Short Interest projects  project 1-3
Statistical Arbitrage and prediction projects  project 4-5
Correlation project(s)  project 6
Order book projects  project 7-8
Short interest projects

- Hard-to-borrowness leads to more buy-ins.

- A buy-in is an event where short holders are forced to cover their positions at market price.

- This can lead to a type of bubble dynamics.

Mike Lipkin and Marco Avellaneda (2009) Propose a joint set of stochastic differential equations to model this effect.
Lipkin & Avellaneda

Stock price

\[ dS_t = \sigma S_t dW_t + \gamma \lambda_t dt - \gamma dN_t^{\lambda_t} \]

Buy-in rate

\[ \lambda_t = e^{X_t} \]

\[ dX_t = \kappa dV_t - \alpha (X_t - \overline{X}) dt + \beta \frac{dS_t}{S_t} \]

\( N_t \) Poisson process

\( \lambda_t \) Jump rate

\( \gamma_t \) Jump size
Short interest projects

Project 1: Chinese Stocks

- Examples of stocks that trade in Hong Kong and Shanghai
- Can be shorted in HK
- Cannot be shorted in Shanghai

- The profile of these stocks is very different on the two exchanges.

Can you calibrate the L-A model to the data, and extract model parameters from a direct comparison of otherwise identical stocks?
Short interest projects

Project 2: Short-interest data

- Short interest data set from Dataexplorer

- Buy-in --> downward jump in price which can be seen as an effective dividend.

- Use put-call parity arguments to back out the dividend. Use this to get buy-in rate.

\[ D_{eff} = \frac{C_{pop} - P_{pop} - KrT}{-ST} \]

1) Is there an (empirical) relationship between short interest and the buy-in rate?
2) Are any of these quantities predictable?
3) Can they be used to predict volatility or stock prices?
4) Can you design option trading trading strategies?
5) “Rebate arbitrage” strategies?
Project 3: Bubbles

Signatures of hard-to-borrow-ness and bubbles

- Look to see if rapid changes in price are accompanied by hard-to-borrow-ness.

- Intra-day and daily time-scales.

- In times of known bubbles check to see if hard-to-borrow-ness (as implied from options or from short interest data) indeed increases.

- Is this universally true?
Statistical arbitrage and prediction projects

Stock returns = systematic part + idiosyncratic part

\[ r_i = \sum_{j=1}^{M} \beta_{ij} F_j + \varepsilon_i \]

Goal: Predict the idiosyncratic part, often mean-reverting.

- Understanding the statistical and dynamical properties of idiosyncratic residuals.
- Designing an attractive trading strategy.
Statistical arbitrage and prediction projects

Project 4: Residuals as an Ornstein-Uhlenbeck process

Following Avellaneda & Lee

The first goal will be to replicate the A&L results using stock return data, then apply to the other data sets (EvA residuals).
Statistical arbitrage and prediction projects

Project 4: Residuals as an O-U process

Interesting questions:

1) How well are the data described by the O-U process?
2) How stationary are the parameters?
3) Find the optimal trading strategy, eg along the lines of Boguslavsky & Boguslavskaya
4) What are the statistical properties of the residuals?
5) What is the mean first passage time (i.e. excursion time) for the model? For EvA’s data?
6) What is the sensitivity on the filters in the paper?
7) What is the effect of better portfolio construction?
Eva is occasionally contacted by external sources who claim to have fantastic trading strategies!
Statistical arbitrage and prediction projects

Project 5: Can you beat the trader?

Eva will provide a universe of stock return data and/or time series of residual returns.

1) Wavelet filtering
2) Kernel smoothing (perhaps with fat-tailed distribution function)
3) Try to predict returns
4) Try to predict behavior of price process itself (first and second derivatives)
5) Can you predict when the price is going to start trending up or down?
6) Is there predictability on different time-horizons?
Project 6: Exploring the structure of correlation:

Options on indices as well as statistical arbitrage strategies crucially depend on correlation (high dimensional).

Stylized facts (with Lisa Borland)

- Intra-day price snapshots, as well as daily data
- What is the structure of correlation on different time-scales?
- Is there memory or clustering as for volatility?
- Conditional properties?
Correlation project(s)

Project 6: Exploring the structure of correlation:

On a higher level (with Richard Sowers)

- What are the dominant statistics of the evolution of correlation on different time-scales?

- How can options on indices be projected on these?

- Can one find a low-dimensional model for the evolution of the “shape” of the market?
Order Book Projects

• Market participants can post either limit orders or market orders.

• A limit order is an order to buy or sell a certain amount of a security at a given price.

• The collection of outstanding limit orders can be summarized by the amounts posted at each price level. This is called the limit order book.

• When a market order arrives it is matched with the best available price in the limit order book and a trade occurs (in an “order-driven” market).

• A limit order sits in the book until either executed against a market order or canceled. This comprises the dynamics of the order book.
Order Book Projects

Project 7:

Gerry and Kay propose creating a trade simulator for the dynamics of the order book.

This will allow for testing of certain market-impact models.
Order Book Projects

Project 8: Can the order book predict anything tradable?

-Can information in the order book be used to predict price movements?

-On a tick-by-tick time scale?

-On a larger time-scale (for example, can an integrated order book profile predict anything over longer horizons?)
Data sets

- Stock return data (daily)
- EvA residuals
- Intra-day price snapshots (candle data)
- Options data (daily, possibly intra-day snapshots)
- Order book data (from 2009 projects)
- Short interest data (from DataExplorer)