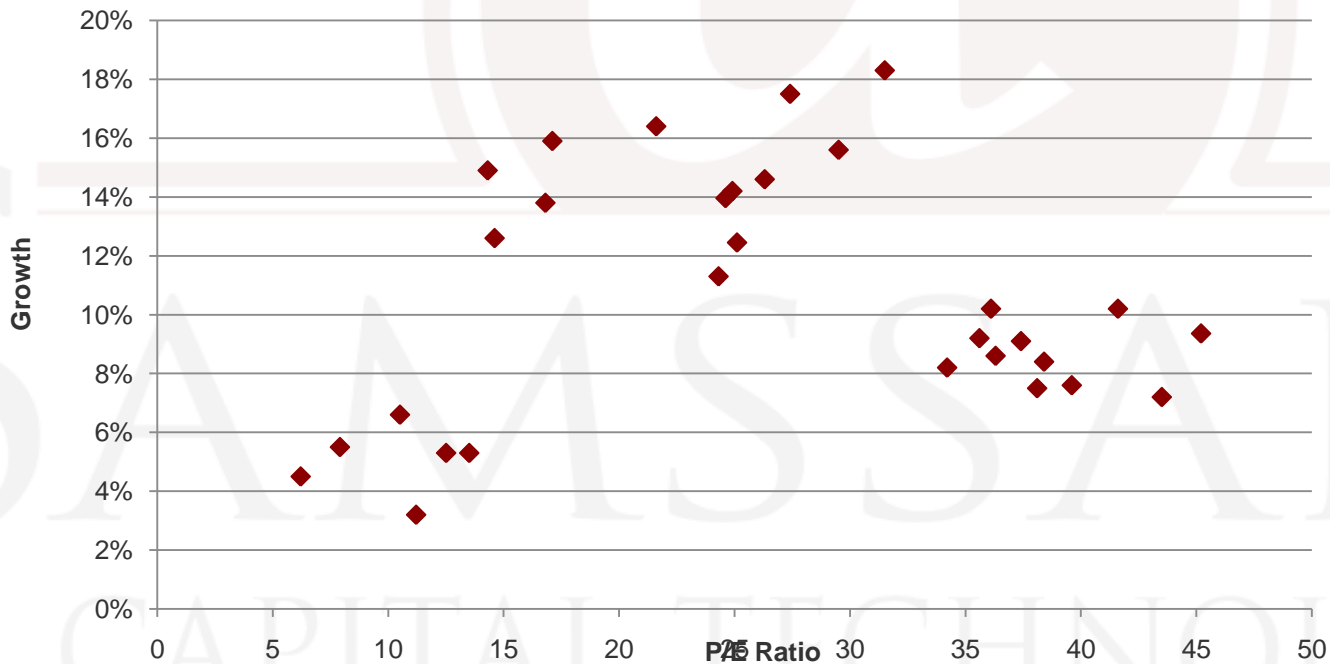
Regression

- Useful in identifying alpha-generating factors

$$y = mx + c$$

$$y = 0.659x$$

$$R^2 = 0.720$$
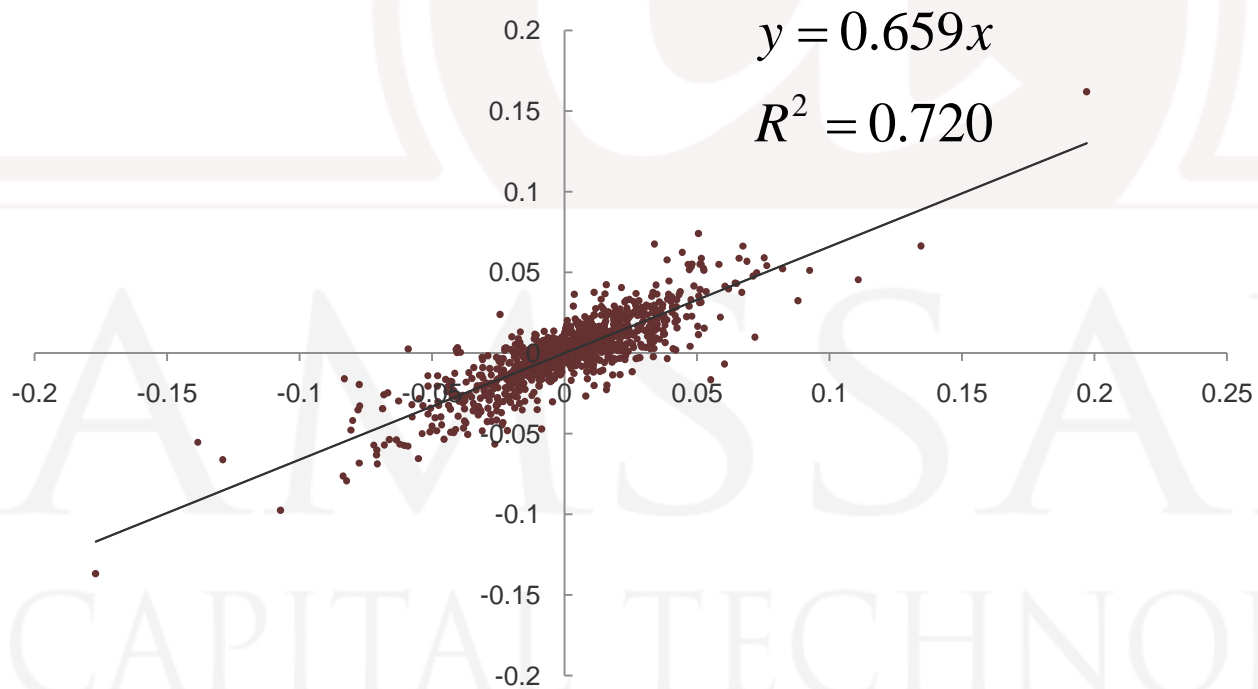
Market microstructure

- Used in UHFT, HFT, Agency Trading

Bid Qty	Price	Ask Qty
	1001.50	13
	1001.00	19
	1000.50	2
	1000.00	17
	999.50	9
	999.00	
10	998.50	
4	998.00	
16	998.00	
7	998.00	

Last Traded Price → 999.00

Bid-Ask Spread

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The volatility

- Volatility is deviation from mean

- Volatility in daily, 5 min, 10 min etc.

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \mu)^2}$$

Market microstructure

- Market Price of Reliance in 5 min buckets

09:15	09:30	09:45	10:00	10:15	10:30	10:45
1005.00	1007.50	1004.50	1003.00	1008.00	1010.50	1009.50

$$n = 5 \qquad\qquad \mu = 1006.70$$

$$\sum_{i=1}^{n}(x - \mu)^2 = 35.3 \qquad\qquad \boxed{\sigma = 2.657}$$

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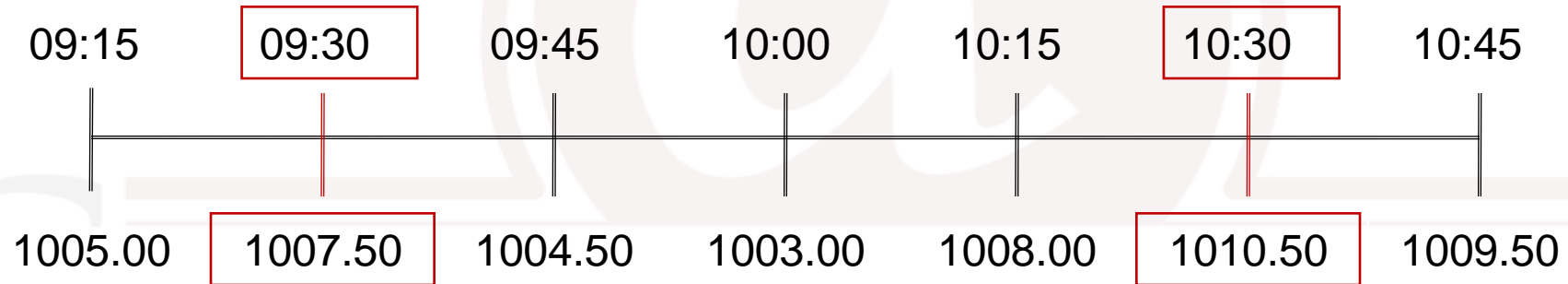
The spread

- Spread in BP

$$Spread(BP) = \frac{(BestAsk - BestBid)}{(BestAsk + BestBid)\big/2} \times 10000$$

- Spread in ticks

$$Spread(Ticks) = BestAsk - BestBid$$

The market curve

- Volume / Market curve

$$VolumeRatio = \frac{BucketVolume}{DaysTotalVolume}$$
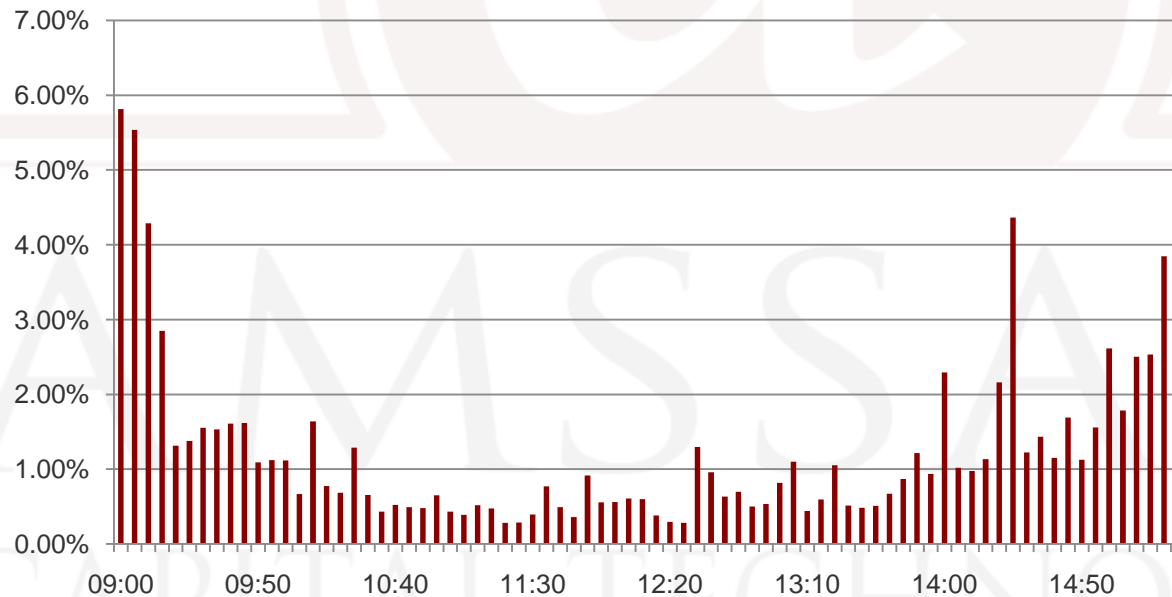
Session III:
Global trends in algorithmic trading

The size of algorithmic-trading

- TABB group reported in Aug'2009
  - 300 securities and large quant funds
  - Recorded $21 billion in profits in 2008!

- Pure high-frequency firms represents
  - 2% of the 20,000 trading firms in US
  - Account of 67% of all US volumes

- Total AUM of high-frequency trading funds
  - $141 billion
  - Down 21% from the high
  - Compared to global hedge fund shrinking by 33% since 2008

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The volume rush

- **Volume Characteristics in US**
  - In 2005 less than 25% of volume was from high-frequency
  - 2/3rd of daily U`S volume now from high-frequency strategies
  - HFT Strategy grew by 164% between 2005 and 2010

- **Trading volume (Non-US)**
  - Europe: 40% of trades
  - Asia: 5-10% (Growing extremely rapidly)

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The global rush

- All global I-bank has desk in algorithmic trading

- Risk savvy banks - higher Prop focus E.g.: GS (US Banks)

- Risk averse banks - higher Agency focus E.g.: CS (EU Banks)

The brokers algorithmic platform 1

I-Banks	Products	Selected Strategies
BoA	Electronic Trading Services (ETS)	VWAP, TWAP, TVOL, Razor, Market on Close, Arrival Price, Market Call
Citigroup	Alternative Execution	VWAP, TWAP, MOC and Participation
CS	AES	Slippage from Arrival Price, Reducing market impact, VWAP and In Line with Volume
GS	GSAT	VWAP, Implementation Shortfall, Piccolo (Small Order Spread Capture algorithm) and TWAP.

The brokers algorithmic platform 2

I-Banks	Products	Selected Strategies
ITG	SmartServer	VWAP, TWAP, Implementation Shortfall (Decision Price) and Market Close
JPM	Electronic Execution Services	VWAP and Implementation Shortfall (Arrival Price, Close Price) and a 'trader pre-defined benchmark
ML	ML X-ACT	OPL (Optimal), QMOC, VWAP, CLOCK (a TWAP engine), POV (Percentage of Volume) and TWIN (trades two stocks based on a price per ratio or spread).

The growth path

New Algorithms

New Clients

New Asset Classes

New Markets

The algorithms across exchanges

9:31:00.00 AM INVESTOR SUBMITS ORDER

A mutual fund submits an order to purchase 5,000 shares of company XYZ. They will pay up to $21.05, and NASDAQ only has 1,000 shares available at the "national best offer" or NBBO of $21.00, but right that second they don't have another offer below a price of $21.04. By law, they must relay the rest of the order over to BATS, who have another 4,000 shares available at a price of $21.03

9:31:00.01 AM NASDAQ CREATES "FLASH" ORDER

Before routing the order out to BATS as it must, NASDAQ creates a "flash" order by the mutual fund at a price slightly better than BATS best price, $21.02. It will keep it out there for up to 500 milliseconds
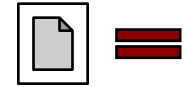
9:31:00.10 AM

A high-frequency trading system sees the flash order. Calculating that buying pressure is only making this stock go up briefly before coming back down, it takes the mutual fund up on it's bid of $21.02 for 2,000 shares.

9:31:00.50 AM

Its 500 milliseconds up, NASDAQ routes the remaining 2,000 shares over to BATS to be filled at a price of $21.03

Its order complete, the mutual fund has paid $105,100 for its shares in XYZ, $20 less than it would have paid without the "flash" order.

SHARE PRICE

$21.03

$21.02

$21.01

$21.00

0.0   0.1   0.2   0.3   0.4   0.5   0.6
SECONDS

Source: www.thefinanser.co.uk

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The algorithms across exchanges

1 Order to a stock exchange (Primary). Monitor and compare the prices of the primary stock exchange and kabu.comPTS.

2 Change the markets when kabu.comPTS offers more advantageous price.

3 If the order isn't executed after changing markets, it is sent to the market which has the best price as a result of monitoring and comparing.

4 All orders including changing markets are checked by the automatic detail checking system.

kabu.com カブドットコム証券

Order — Trading system for private investors

Stock exchange (Primary)

Change

Monitor

Change

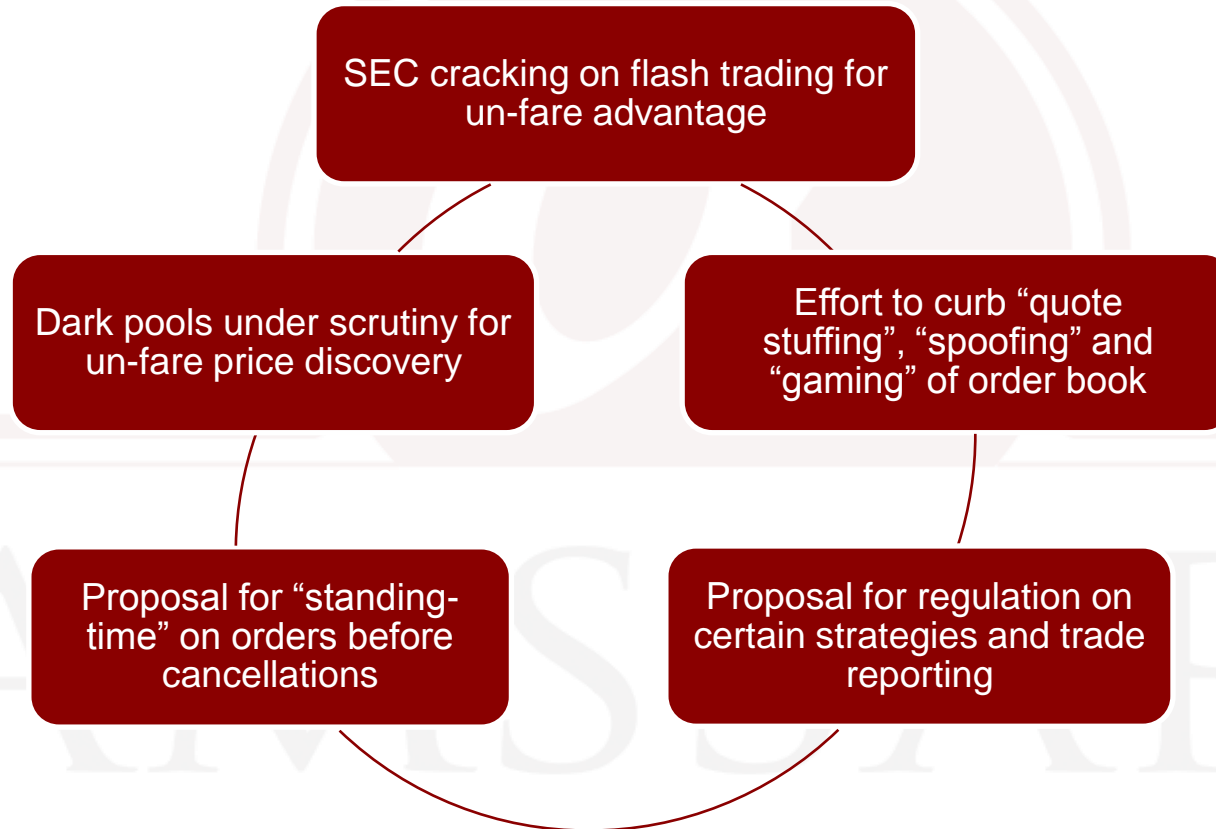kabu.comPTS

System of monitoring execution status of orders

Source: www.kabu.com

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The geographical divide

- **Matured markets**
  - E.g.: US, Japan
  - Getting to next stage of bleeding edge innovation
  - Cut throat competition to save every 1 BP in Agency
  - Cut throat competition for every percentage of additional alpha
  - Lateral shift to ultra-high frequencies and nano second latencies

- **Growing markets**
  - Understanding the implications of algorithmic trading
  - Coming in sync with investors and their growing execution needs
  - Computer algorithms eating the bread-and-butter strategies
  - E.g.: Perish of pure Index arbitrage, BSE/NSE arbitrage in India

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The regulatory structure in US

SEC cracking on flash trading for un-fare advantage

Effort to curb "quote stuffing", "spoofing" and "gaming" of order book

Proposal for regulation on certain strategies and trade reporting

Proposal for "standing-time" on orders before cancellations

Dark pools under scrutiny for un-fare price discovery

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Session IV:
Lifecycle of Algorithmic Trading

Lifecycle of Algorithmic Trading

Strategy/Pattern Recognition

Data Gathering/Data Cleaning

Back Testing

Factor Optimization

Monte Carlo Simulation (Parameter Optimization)

Trade/Portfolio Result Analysis

Simulated Trading/ Risk Management

Live Trading and Execution

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Identify Trading Patterns

- Talk to experienced traders

- Talk to clients

- Read books and articles on internet and trade magazines

- Watch market movements (Intra-day, Daily)

- Test simple technical patterns on excel sheets

- Brainstorm and team approach

- Technical analysis is very useful to get the initial signal

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Back-testing

- Most critical element of algorithm development

- Why back-test?
  - Avoid past mistakes
  - See repeated ness of a pattern
  - Analyze risk, reward, pit-falls etc.
  - Analyze robustness across different market environment

- Back-test data: bearish, bullish and range-bound markets

- In-sample and out-of-sample testing

- How?
  - Programming: Excel, VB Macros, Java, C++
  - Statistics: Matlab, R, Python

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Steps in back-testing

Data Gathering and Cleaning
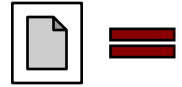
Back testing the trading strategy

Regressing against profitable factors

Analyzing Trade/Portfolio Return

Drawing Return Curve

Analyzing Sharpe Ratio and Max Drawdown

Re-run the back tests

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Alpha generation

- Identifying factors to improve profitability

- E.g.:
  - Pair-trading: co-integration, beta
  - Trend following: SMA, EMA or MACD
  - High frequency: Bid to Offer ratio for short term long position

- Use statistical and mathematical factors

- Mathematical modeling
  - Price pattern broken into deterministic and random components
  - Modeling the deterministic component of the time series

- Regression of trade return vs. statistical factors

- Caution: Factors make intuitive, logical and business sense

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Monte-Carlo simulation

- Identifying optimal parameters for each factor

- Tests carried across multiple values for one or more factors

- E.g.:
  - Value of z-score in pair trading (-1.5, -2, -2.5 etc.)
  - Moving average length: 20 period, 50 period etc.

- Optimal solutions is tested for
  - Annualized percentage return
  - Max peak to trough drawdown
  - Average peak to trough drawdown
  - Annualized Sharpe ratio
  - Maximum non-performing period

- Caution: Avoid over-optimization and data-fitting

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Transformation – trade to equity curve

- Trade 1:   Buy Tata Motors, 11th Oct, 2010 @ 767.00
  Sell Tata Motors, 15th Oct, 2010 @ 791.00 (+3.13%)

- Trade 2:   Buy Tata Steel, 11th Oct @ 644.75
  Sell Tata Steel, 13th Oct @ 632.25 (-1.94%)

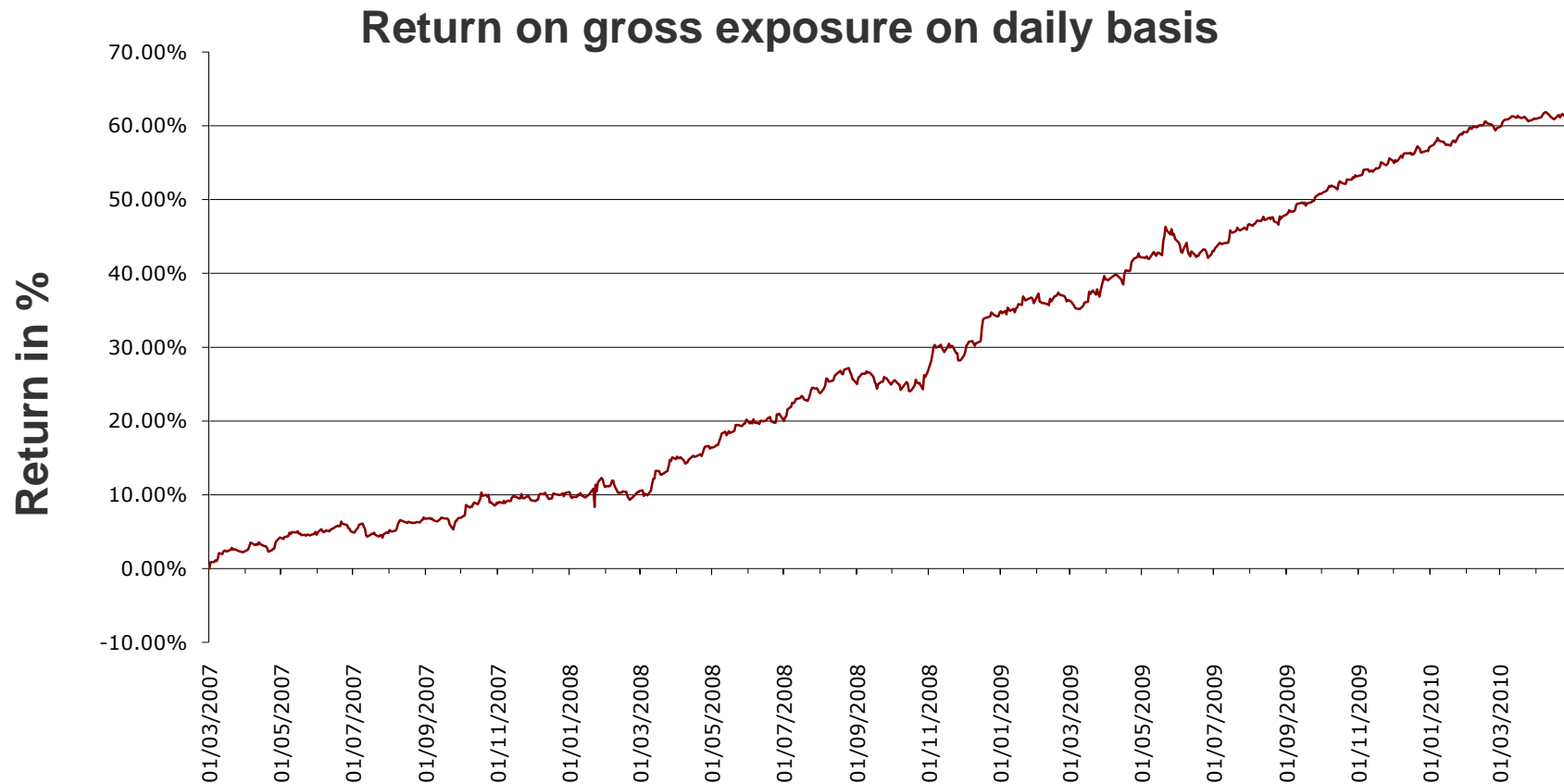| Date	Tata Motors	Tata Steel	Trade1 Return	Trade2 Return	Portfolio Return
11th Oct	771.00	639.00	0.52%	-0.89%	-0.19%
12th Oct	783.65	633.10	1.64%	-0.92%	0.18%
13th Oct	800.00	632.25	2.09%	-0.13%	1.16%
14th Oct	788.00		-1.50%		0.41%
15th Oct	791.00		0.38%		0.60%

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The equity curve (portfolio return)
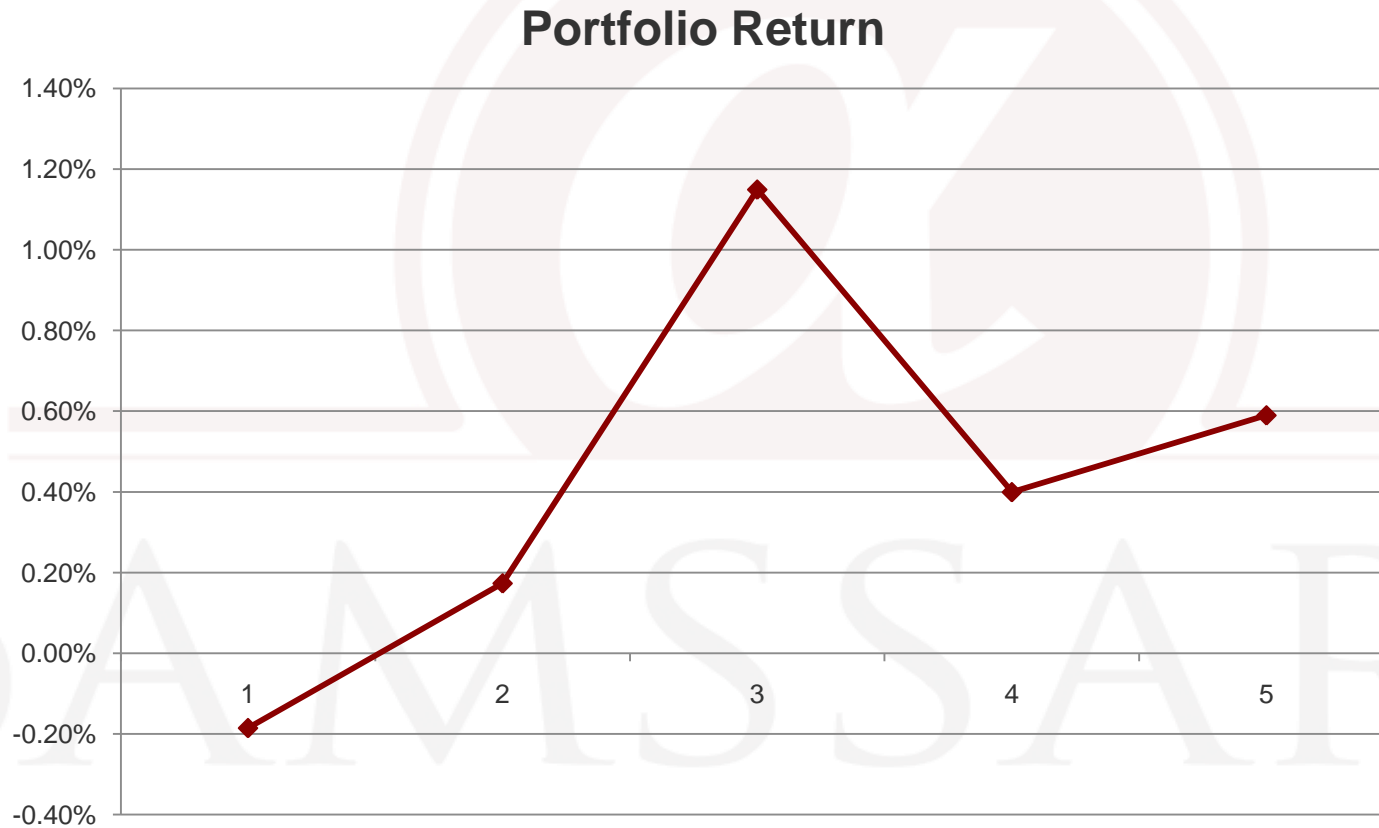
Portfolio Return

The equity curve

- It is a graphical representation of the growth of the portfolio in the terms of profit returns achieved

Return on gross exposure on daily basis

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The litmus tests

- Peak to Trough Drawdown: Maximum retrenchment of portfolio returns in the equity curve

- Annualized Percentage Return

$$R = r \times T$$

- Annualized Sharpe Ratio

$$SH = \frac{r - r_0}{\sigma} \times \sqrt{T}$$

Where:

R = Annualized percentage return

r = Average Daily Return

r_0= Daily risk-free rate of return

T = No. of Trading days in the year

σ = Std Dev of Daily Returns

Stress test

- 3 std-dev (1 in 25 years) happens every 6 months

- 10 std-dev (1 in 500 years) happens every 2 year

- Effect of "very fat-tails" in algorithmic trading

- Stress testing with dynamic and random price series

- Analyze large losses and unforeseen drawdown

- Work on optimization and event-risk

Simulated trading

- **Most algorithmic trading fails because of**
  - Lack of execution know-how
  - Gaps between back-test and real-life execution
  - Slippages, transaction costs and other charges
  - Increasing size and quantity beyond the model capacity

- **Simulated trading is important**
  - Trades signal are generated at right time
  - Execution pit-falls are ironed out
  - Slippages w.r.t to the signals are minimized
  - Real-life trading is consistent with back-testing

- **Usual period: 3 weeks to 3 months**

- **After 3 weeks, start real-life trading with minimal quantity**

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Automated execution

- Reduce the time between signal and execution

- Non-emotional and systematic approach

- No view-point or self-analysis overlay on the signals

- Execute orders using
  - An execution guy, punching the order as it appears (low-cost)
  - CTCL connectivity of NSE provided by 3rd party vendor software
  - DMA platform provided by Institutional brokers
  - DSA platform provided by Institutional brokers
  - FIX protocol (global standard) for information exchange
  - In future: Agency algorithms (VWAP, Passive etc.) for execution

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Going live

- Risk: Limit on daily turnover and on each trade execution

- Commit to a strategy for a longer term (1 year at least)

- Start small and consistent quantity and size

- Set aside a draw-down and stop loss limit (E.g.: Rs.10 lacs)

- E.g.: I don't know, I don't care, I know my stop-loss

- Don't change the quantity and trading sizes abruptly

- Understand the flattish period in the performance

- Calculate daily
  - Gross & Net exposure
  - VAR (Value-At-Risk)
  - Daily Profit/Loss and returns on gross exposure

- Avoid excess leverage

Session V:
Risks, Returns & Roles in algorithmic trading

What is Risk?

- Deviation from possible outcomes
- Fat-tails in the market
- Risks: Systematic and Non-systematic
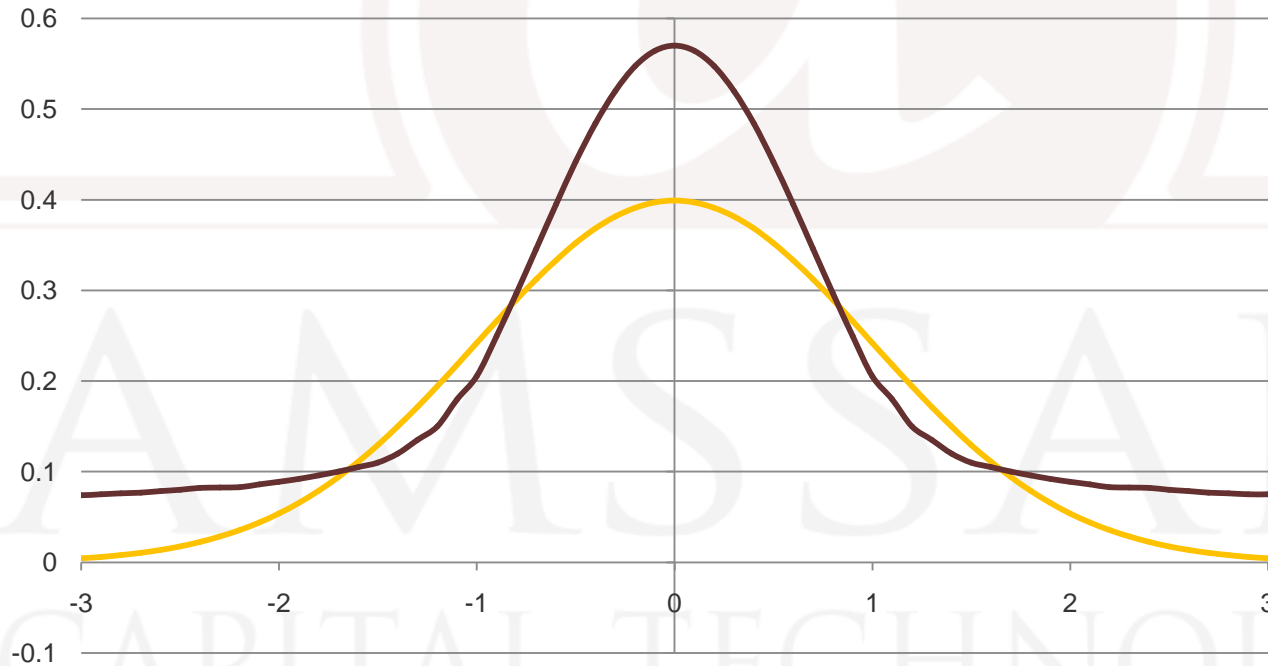
Systematic Risks

- Systematic Risks

- We can foresee and prepare for these risks

- Market direction risk, net rupee exposure

- Sector risk1

- Single stock risk (E.g.: Satyam)

- Slippage risk

- Execution risk (software crash, power failure etc.)

Systematic risk mitigation

- **In design**
  - Market direction, net rupee risks / Market direction neutral
  - Single sector exposure risks (< y% of the portfolio)
  - Single stock exposure (< x% of the portfolio)

- **During execution**
  - Design to take order book (bid and ask) into account
  - Caps on daily turnover in the system
  - Caps on single trade max rupee value to be executed
  - Caps on number of trades in a day
  - System should handle power failure and software crash

- **When live**
  - Live monitoring by the IT people on connectivity, re-start etc.
  - Switch-on and Switch-off during rare market circumstances

Non systematic risks

- Event risk
  - E.g..: India elections 17th May'2009
  - Large losses, if caught on the wrong side of the market
  - Less frequent in nature

- Algorithmic wars (New age nuclear war!)
  - More prevalent in matured and 100% electronic markets
  - Triggered when a profitable algorithm becomes too crowded
  - Usually presided by a very profitable period
  - Then stop-losses trigger and some large funds unwind
  - Leads to "ripple-effect", causing large movements in the positions

Examples when algorithm fails

- October'1987 US stock market crash: Automated trading

- August'2007 Quant meltdown: Crowded factor model

- May 6th 2010, US Intraday movement: Crowded high frequency

Examples when algorithm fails

- **Long Term Capital Management**
  - Founded in 1994 by John Meriwether and Myron Scholes
  - 40% annualized returns after fees in first 3 years
 - Lost $4.6 Bn. in 1998 within 4 months
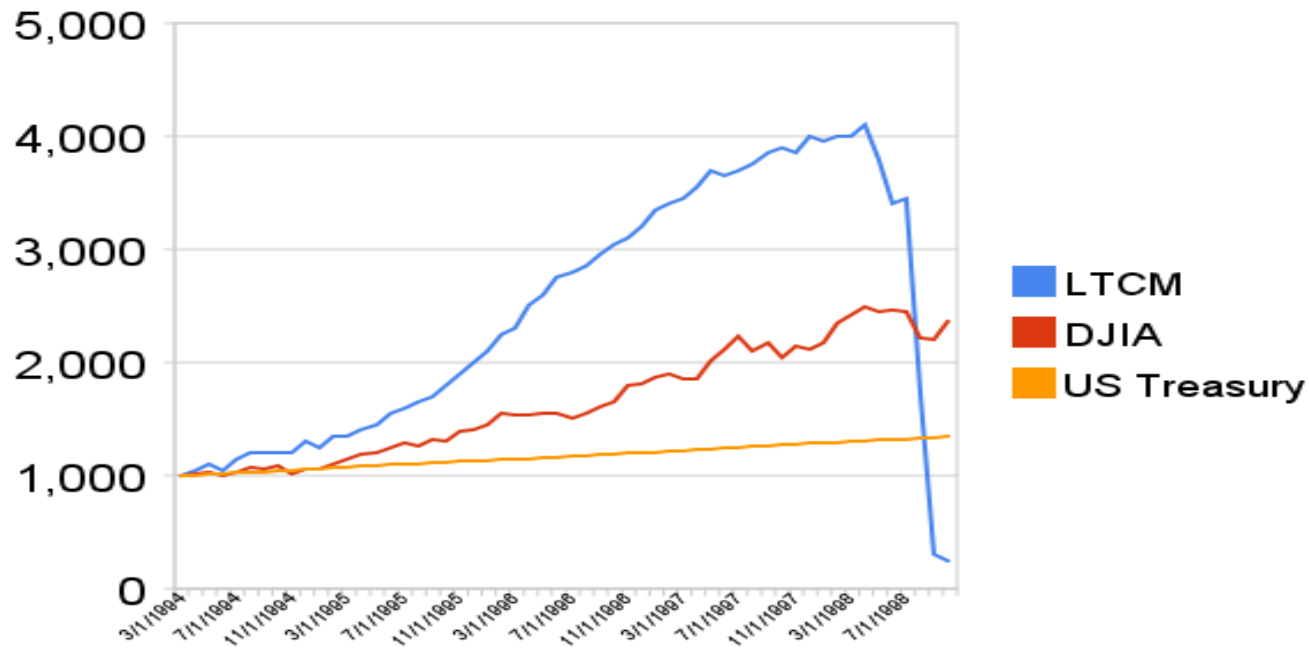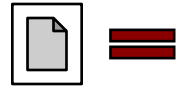
Source: Wikipedia

The returns

- Strategies to yield returns on market direction / direction-less

- Once designed properly, can become a cash-cow

- Lesser players implies higher returns

- Returns in India
  - Stat-arb strategies: 25-40% returns
  - Ultra high frequency: Deterrent in India due to STT costs
  - Trend following and momentum strategies: 25-35 % returns
  - Long/Short equity strategies: 20-25% returns
  - Intra-day / BTST-STBT strategies: 30% returns

- Best quant funds: Renaissance Technologies & DE Shaw

- More then 20% p.a. returns after fees for last 20 yrs.

Example: Pair-trading in India
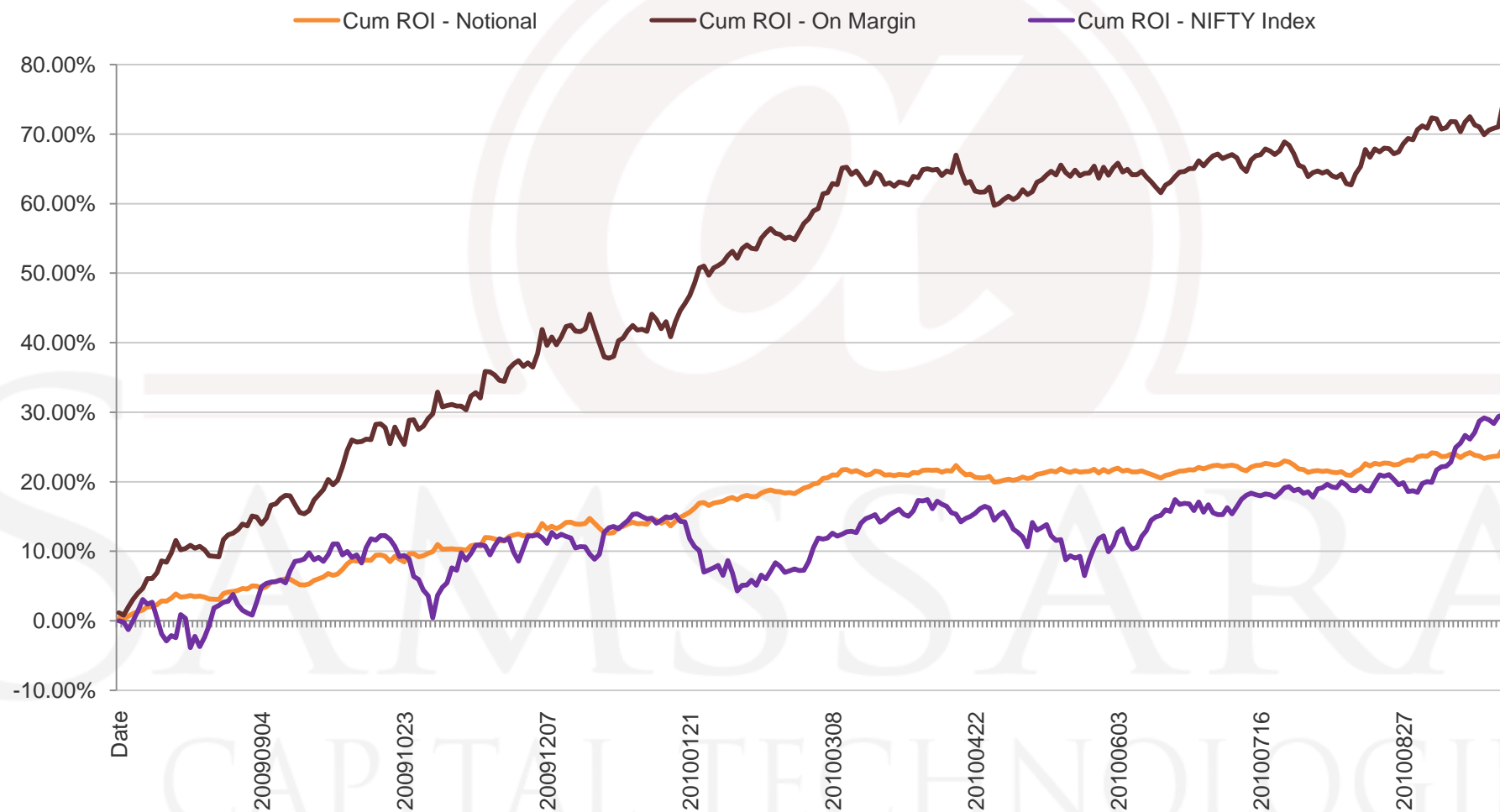
Costs

Securities Transaction Tax

Product	Transaction	STT rate	Charged on
Equity-Delivery	Purchase	0.125%	Turnover
Equity-Delivery	Sell	0.125%	Turnover
Equity-Intraday	Purchase	-	-
Equity-Intraday	Sell	0.025%	Turnover
Future	Purchase	-	-
Future	Sell	0.017%	Turnover
Option	Purchase	0.125%	Settlement price, on exercise
Option	Sell	0.017%	Premium

Other Charges on Futures

SEBI Turnover Charges	0.0001%
Transaction Charges	0.002%
Total Charges on Futures (Buy & Sell) = 1*1.7 BP+2*0.01 BP+2*0.2 BP	2.12 BP (0.0212%)

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The major costs

- **Slippages**
  - India has lowest spreads in Asia: 5 BPS
  - Indian market lacks order book depth
  - Liquidity dries beyond top 70-80 stocks
  - Options: Index and top 7 scrip
  - Hence, slippages occur while executing large orders
  - Trick: Capture the Indian market breadth and NOT depth

- **Brokerage**
  - Understand the average per trade return
  - High frequency ~ 0.08%-0.30% per trade
  - Medium frequency ~ 0.8% to 2% return per trade
  - Low frequency ~ 2% to 10% return per trade
  - Hence brokerage should be at 0.02% and below in high-frequency
  - Can be larger 0.02% to 0.05% for medium to low frequency trades

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Roles - Trader

- Identify trading patterns and strategies

- Watch market movements and opportunities

- Give practical experience & feedbacks

- Work closely with IT and quant team

- Check the back tests and historical performance closely

- Monitor live time risk and positions

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Roles - Quant

- Convert "business language" into "mathematical language"

- Gather and clean data

- Back-test strategies

- Identify alpha generating factors using statistical tools

- Build simulated trading environment

- Test strategies in live market

- Take feedbacks and risk-control measures from traders

Roles - IT

- Convert "mathematical language" into "computer language"

- Support Quant in building the IT systems

- Develop processes to store, clean and manage data

- Develop systems to back-test and simulate

- Develop system to manage order execution

- Support the end-to-end lifecycle of algorithm development

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Roles – risk manager / compliance

- Risk assessment on strategy level and daily VAR levels

- Analyze correlation between various strategies

- Assess limits and exposures in each strategies

- Ensure compliance with SEBI and exchange regulations

- Ensure that trades send to the market uses standard connectivity protocols

- Ensure provision in system to restrict certain stock

- Inform higher management towards unforeseen risks

Session VI:
The trading strategies

70

Agency algorithms

- Agency: Execution of trades on client's behalf

- Heavy use of Market Microstructure

- Spreads, Volume curve, Volatility, Order book depth etc.

- Algorithms
  - VWAP / TWAP
  - Aggressive
  - Passive
  - Liquidity pools and smart order routing

- Hear more and more about agency trading in future

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Reliance Industries: Intraday VWAP
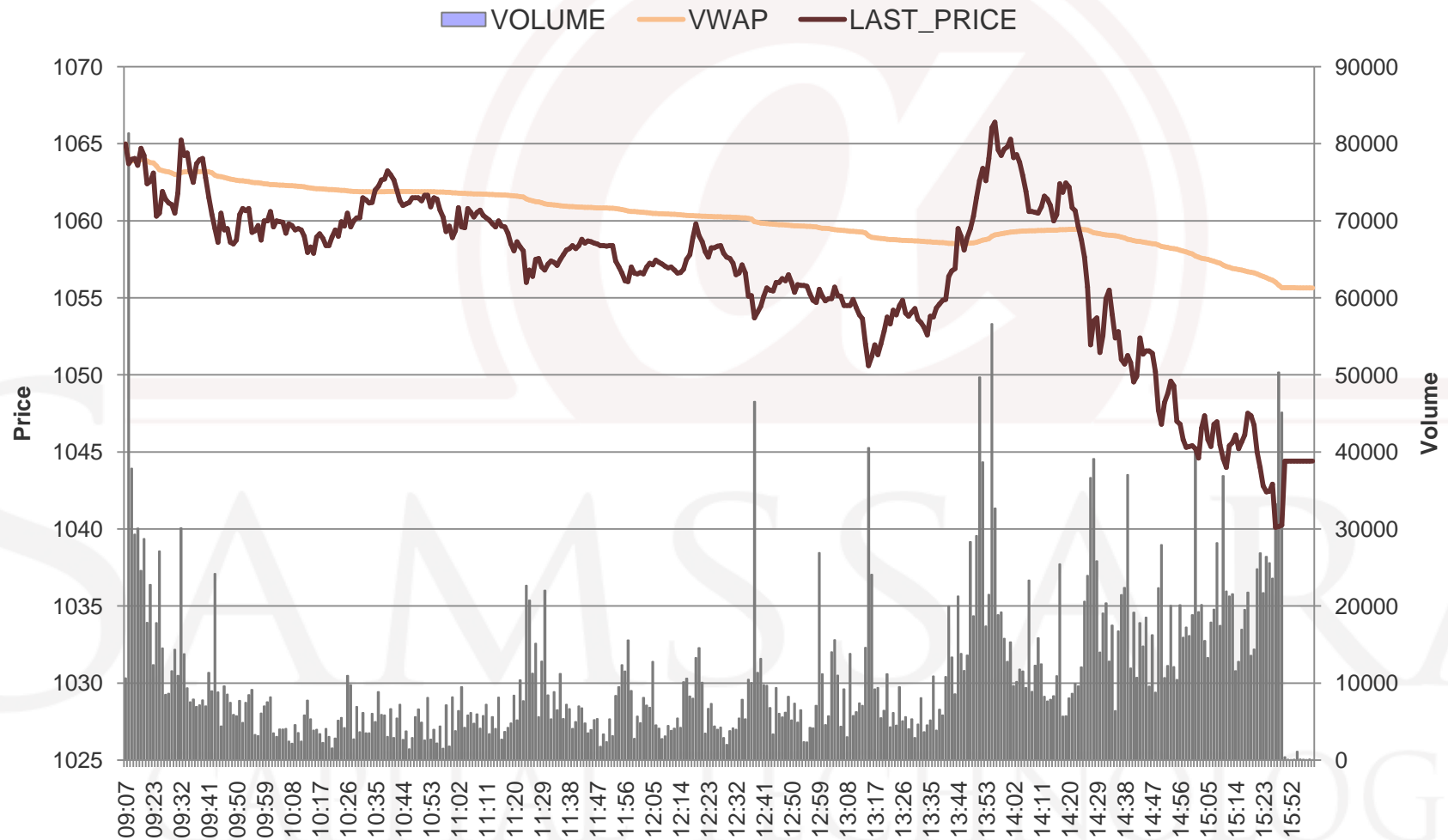
Agency trading – VWAP,TWAP

- VWAP: Volume weighed average price

- TWAP: Time weighted average price

- Most widely used benchmark for agency trading performance

$$VWAP = \frac{\sum P_i V_i}{\sum V_i} \qquad TWAP = \frac{\sum P_i T_i}{\sum T_i}$$

- Trade execution as per day's historical volume curve

- Aggressive at buying below the VWAP price and vice versa

- Challenge: Crossing the spread vs. limit order

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Agency trading – Inline, Aggressive, Passive

- Inline: Trade executions in-line with the existing trading volume

- Aggressive
  - Directional call
  - Very rapid execution till client set prices
  - Aggressively crosses spreads and absorbs bid / offer
  - Aggressive for fixed time period
  - Implemented when sure about the market direction
  - E.g.: Sniper, Guerilla (CS), Stealth (DB)

- Passive
  - Sits of bid or offer
  - Does not cross spread
  - Waits for fills on limit order, before pushing more volume

Agency trading – Liquidity pools

- Market On Close (MoC) beating trading strategies

- Liquidity pools
  - Primary exchange
  - Secondary exchanges
  - ECN (Electronic Communication Network)
  - Inter-broker dealer
  - Dark-pools
  - Internal crossing

- SOR: Smart Order Routing

- Flash Trading: Flashing orders before routing

Prop algorithms

- Factors
  - Technical: To get the initial trade-start right
  - Statistical/Mathematical: To increase probability of profitability
  - Back test: To get the overall strategy right and systematic
  - Risk assessment
 - Portfolio management and bet sizing

- Algorithms
  - Arbitrage
  - Mean reversion (Stat-arb, Pair trading etc.)
  - Momentum
  - High frequency or Low latency
  - Low frequency – Long/Short

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Prop trading – Arbitrage

- Price difference between two or more markets

- Risk based / Risk free

- Simultaneous transactions, Same value

- E.g.: BSE/NSE, cash/future, India/GDR

- Index arbitrage and program trading

Pair trading example
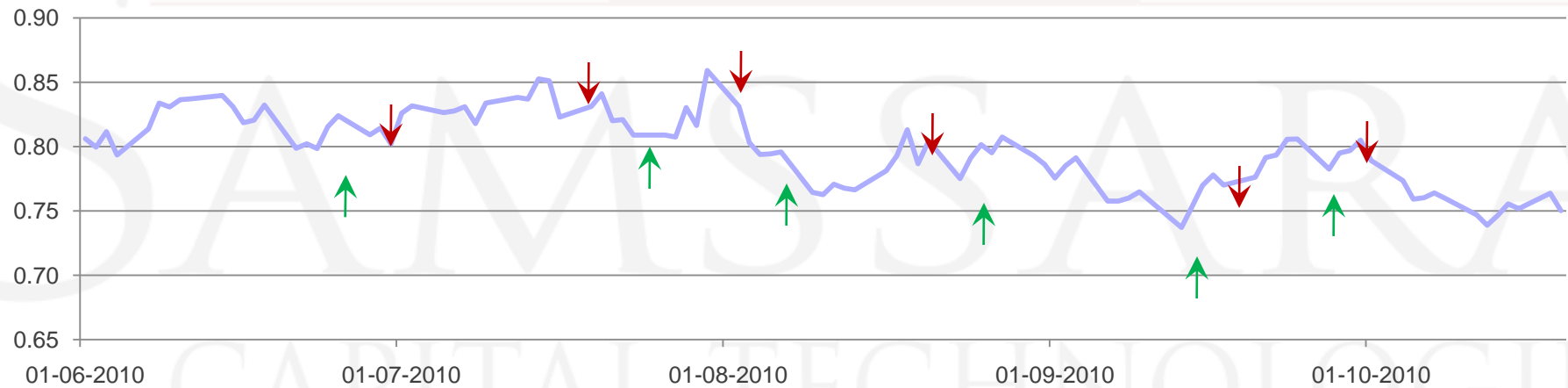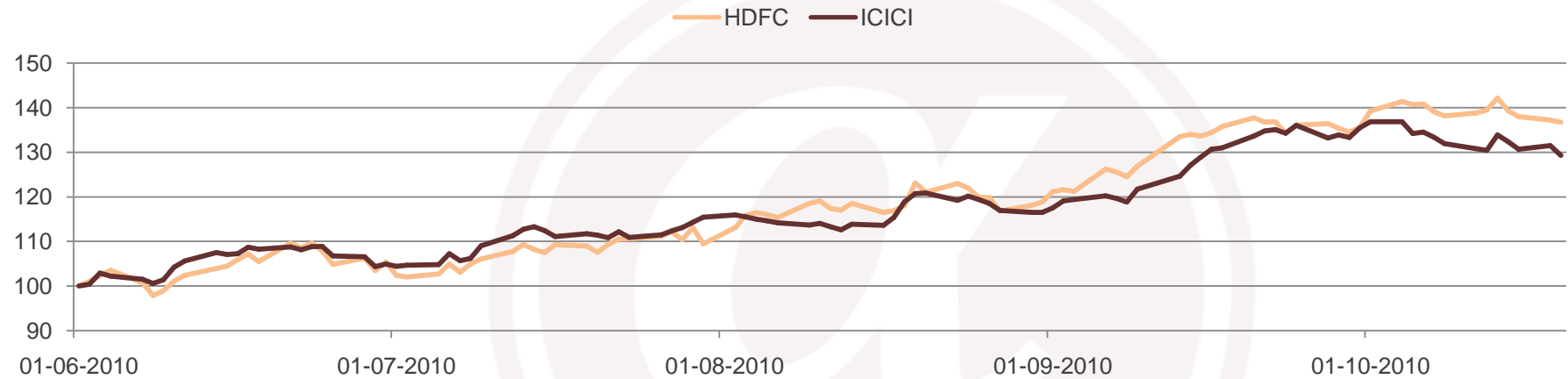
Prop trading – Mean reversion

- Buy on dips, Short on strength

- Bet on convergence of time series

- Single stocks, pairs, baskets of stocks, commodities

- Frequency: weekly, daily, hourly

- Technical: Bollinger bands, RSI

- Statistical
  - Correlation: correlated returns
  - Beta: similar movement in unit returns
  - Co-integration: stationary mean, stationary variance

- Risk : Single stock exposure limits

- Options: Calendar spread, Strike spread

Trend Momentum example
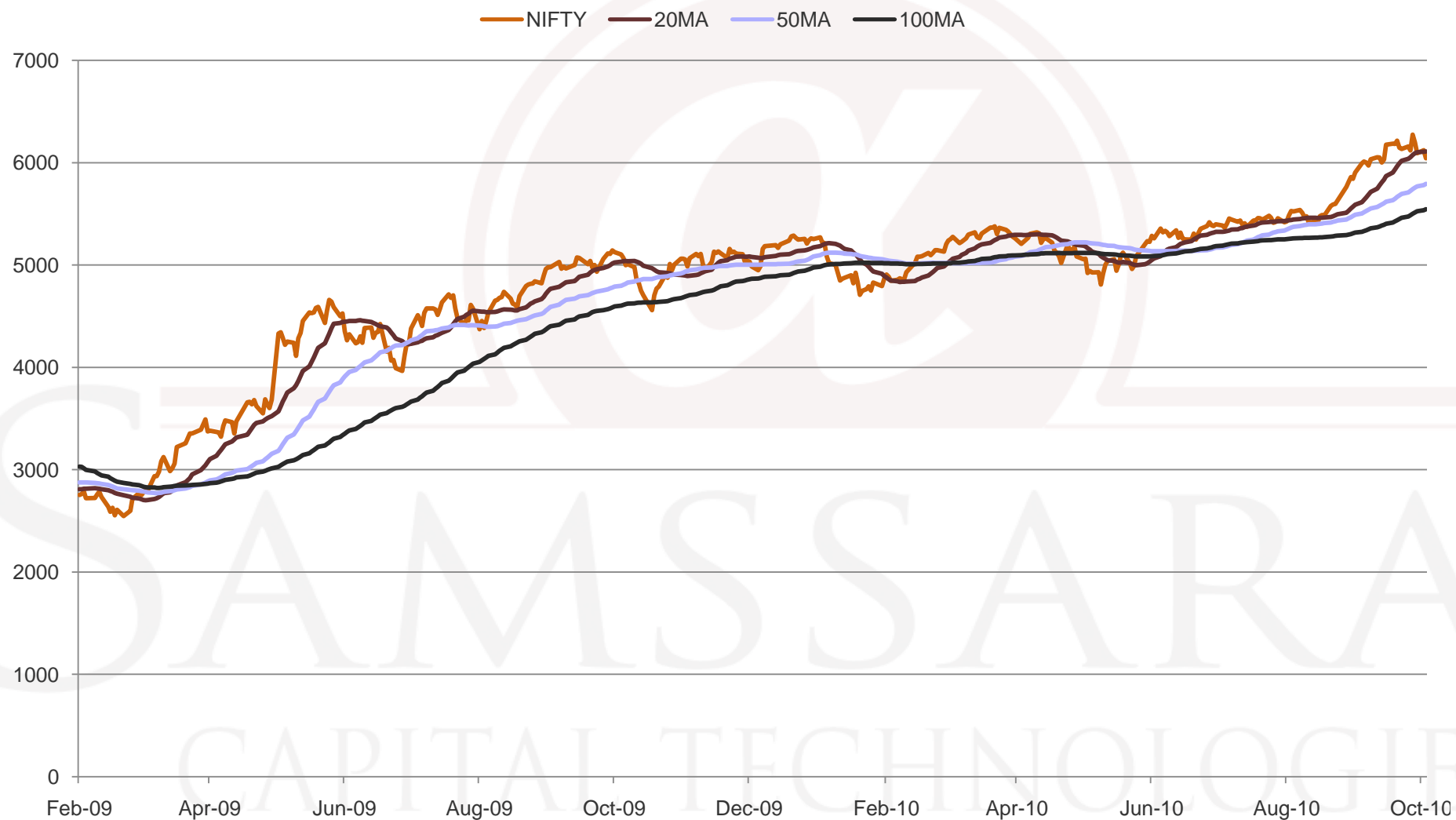
Prop trading – Momentum

- Buy on strength, Short on weakness

- Bet on trend following / continuation of the rally

- Single stocks, futures, index, commodities

- Frequency: weekly, daily, hourly, minute

- Technical: SMA, EMA, MACD

- Statistical:
  - Volatility: Lower volatility is preferred
  - OU process: Non fixed mean time series detection

- Risk
  - Stop loss
  - Money management / Bet sizing
  - Trailing stop losses

Prop trading – High frequency

- Market-making based on order flow (Sell-side)

- Market-making based on tick data information

- Short term direction based on tick/quote information (Buy side)

- Statistical arbitrage & Automated scalping

- Short holding period: milliseconds to minutes

- Low-latency trading
  - Provides competing bid/offer
  - Trades on demand/supply imbalance
  - Front-run large orders in the network
  - Co-located in exchange and very sensitive to speed
  - "Talk to Trade" ratio

Diagram for HFT
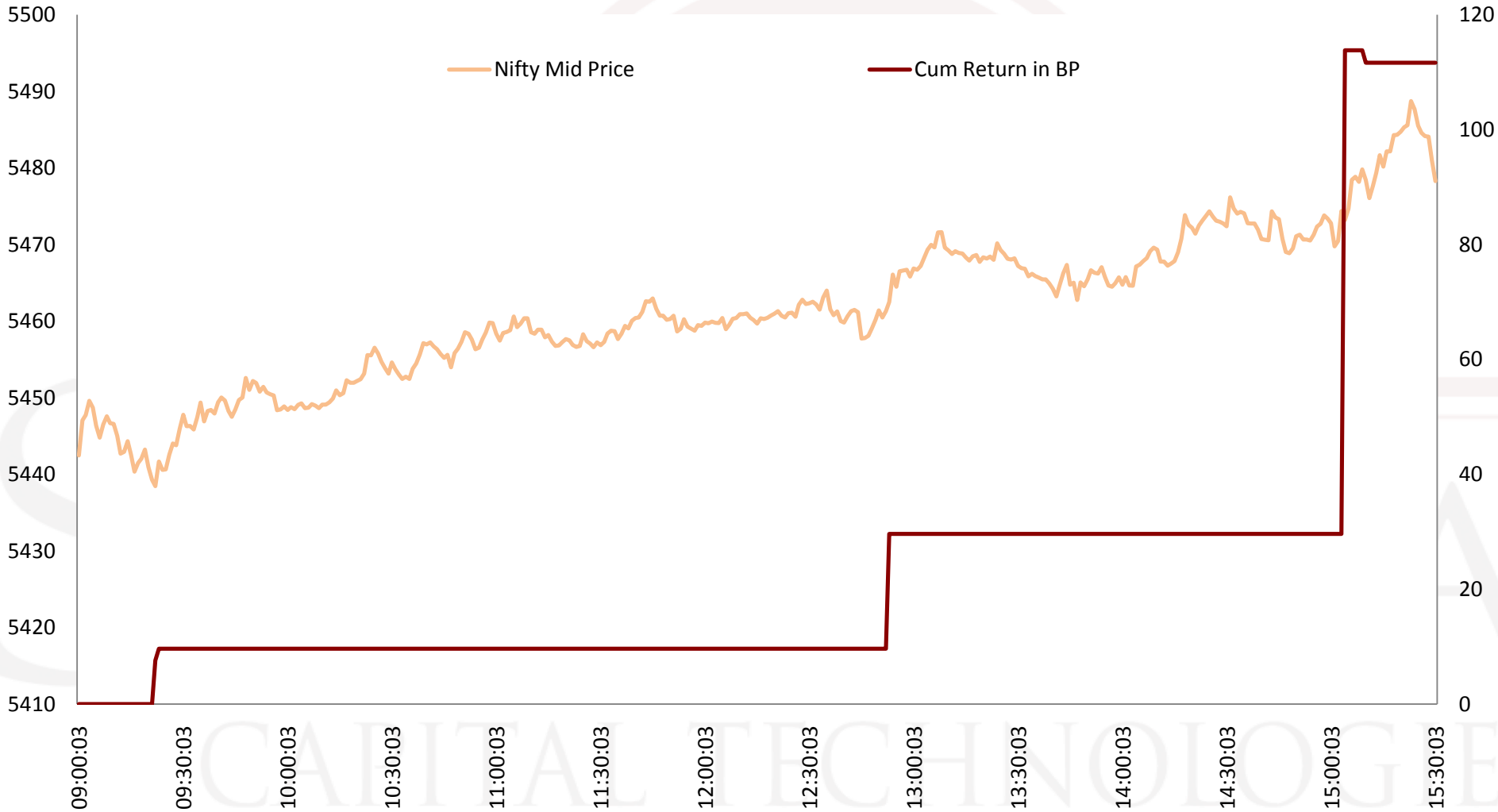
High frequency example

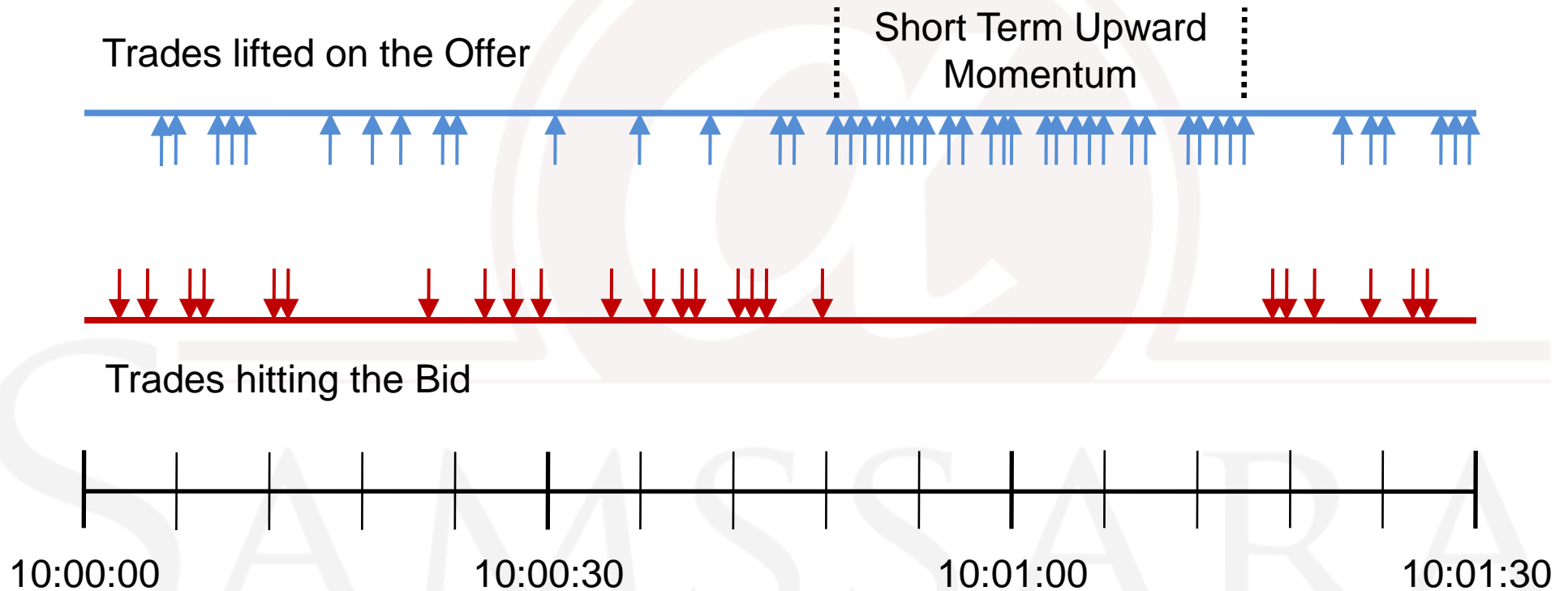- Bid-Ask Density function using equivalent volumes

$$f(Bid, Ask) = \frac{VA_{eq}}{VB_{eq}}$$

$$VB_{eq} = B_0 + (B_1)^{1/2} + (B_2)^{1/3} + (B_3)^{1/4} + (B_5)^{1/5}$$

$$VA_{eq} = A_0 + (A_1)^{1/2} + (A_2)^{1/3} + (A_3)^{1/4} + (A_5)^{1/5}$$

	1055.00	2
	1054.00	7
	1053.00	15
	1052.00	25
	1051.00	31
	1050.00	
42	1049.00	
20	1048.00	
15	1047.00	
11	1046.00	
6	1045.00	

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High frequency example

Trades lifted on the Offer

Short Term Upward Momentum

Trades hitting the Bid

10:00:00   10:00:30   10:01:00   10:01:30

Prop trading – Low frequency, Long/Short

- Equity basket long/short strategy

- Fundamentals based on quantitative techniques

- Growth:
  - 5 years long-term historical growth
  - Forward IBES estimates of next year growth
  - ROE/ROA growth

- Value
  - P/E
  - P/B
  - P/D

- Growth basket: Long top 10% growth stock, Short bottom 10%

- Value basket: Long top 10% value stock, Short bottom 10%

Factor model example
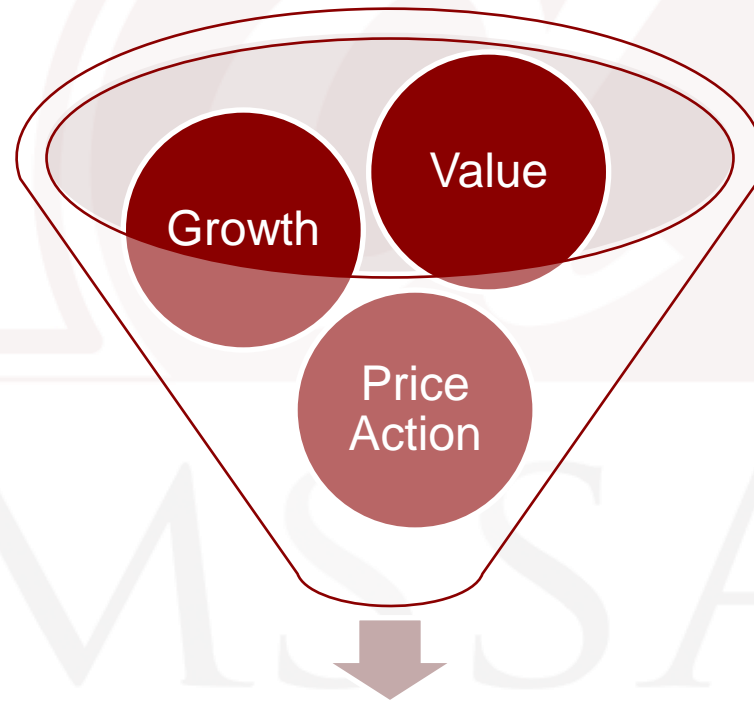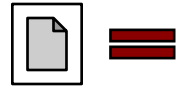
Hybrid Factor Model

Session VII:
Business aspect of algorithmic trading

Launch of algorithmic trading

- Priority: Proprietary or Agency trading

- Proprietary trading: higher risk, higher return

- Agency trading: stable source of revenue as commissions

- Most I-banks have both desks and priority differs

- Asset classes: Equities, commodities, interest rates, currency

- Markets: Supports electronic trading

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Client driven

- **Large Institutional clients want superior execution**
  - Agency approach: VWAP, aggressive, passive algorithms
  - Provide intelligence on executing large basket orders
  - Use a mix of sales trader execution and partly algorithms based
  - E.g.: BGI wants to trade large MSCI Index basket

- **Clients want quantitative intelligence on trades**
  - Quantitative research and algorithmic support
  - Support client-decision making
  - E.g.: Marshall Wace requires analyst ranking data

- **HNI / Private banking client wants to manage money**
  - Internal quantitative hedge fund approach
  - Manage money on profit sharing basis on internal strategies
 - E.g..: Private banking at most major I-Banks

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Product driven

- Internal research and development (Organic route)
  - Product developed first with Prop focus
  - Then AUM deployment holds larger potential
  - Approach clients for deployment of money
  - Enter a profit sharing agreement
  - E.g.: Goldman alpha fund

- Hiring profitable algo desks and quant traders (Inorganic route)
  - Expensive at first go
  - Cut-down the research cycle
  - Aim to generate revenue from day-one based on past track record
  - Sometimes risky as the environment might differ
  - Develop multi-strategy group to act under diverse environment
  - E.g.: Goldman prop desk – always on a look-out

The costs

Cost heads	Per head cost in INR
OMS/PMS system	0 – 10 L
Automated order execution	60 K – 8 L
Data (live time, historical, intra-day, tick-data)	40 K – 3 L
Software (Matlab, Excel, Java, C#, R)	0 – 6 L
Quant Analysts (1 to 5)	2.5 L – 12 L
IT Engineers (1 to 8)	1.3 L – 8 L
Total cost range (Rs. p.a.)	**4.8 L ~ 47 L**

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The system integration
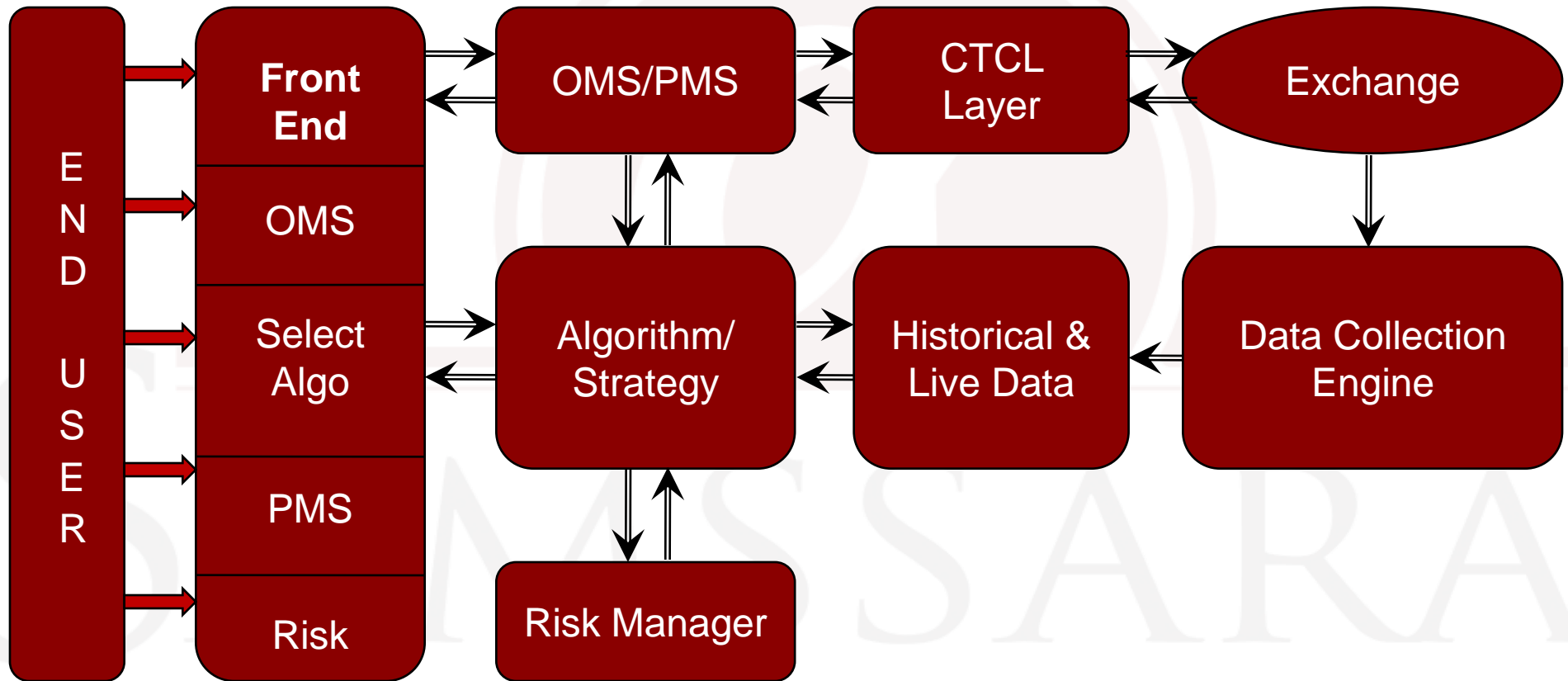
Vendor and 3rd party in India

- **OMS systems**
  - Neat by NSE
  - ODIN by FT
  - Online interface provided by most brokers

- **NSE CTCL & BSE IML: Vendors in India**
  - 3i
  - Omnesys
  - Greeksoft
  - Financial Technologies

- **Data vendor in India**
  - Bloomberg
  - Reuters
  - Tickerplant
  - Newswire18

Revenue models in agency algorithms

- **Brokerages and Commissions on**
  - Single large order at WVAP over multiple days
  - Program trading and basket execution (E.g.: Index arbitrage)
  - Clients strategy execution (E.g.: Pair trading: ICICI-HDFC together)
  - Special executions like beating MOC prices (E.g.: Futures 30 min)
  - Desks in US and Japan makes more than $100 Mn. Annually

- **Guaranteed VWAP orders**
  - Clients off-load execution risk and execute at average price
  - Prop positioning with clients
  - Desks in US and Japan make more than $25 Mn. Annually

- **DMA/DSA**
  - Client send orders directly to exchange using broker platform
  - Client choose the execution strategy (VWAP, Aggressive etc.)
 - Client choose the quantity, price and order type directly

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Revenue models on prop side

- A good strategy can yield cumulative 25-50% p.a. return

- A good strategy Sharpe ratio is > 2.5

- Diversified strategy
  - Frequencies (High, Medium Low)
  - Strategies (Mean reversion, Momentum)
  - Fundamentals (Growth, Value)
  - Asset classes: Options, Equities, Commodities, Currencies

- Run money
  - In-house
  - Close business associates and friends
  - Clients (usually on a 2/20 hedge-fund model)

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Competitive factors

- **Competitive edge can be built in**
  - Algorithms (Superior alpha factors)
  - Execution
  - Diversification
  - Speed and co-location
  - Brokerage and transaction costs
  - Quantitative & IT team
  - Global outlook and reach to multiple geographies / markets

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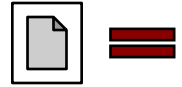
Session VIII:
India in algorithmic trading

The exchange regulatory structure

- **Unofficial figure quotes that DMA trades**
  - 5% of the equities
  - 15% - 25% of the F&O

- **Strict exchange regulations**
  - NSE has throttling control on number of trades per second
  - Approval process for algorithmic trading
  - Multi-exchange algorithmic strategies is not legally allowed by NSE
  - Cross-exchange arbitrage and SOR cannot take place
  - STT applicable to all transactions
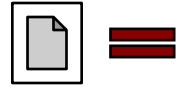
The potential

- Indian market is very big!

- 10th largest in dollar value

- Huge potential as in "number of trades" – 3rd largest!

- Worldwide median per trade: $10 K

- India median per trade: $500

- All exchanges offer co-location facilities

- Spreads are amongst the lowest in the world at 5-6 BP

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The cost structure – pros and cons

- **STT (Securities Transaction Tax)**
  - Very high (2 BP in F&O, 12.4 BP in Cash)
  - Deterrent to high-frequency (Making 2-10 BP per trade)
  - Focus on: Intra-day, 10 min. to 3 hour holding strategies
  - Focus on: Medium to low frequency strategies

- **The order book depth**
  - Indian market lacks depth
  - Execution of 5 lots at once, moves the market
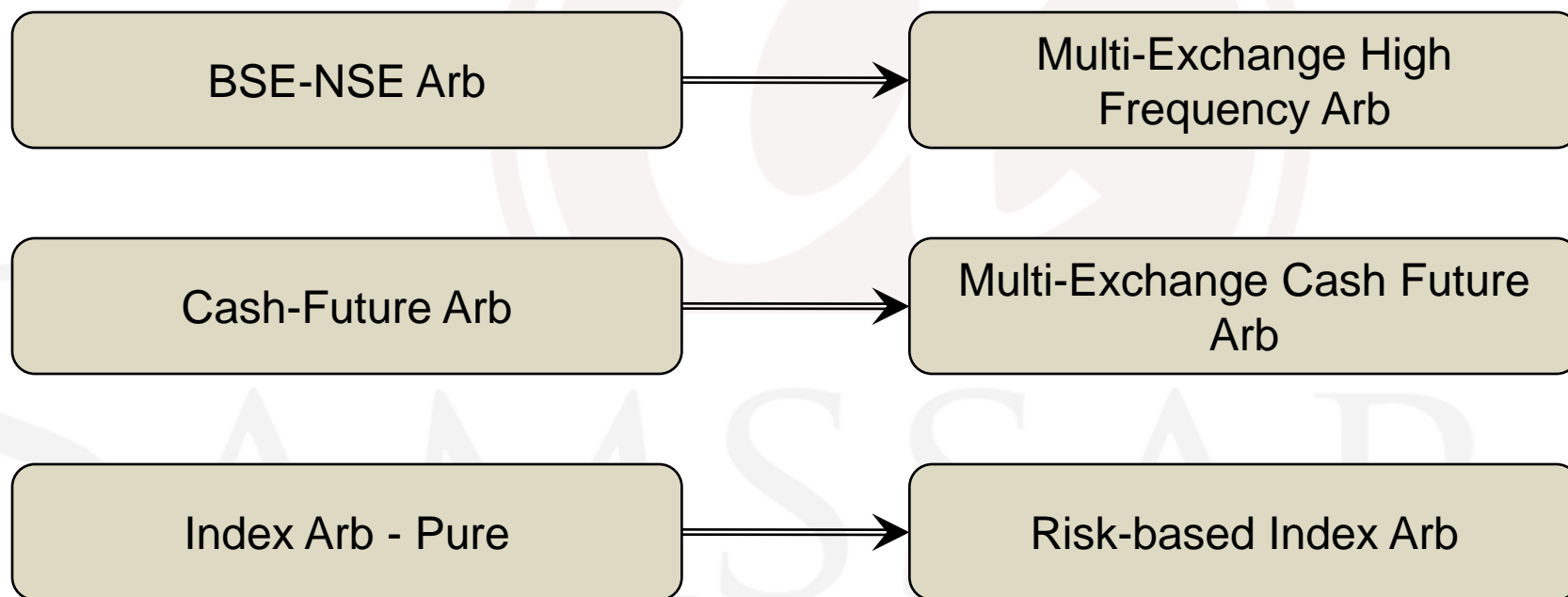 - Beauty lies in breadth and Signal longevity

Trends in Indian market

- **Proprietary desks**
  - Indian brokers have very large prop focus E.g.: Edelweiss
  - Automated trading becoming popular
  - E.g.: Cash-Futures arbitrage, Pure Index arbitrage
  - Big challenge is alpha-generation

- **Agency desks**
  - Awareness is very little
  - Most foreign brokers have quickly replicated electronic/DMA/DSA
  - Indian brokers slow in adoption

- **Major challenges in Agency desk implementation**
  - Initial cost to pay-off ratio is very steep
  - Lack of awareness, man-power and skill-set

Current state of Algorithmic Trading | Prop Algos

Present   **Future**

| BSE-NSE Arb | → | Multi-Exchange High Frequency Arb |

| Cash-Future Arb | → | Multi-Exchange Cash Future Arb |

| Index Arb - Pure | → | Risk-based Index Arb |

Present

Future

Present	Future
Pair Trading Technicals	Pair Trading on Statistical and Advanced Algos
	Pair Trading on Baskets
Tend Following – Technicals	Trend Following on Multi-Statistical Factors
Fundamentals on Equity Research	Factor Modelling

Current state of Algorithmic Trading | Agency Algos

Present

Future

Manual Order Slicing	→	Volume Curve based Order Slicing
Manual Directional Calls	→	High Freq. Analysis based directional calls
Manual Market Making	→	Quote and Tick Analysis based market making
Basic VWAP and Inline Engines	→	Spread, Volume Curve, Volatility Analysis on VWAP

New Algos: Aggressive, Passive, Basket Executions, MOC Algos

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A note on retail clients - 1

- Retail clients forms a big part of Indian markets

- Smart thinking and execution is required to tap the retail

- First successful step: online / mobile trading (pure OMS/PMS)

- New ideas and innovation to beat the competition

- Smart execution strategies
  - E.g.: Client wanting to buy 1000 shares of Reliance over the day
  - E.g.: Client wanting to execute a HDFC-ICICI pair at ratio of 2.21
  - E.g.: A client wanting to beat the MOC by last 30 min. execution

A note on retail clients - 2

- Smart portfolio management
  - E.g.: Advising clients on Buy, Hold, Sell based on technical
  - E.g.: Advising clients based on analyst rankings on the stock

- Smart Trade Selection
  - E.g.: Developing automated Intra-day momentum strategies
  - E.g.: Automated Pair-trading strategy which advises 1 or 2 signals in a day

The challenges and positive side

- **The challenges**
  - Serious lack of skilled man-power
  - Most experienced people are sitting in foreign I-Banks
  - STT (Securities Transaction Tax)
  - Lack of awareness and widespread acceptance
  - Mindset of quick Return on Investments
  - Paying huge upfront costs, getting nothing, leading to frustration

- **The positive side**
  - Huge pool of IT resources
  - Street smart traders: Good fundamental and technical know-how
  - New generation willing to accept change
  - Tough competition and feeling of left-out on missing an opportunity

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The challenges to Indian exchange

- As markets develop – number of algorithms will explode

- Highly trained personnel required for evaluation

- Algorithms might change often and can be very dynamic

- Exchanges might not be able to keep track

- Intellectual property issues will become prevalent

- Exchanges might end in invidious position (blame sharing)

- Strong multi exchange competition

- High pressure on network and bandwidth

- Will require new and strong IT system (E.g.: Japan Arrowhead)

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The growth projections

2015-2016: Fully realized HFT at around 30% of volumes similar to international markets

2013-2016: Dark Pools and internalization. Difficult due to regulations and could see delayed implementation

2010-2015: ATS, PTS which are slow to develop due to exchange concentration and regulations

2009-2010: DMA and DSA Evolution

2010-2012: Execution Algorithms on VWAP, TWAP as Co-location and DMA are introduced

2009-2010: Connectivity improves with SOR, exchanges offering co-location, brokers adding multiple connections

Source: Celent Market Research

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Recommended referrals

Prop trading

- High-Frequency Trading: A Guide to Algorithmic Strategies and Trading Systems by Irene Aldridge
- Statistical Arbitrage: Algorithmic Trading Insights and Techniques by Andrew Pole
- The Encyclopedia of Trading Strategies by Jeffrey Owen and Donna McCormick

Agency trading

- Algorithmic Trading and DMA: An introduction to direct access trading strategies by Barry Johnson
- Quantitative Trading: How to Build Your Own Algorithmic Trading Business by Ernset P. Chan

Web forums

- Wilmott forum: www.wilmott.com
- Nuclear Phynance: www.nuclearphynance.com

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Summary

- The steady race to catch the developed markets in terms of turnover, liquidity, profitability and sustainability in Algorithmic trading has just started.

- Much depends on the regulatory structure, exchange regulations, competitiveness and awareness – as to how the next 3-5 years is going to shape.

- Looking at the global trends India cannot be left far behind in the search for its own space on liquidity generated by Algorithmic trading.

- The big boys of algorithmic trading globally has already started to grab a pie of the growth

- It remains to be seen and sensed whether the domestic players and exchange members are well prepared to take the challenge and compete with the larger players head on to grab a pie of the lucrative business called Algorithmic Trading.

About Samssara Capital Technologies LLP

COMPANY BACKGROUND

- Samssara Capital Technologies LLP ("Samssara") is an investment solutions firm focused solely on developing automated algorithmic and quantitative trading and investment strategies

- It was launched in 2010 by a team of IIM Ahmedabad and IIT Bombay graduates - Rajesh Baheti, Manish Jalan and Kashyap Bhargava

- Samssara caters to its clients' needs of providing an alternative asset management vehicle, with the focus on 100% automated and quantitative trading strategies

- The team at Samssara works on mathematical models and statistics that identify repetitive patterns in equity, commodity and currency markets

- The addressable market for Samssara is global - as the firm can develop and build models which can function in both developing markets with limited competition and developed markets with strong competition

- Samssara's client base includes the leading international and domestic banks, international and domestic stock brokers, family offices, corporate treasuries and HNIs

PRODUCTS OFFERED

- Samssara's products vary from pair trading (statistical arbitrage), factor models, Nifty Index beating products to very high frequency trading strategies

- samCAP, a key product offered by Samssara, is a factor model, where the model identifies a basket of stocks in Nifty that tend to outperform the index and takes a long position in these stocks. Alongside, the product also hedges the investor's portfolio using Nifty futures – whenever the market turns bearish

- Other products offered include samTREND - a trend following strategy in equities, commodities & currencies and samWILLS – a long-short strategy based on statistical arbitrage

- Samssara also develops in-house products which are used by investors like HNI's, corporate treasuries, Prop houses of brokers and investors who wants an alternative vehicle for investment apart from equities and fixed income.

- The products are designed to generate consistent returns and ride the volatility of the markets with systematic approach

- Additionally, Samssara works on providing high end services and strategy development consultancy to hedge funds and International Banks globally

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