THE MECHANICS OF TRADING

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The process of integrating technology and finance is not new and the threats that developments in software bring to the finance industry are well documented. However, the rapid innovation that is occurring in the field of Artificial intelligence demands a new outlook in the process and delivery of financial services, specifically trading.
As a student of Economics and Computer Science I have always been heavily intrigued by the applications of technological change on the delivery and outlook of financial services.
I will be looking at a range of different factor models used so far in the ascertainment of risk in stock markets and how AI is now being implemented to make this process more effective.

Artificial Intelligence

What is AI? A buzzword rumbling within the underbelly of the tech industry, an unexplainable phenomenon to be feared by workers and the government alike, or simply an exaggeration by those who claim it is the solution to all the world's problems?
A.I. is an abbreviation of Artificial Intelligence
Artificial Intelligence is, if we ask the dictionary, the 'simulation of human intelligence processes by machines, especially computer systems'.

Machine Learning

This is a field that is focused on how machines can learn by experience and gain skills without human involvement.

Deep Learning

This is a subset of machine learning where artificial neural networks, which are algorithms inspired by the human brain, learn from large amounts of data.

Stock Market Analysis- Capital Asset Pricing Model

This model describes the relationship between expected return and risk for assets, mainly stocks. It is used in finance to price risky securities and finding expected returns for assets given the riskiness of them and the cost of capital.
$ERi = Rf + \beta i(ERm - Rf)$
ERi = Expected return of investment
Rf = Risk-free rate: accounts for the time value of money
βi = Beta of the investment: measure of how much risk the investment will add to the portfolio
>1: stock is riskier than the market
<1: stock will reduce the risk of a portfolio
ERm = Expected return of market
(ERm - Rf) = Market risk premium: This is the return expected from the market above the risk-free rate
Problems with this formula

- Price movements in both directions are not equally risky. Beta assumes that risk can be measured by the volatility of the price of a stock.
- Assumes that the risk-free rate will remain constant
- The market portfolio used to find the market risk premium is theoretical. Investors often use a stock index, like the S&P 500, to substitute for the market, which is an imperfect comparison.
- CAPM assumes that future cash flows can be estimated for the discounting process

CAPM and the Efficient Frontier

If an investor were able to use this model to perfectly optimize a portfolio's return relative to risk, it would exist on efficient frontiers

Arbitrage Pricing Theory (APT)

A multi-factor asset-pricing model that is based on the idea that an asset's returns may be predicted with the linear relationship between its expected return and some macroeconomic variables that examine risk.

The Formula for the Arbitrage Pricing Theory Model Is
$E(Rp)=Rf+\beta 1f1+\beta 2f2+\ldots+\beta nfn$

E(Rp)=expected return
Rf=risk-free return
The return if the asset had no exposure to any factors
βn=sensitivity to the factor of n
fn=nth factor price
Unlike the CAPM, which assumes markets are perfectly efficient, APT assumes that securities are sometimes mispriced.

Problems with this formula
- It contains multiple factors, while the CAPM only takes into account one factor, the market risk. This means much research is required to determine these factors.
- The factors are subjective choices, which yield varying results

Fama and French Three-Factor Model

This is an asset pricing model that expands on the CAPM, it adds size risk and value risk factor to the market risk factor in CAPM. It accounts for how value and small cap stocks regularly outperform markets.
Eugene Fama and Kenneth French researched many stocks and found two interesting observations
- That value stocks outperform growth stocks
- Small-cap stocks tend to outperform large-cap stocks
This model is the result of an econometric regression of historical stock prices.
This model highlighted that investors with a long term outlook of 15 years or more would be rewarded for short term losses.
r=Rf+ß(Rm-Rf)+ bs x SMB + bv x HML + α
Rf: the risk-free return rate
Rm: the return of the market portfolio.
SMB: Small Minus Big- market capitalisation
This is a size effect they identified, measuring the historic excess of small-cap companies over large cap.
HML: High Minus Low- book to market ratio
This is a value premium represents the spread in returns between companies with a high book-to-market ratio (value companies) and companies with a low book to market ratio.
This model explains over 90% of the diversified portfolio returns, compared to the average 70% given by the CAPM. Fama, E. F., French, K. R.. (1992)
In 2015, Fama and French added two additional factors to their 3 factor model. These factors were profitability (stocks of companies with a high profitability perform better) and investment (stocks of companies with high total asset growth have below average returns).
Although this is a development there still are many criticisms of the model
- It ignores momentum and low volatility
- The definitions of some of the factors are unclear and can be misinterpreted.

How analysts use these models?

Quantitative analysts research potential factors and examine the factor's significance on asset return: research is based on economic and financial theories, empirical study, or data mining. Analysts will rank stocks according to those factors and include the top groups into their portfolio.

The downside of factor models

Sisyphus pushing a boulder up the mountain only to have it roll back down is an analogy we compare to how factors that seem to perform well in the past can turn around and perform poorly the next period. Factors that seem to perform well in the past can turn around and perform poorly the next period. Analyst have to keep working the trial and error method and either come up with new factors or retest existing factors. When a factor that works stops working, they need to start all over again.

AI - "Artificial intelligence is to trading what fire was to the cavemen."

Algorithmic analysis of financial markets is not about placing individuals into boxes, it is about placing all people in the same box and interpreting their reactions and interactions. But the issue is that there is no single way to make trades in the stock market, each approach is slightly different.

How do people make decisions in the stock market? Some rely on news stories. Some rely on the reputation of the company, or whether they like the products they sell. Some look at fundamentals e.g. balance sheets, or rely on technical analysis. But in the end, why does not matter, what is the effect on the market? Mass psychology is a phenomenon shown very clearly in these analyses, people tend to follow the path of others and together they push the prices of the market in one direction or the other.

Algorithmic systems can take in years of market data and pinpoint patterns humans cannot observe, combining analysis of stock trends with human emotion and the movement of the market. Traders typically use fundamental and technical analysis to determine the best trades for their portfolio, but there is too much market data.

Kavout Corporation

This company develops artificial intelligence (AI) driven investment solutions for asset managers, hedge fund, buy-side traders and financial advisors. One of these solutions is Kai Score: this provides predictive stock ranking data powered by deep learning.

The Kai Score values factor based investing, Kavout groups their internal research into four categories: Quality, Value, Growth and Momentum, taking into account macro and micro market data and technical indicators.

They summarise it into a single number, a K Score, which assign stocks with scores from 1-9. The higher the score, the greater the probability of a stock going up in the next 30 days.

The key issue with the incorporation of AI and machine learning in assisting in asset selection is scale. The K Score is available in the US and China, but not yet elsewhere.

Epoque

Epoque's AI trading service has a slightly different approach to Kavout.

Their AI trading is a fully automated machine consists of three-interconnected engines

- Strategy Engine: observes and analyses potential trades
- Order Engine: create orders and perform operational actions
- Logical Engine: governs active orders and improves its own performance through machine learning

The benefits of Machine learning-based models to traditional statistical models

- Capacity to learn: ML models learn, adapt and improve their methods whereas traditional statistical models are static
- Number of variables: ML models can address thousands, even millions of variables due to advancements in computer power whereas traditional statistical models can only address a limited number of variables
- Ability to sift through 'noisy data': ML models can extract meaningful insights from unstructured, 'noisy' data like social media while traditional statistical models cannot

AI is still an emerging technology and thus has its disadvantages

- Cost: the creation and dispersion of smart technologies can be expensive and repair and ongoing maintenance costs
- Implementing and upgrading AI times are often lengthy
- Mistakes are hard to be accounted for, who is exactly to blame?
- Bias needs to be eliminated in AI created by humans

However, despite these downsides, the mass of historic data available on stock trading has huge potential to train these machine learning models.

The Future

Electronic trades account for almost 45% of revenues in cash equities trading, according to the UK research firm Coalition. There are several firms all over the world competing to make the most efficient AI trading service, the market is becoming rapidly more saturated. AI has truly changed how we look at stocks, but we need cooperation and synergy between human and computer in order to truly reach market efficiency.

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