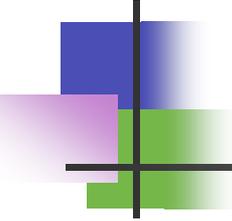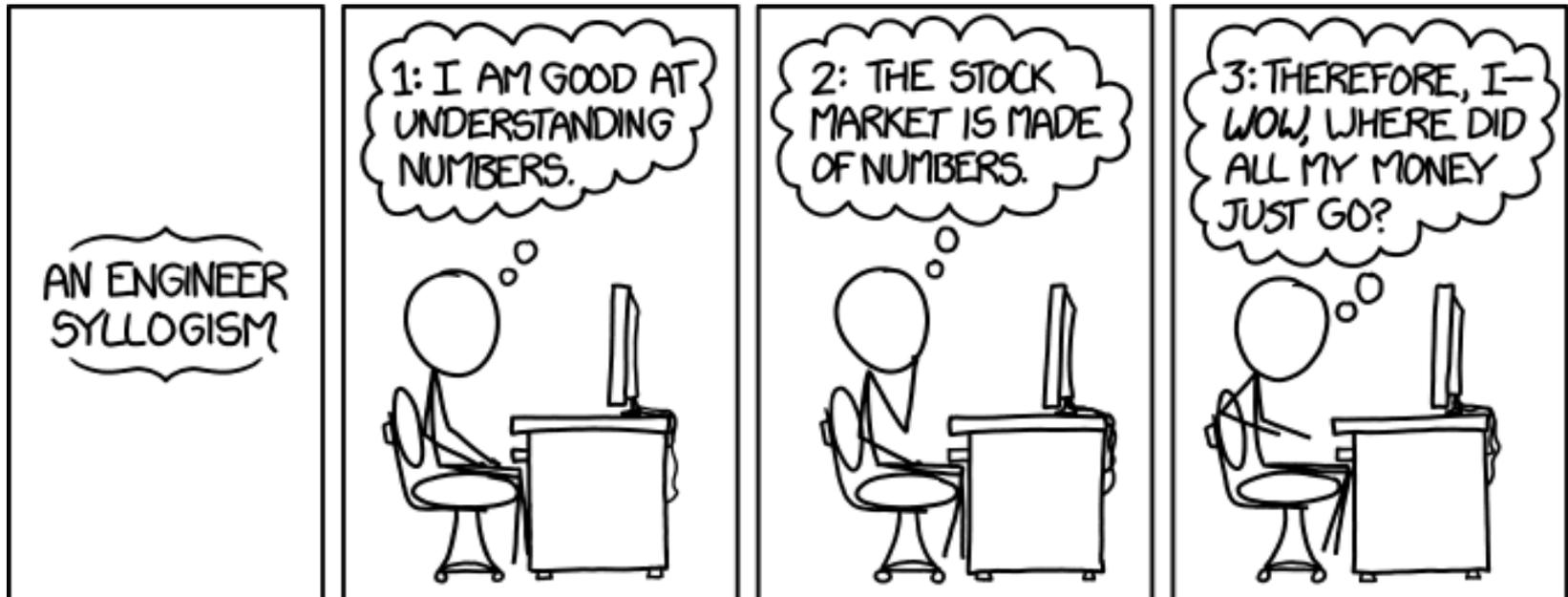# Machine Learning in Finance and Trading

Machine Learning in Finance and Trading

- ## Quantitative Trading/Investing
- ## Algorithmic Trading/Investing
- ## Programmatic Trading/Investing

- Data oriented
- Numbers oriented
- Stock markets are made of numbers
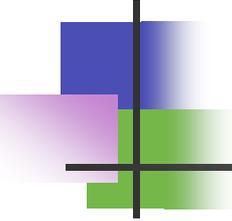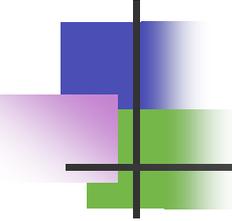
Machine Learning in Finance and Trading

Overview

- Advantages & Disadvantages
- Terms
- Investing and Trading
- Timeframes, Costs, & Liquidity
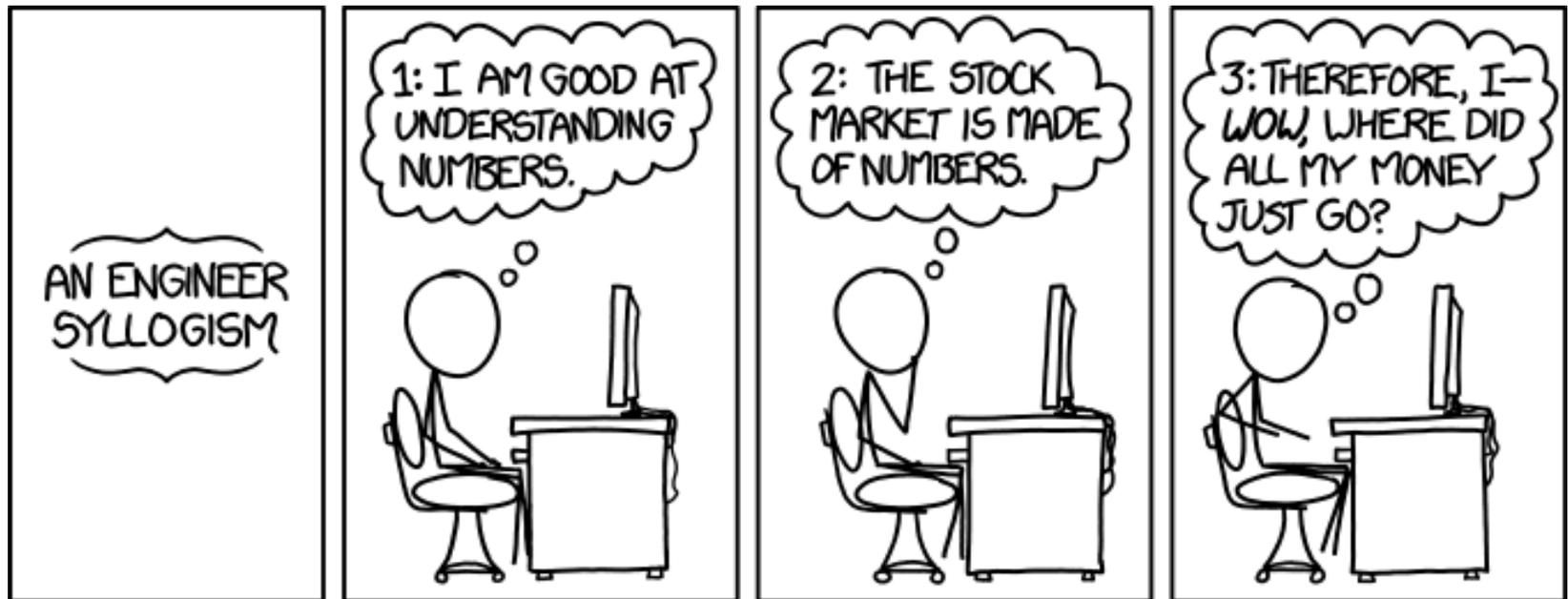
Advantages & Disadvantages
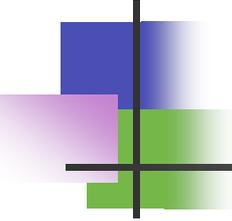
- Advantages
  - Take the emotion out
  - Clear path/strategy
  - Mathematically optimal
- Disadvantages
  - Market is 70+ % non-emotional algos already
    - Backed by well paid quants
  - Optimal for assumptions only
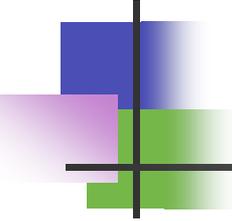 - Still no guarantee of a profit
 - Markets change

Advantages & Disadvantages

Terms

- Investing vs Trading
- Time Frames
- Costs: data, trading, risk, regulatory
- Stochastic, and worse

Investing

- Long(er) term holdings
- Portfolios and Portfolio Balancing
- 'Universal Portfolios'
  - Thomas Cover, Stanford (& extensions)
  - Step-by-step refinement
  - Mathematically optimal
    - Ignores costs
    - Large firms, low costs, have the advantage
    - Index funds take advantage of this
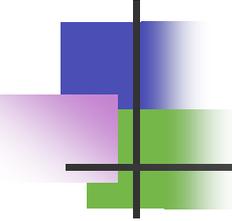
Trading

- ## Classic Exchange Arbitrage
  - ### Sell something on NYSE for 100.10 *right now* what you can buy on NASDAQ for 99.90 *right now*
- ## Statistical Arbitrage
 - ### Most common for machine learning and quantitative trading
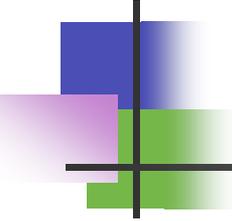
Statistical Arbitrage

- Stock XYZ has an average price of 100, with a variation of 5% over some time period.
    - Buy at a low fluctuation point, say 95
    - Sell at a high fluctuation point, say 105
   - Value At Risk – 95 for whatever the average time period is.
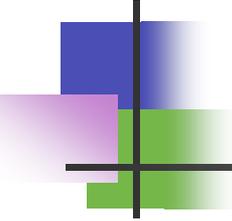
Statistical Arbitrage (better)

- ## Stocks A & B (idealized)
  - Same industry, size, price, and variation
- ## Synthetic (A-B) – avg cost 0
  - When A-B >0, Sell A (short) & Buy B
  - Sell A at 105, Buy B at 95 - Immediate 10 profit
  - When they return to avg prices, Sell B and Buy (cover) A.
  - If market goes up or down, A & B tend to move together.
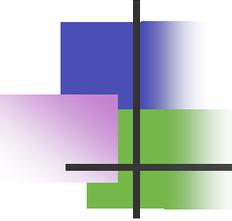
Statistical Arbitrage (better)

- Looking for correlations between stocks (may vary by timeframe)

- Can extend to other asset classes, such as bonds, options, commodities, futures, options on futures, etc.

- ~36 k listed stocks in the US
  - ~600 k listed stock options
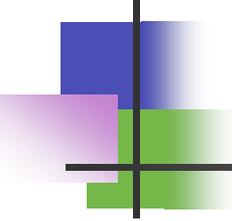
Other 'Synthetics' Arbitrage

- Index Arbitrage
  - S&P 500 (SPY)
  - Nasdaq 100 (QQQQ)
  - … ETFs, sector funds, etc.

- Realm of High Frequency Traders
  - They know the index weights and prices tick-by-tick.
  - Buy SPY, sell the 500 components (or vice versa)

Statistical Arbitrage Opportunities
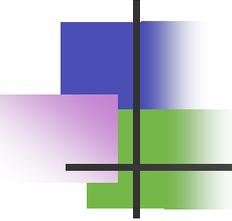
- Opportunities to identify profitable trades are almost boundless
  - ~36k listed stocks => ~648 M pairs
  - Compounded by different asset classes
  - …different markets
  - …different time frames
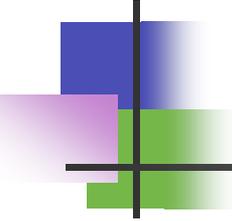
…on the other hand, there are costs and risks

- Costs
  - Trading fees, clearing fees, exchange fees
    - Volume based, risk based
    - Short sale interest
    - Adding/taking liquidity
  - Data fees
    - Hourly plus – very low cost
    - Consolidated – many 100s $ per month
    - Direct feeds – many 1,000s $ per month
      - Proprietary formats
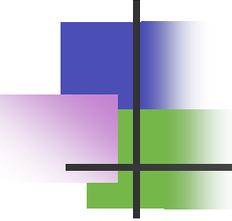
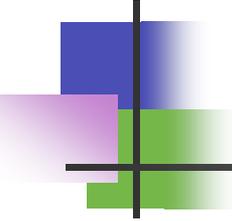# …on the other hand, there are costs and risks

- Risks
  - Liquidity
    - Can you trade? Not all stocks trade every day
   - ~800 stocks 'actively' traded daily

  - Time frames
    - Longer your timeframe, the more external influences can impact your correlations
    - Shorter timeframes reduce risk, increasing profitability, but they much higher costs
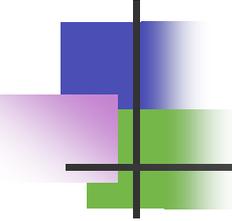
Trading as Competition

- 70+ % of the trading volume today is algos
- Much of the time they are competing with one another via technology (speed) on nearly risk-free strategies (high speed index arbitrage)
- Their trading fees can be pennies per share (or even negative) based on volumes and liquidity
- Huge investments in equipment & staff
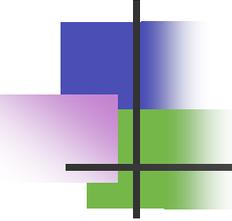
Trading as Competition

- Large firms must make huge profits to cover huge costs
  - Making $1M per day is no good is your costs are $2M per day.

- Firms 'blow up' all the time
  - Knight Capital lost ~$478M in 45 minutes of trading. That killed their company.

Trading as Competition

- Ignoring technology / speed plays like Index arbitrage, trading firms are changing strategies all the time

- Some firms create new strategies on the order of one every 6 weeks
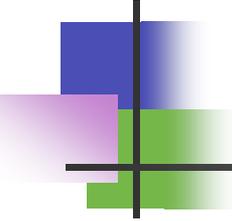
It Always Changes

- Stochastic – for a given set of initial conditions, the next step is random

- If someone trades a correlation, they change the market
  - Prices change in response to the trade
  - Occasionally others may notice, and trade it too
  - Correlations will disappear if traded large enough or long enough.
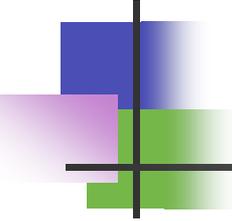
Summary

- Possible correlations are almost limitless
  - But they change with time

- Costs impact strategies
  - Investment portfolio balancing can be optimal if costs are negligible
  - More frequent trading is costlier.