FUSION
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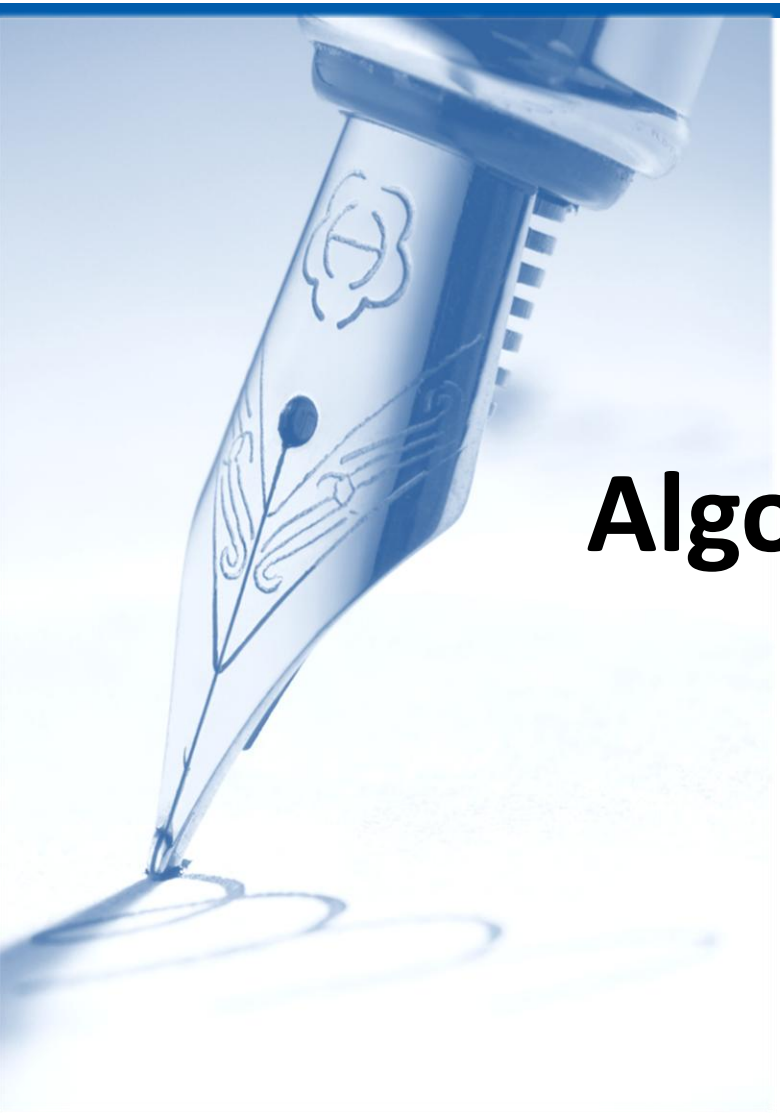

Algos for non-professionals

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Fusion Asset Management

FX Week Europe, 26th November
London

2014 ALGOTRADING MARKET IN NUMBERS

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Development of Algo trading in the last 10 years

	Equity	FX
Annual volume, trillions a year:	30-70	300-600
% of Algorithmic Trading	70-80	80-90% (20% in 2006)

- Execution fee 0.1-0.05 bps
- Main players are banks and brokers (up 5 in the US, the same amount are in Europe)
- Up to 20% already is market share of small houses like GSA which can easily execute FX spot orders for corporate with their algorithms

THE BIRTH OF ALGO TRADING

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- Since the beginning of 90-th an investment company could no longer afford to wait for a human to execute the trade a computer recommended;

- Computers were programmed to act immediately on fleeting information;

- LTCM used computers to detect small and fleeting differentials in securities prices to make huge profits in global bond and derivatives markets in the late ’90s. Their computer trading algorithms were soon imitated by others, which required LTCM to seek out new methodologies and markets.

- Chartists and algorithmic traders now rule the day, and computers now do battle against one another’s algos.

ALGOS: WHAT IS IT AND WHY IT MATTERS

Algorithmic trading:

The use of programs and computers to generate and execute (large) orders in markets with electronic access.

The main objective of algo trading is not necessarily to maximize profits but rather to control execution costs and market risk.

Algo-trading is used in many forms of trading and investment activities, including:

- Mid to long term investors or buy side firms (pension funds, mutual funds, insurance companies) who purchase in stocks in large quantities but do not want to influence stocks prices with discrete, large-volume investments.
- Short term traders and sell side participants (market makers, speculators, and arbitrageurs) benefit from automated trade execution; in addition, algo trading aids in creating sufficient liquidity for sellers in the market.
- Systematic traders (trend followers, pairs traders, hedge funds, etc.) find it much more efficient to program their trading rules and let the program trade automatically.
- Algorithmic trading provides a more systematic approach to active trading than methods based on a human trader's intuition or instinct.

THE THREE STEPS IN ALGORITHMIC-TRADING

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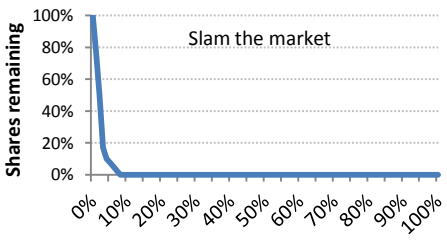
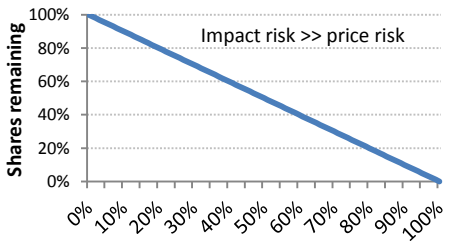
Trading Strategy

How to split the order in small pieces (Impact risk vs. Price risk)

Almgren-Chriss Model (Expected Shortfall), 2000





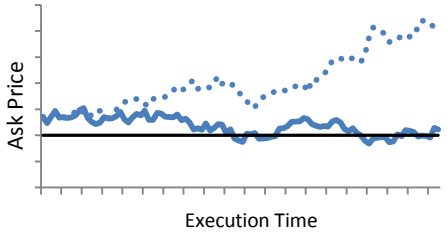
Order Placing

How to execute the small orders electronically (Limit Order Book)

Barrier-Diffusion Model, Harris (1998)

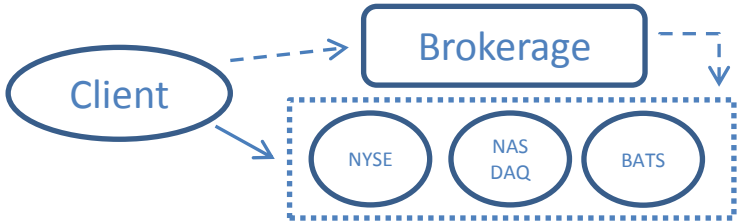
BDM with Random Reservation Price

Empirical Analysis of Limit Order, Lancaster (1997)



Smart routing

Best venue to trade, in case more than one venue is available



STRATEGIES AND BUSINESS MODELS

The various strategies can be classified as follows:

Classic arbitrage

- Exploits the differences between market prices and prices implied by “no arbitrage” conditions. If the price gaps are large enough to cover transaction costs, trades can be executed to lock in a risk-free profit. In spot FX, the arbitrage would be done with a set of currency pairs and the relevant cross rate, eg. EUR/USD, USD/JPY and EUR/JPY.
- Arbitrage could also be done across the spot and futures prices of the same currency pair.

Latency arbitrage

- Exploits the small time lag between when market-moving trades take place and when market-makers update the prices they quote. By directly detecting potential price moves, the HFT player can profit from what it has learned ahead of other participants that rely on market-makers’ quotes.

Liquidity-providing

- Strategies aim to detect order book imbalances for a particular currency pair and pricing discrepancies across trading platforms. The HFT participant earns a spread by arbitraging these differences.

Complex event

- Processing includes a number of different strategies. They aim at detecting profit opportunities by exploiting various properties of currency prices such as momentum, mean-reversion, correlation (with other currency pairs or with other assets) and response to economic data releases.

HFT

The greatest portion of present day algo trading is high frequency trading (HFT), which attempts to capitalize on placing a large number of orders at very fast speeds across multiple markets and multiple decision parameters, based on pre-programmed instructions.

- Market functioning: HFT helps to distribute liquidity across the decentralised market, improving efficiency, and has narrowed spreads
- Systematic risks: HFT may accelerate and propagate shocks initiated elsewhere ("flash crash"6 May 2010)
- Market integrity and competition: A key question is whether other market participants are able to adapt to the presence of HFT, and how the market environment will be affected when those failing to keep up change their trading behaviour or exit the market completely
- Looking ahead: The future of HFT in FX depends on various ongoing regulatory reform initiatives

MARKET MICROSTRUCTURE: TWO SIDES OF THE COIN

Two sides:

- **High-freq trading**
- **Large order execution**

Angles:

- Market makers: liquidity providers, gain from uninformed traders, might loose to informed ones;
- Informed traders: trade multiple times, should take into account the result of own trades (uninformed, noise traders normally trade only once);
- Optimal execution: The main objective of algo trading is not necessarily to maximise profits but rather to control execution costs and market risk;
- Market impact: The demand for a large amount of liquidity will typically affect the cost of the trade in a negative fashion (“slippage’’);
- Stability: market failures.

LARGE ORDER EXECUTION

Volume-weighted average price (VWAP): minimisation of market impact. Splitting of a large order depends on the time of day

- trade sizes are known in advance
- volume function is estimated using historical data

Percentage of Volume (POV): VWAP + a constant percentage participation in the market along the trading period

Almgren-Chriss algorithm: minimisation of "Expected Shortfall". Market impact combined with "urgency in execution" (price risk)

- Almgren, R. and N. Chriss (2000). Optimal execution of portfolio transactions, J. Risk 3(2), 5–39; Almgren, R. F. (2003). Optimal execution with nonlinear impact functions and

Minimisation of expected loss

- Bertsimas, D. and A. W. Lo (1998). Optimal control of execution costs. J. Financial Markets 1, 1–50

TRADEBOOK FX PROPRIETARY ALGORITHMS

Schedule-Based Algorithms *(TWAP)*

TWAP: Anti-gaming through multiple working orders and randomisation of both schedule and size and being both passive and aggressive within the market.

Better queue placement through multiple order management. Seeks to collect the spread.

Contingency and Event-Driven Algorithms *(OCO, IF-DONE)*

One Cancel the Other: Combines a stop order with a limit so if the price breaks above or below the set levels one order will be triggered into the market and once executed the other leg will be cancelled.

If Done: Works as an AS DONE order so the second order gets sent into the market piece-mail and proportional to the fills of the first order.

Price-Based Orders and Algorithms *(Limit, Stop, Pegging, APA(VWAP), Reserve Scale Back, Trailing Stop, Looping)*

Pegging: Execute a dynamic limit order using a specific reference price.

APA (VWAP): Execute an order with a soft limit by working an average rate. Order will execute at any level as long as its maintaining a working average rate no worse than defined. If APA is entered via Sweep mode this defines a VWAP based on the current market levels. Used to lock in defined price

Reserve Scale Back: Passive Algo designed to buy on weakness and sell on strength.

Trailing Stop: Let profits run but cut losses at the same time. As the market moves in your favour your 'stop' level will float along with the market by a set trial limit. Once the market starts coming back into your level, your stop price will lock in. If the market continues to move in that direction your stop limit will trigger. If the market starts moving away again, your trail parameters will once again kick in.

Looping: Looping enables traders to try to profit on range bound market fluctuations as well as focus on other core activities while the loop order will be managed by the system directly. It allows for a dormant order to be entered and executed upon completion of initial order. When the price for the active order is reached, it executes and the second order becomes active. It then creates another dormant order and will be done when all loops are completed or the order is stopped.

Trading Strategies *(Discretion, Iceberg/No-show orders, TAC)*

Discretion: Order is entered at the limit price however will cross discretely cross the spread if the market moves within the discretion level.

Iceberg/No-show orders: Work orders while only displaying a portion of your true amount, including full no-show orders that can be 100% hidden into the market.

TAC Orders: (Time-And-Cancel Orders) Allows for additional capture based on market movements.

Event-Based Algorithms *(Target Orders, Eco Triggered)*

Target Orders: Define entry timing of our order based on levels hit by a specific security or index.

Economic Triggered: Send strategies based off key economic releases.

TRADEBOOK EQUITIES PROPRIETARY ALGORITHMS

Liquidity Seeking

B-Smart: Intelligently posts your order in the most active lit/dark venues using dynamic real-time market information - seeks to maximize exposure and market-sweeping ability. You control by adjusting its aggressive level.

Hide & B-Smart: Stealth version of B-Smart. Does not post in any lit venue.

B-Dark: When executing, seeks to minimise impact and maximize size by trading only with dark liquidity pools.

Auction Close/Open: Automates and optimises global open/close auction participation. Allows market order to be entered in every exchange and will queue orders so they can be entered at any time.

Smart Close: Execute large orders using the day's trading dynamics in both continuous trading and the closing auction to minimize impact. Urgency is automatically determined to balance liquidity and market impact.

Benchmark

Arrival Price: Tradebook's implementation shortfall algorithm that dynamically adjusts to the market opportunistically - with the objective of achieving the arrival price.

VWAP: Tradebook's VWAP algorithm. VWAP dynamically forecasts volume to be as close as possible to the interval VWAP benchmark.

TWAP: Executes evenly over a time-interval-scheduled strategy.

Portfolio Arrival Price or VWAP: Executes a portfolio (list) of equities on a ratio or dollar-neutral basis using either an arrival price or interval VWAP benchmark.

Go-Along: Executes using a target-volume participation rate specified by the user.

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