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Machine Learning and Investing

Artificial Intelligence (AI) has come a long way since the days of the Mechanical Turk that defeated Napoleon Bonaparte and Benjamin Franklin at chess (a human chess master secretly operated the machine from inside), the world's first digital computers in the 20th century, or even the breakthroughs of the early 2000s.

Sceptics about the limits of AI used to find it wanting when comparing it with human intelligence, because of its inability to think for itself. It was, they argued, the unimaginative workhorse toiling for finer human minds imbued with creativity and judgement.

But this is no longer the case. Computer programs have developed an amazing ability to learn, since the scientist and cryptanalyst Alan Turing conceived the idea of a 'learning machine' in the middle of the last century. In recent years machine learning, a field within AI, has developed at breakneck speed. Underneath its more eye-catching and glamorous achievements, such as beating chess grandmasters – for real, this time, unlike the Mechanical Turk – lie more workaday successes that have made it an invaluable tool in industries as diverse as healthcare, autonomous vehicles and oil exploration and production.

Although machine learning has been used in financial services, it has been less widespread in investment management and more prevalent in other areas such as retail banking and the back-office systems of investment banks. To understand why this is the case, we need to think more deeply about what machine learning is. It uses statistical techniques on large amounts of data, either to learn how to perform a specific task, or to find patterns so that it can make predictions and solve problems. The predictions are based largely on finding relationships between variables in the past, asking what happened next, and using this to predict the future. These models automatically improve at this, through experience, with limited or no human intervention. With this technology, autonomous vehicles grow progressively better at anticipating danger, for example.

One might think that investment management would be among the first industries to use machine learning, since it is founded on making predictions to 'discover alpha' – almost every investment decision is based ultimately on speculating how the asset will perform.

Machine learning and investing: problems to overcome

However, many investment managers understand that in their industry, applying machine learning in a mediocre way is easy, but applying it well is a difficult business.

One problem is that the relationships between the variables that people use to make investment decisions tend to be less stable – financial time series are not stationary. To look at this in very top-down terms, a bank may go bust in one year without causing a protracted worldwide recession and the collapse of stock markets, but in another year a similarly sized bank collapse may trigger a collapse in the stock market too. Take the deliciously named Knickerbocker Crisis of 1907, when a bank of that name folded but the panic subsided within weeks. This is largely because John Pierpont Morgan locked the nation's leading bankers in his private library on New York's 36th Street until they agreed a rescue package for the financial system – at which point the dominoes stopped falling. A hundred years later the collapse of Bear Stearns set off a very different train of events – the dominoes kept tumbling until developed markets were in the throes of a deep and long crisis.

Another problem with applying machine learning to investment is that in this industry, the line between the relevant and irrelevant is blurred. For instance, an autonomous vehicle only has to consider what is happening on the road and the pavement but imagine a machine learning program applied to stock markets. It should consider pretty much everything going on in financial markets, but what about political events and social phenomena in countries where the listed company has no market? A nuclear war in Korea is clearly relevant to a domestic US retailer because it would hit equity markets around the world – investors do not need a machine to tell them that, and there are in any case no previous examples of two combatant nations using their nuclear weapons which the machine can learn from. On the other hand, imagine software finding that the S&P 500 moved in perfect and mysterious unison with the UK homicide rate, or rainfall in Wales, or tourist visits to New Zealand. Even the most ardent conspiracy theorist would be reluctant to use this correlation to make predictions about the future behaviour of most US stocks. The real difficulty lies, however, in working out whether much less clear-cut examples than these have any meaning.
A solution to this risk of letting trivia influence investment decisions is to opt for supervised machine learning, where the

investment manager tells the program to look for certain variables that seem relevant, based on common sense and past experience. If the investment manager is interested in US consumer-facing industries, they might tell it to look at rainfall and temperatures in highly populous parts of the US, which alter demand patterns. It might tell it also to examine weather in various emerging markets, which affects US corporate supply chains. But it would not set the program to look for rainfall in Wales, since not much Welsh produce ends up in US stores. This is different from unsupervised learning, where the machine looks at the relationships between all variables, rather than being told to seek specific things.

Machine learning advantages to investing

It is well worth confronting these thorny problems that spring up when applying machine learning to investment. This is partly because anything that is difficult to do well creates a barrier to entry, and barriers create competitive advantage for any investor with the agility or dedication necessary to jump over them. But there also has to be something beyond the barrier that repays the effort involved in vaulting it.

What makes the game worth the candle is the fact that machine learning has several edges over human intelligence. One advantage is that it can handle so much more data than human intelligence. Another advantage is that it is less subject to bias. Consider three analysts looking at the same stock. The first has a background as an economist, which makes him concentrate more than the others on the effect of interest rates. The second has a background in accounting, so she places greater weight on the company's profit and loss account and balance sheet. The third has the same expertise in accounting, but despite this his bias is still different from the second analyst's. Early in his career he audited a company that appeared perfectly healthy because of unrealistically optimistic accounting assumptions, but it went bust a few years later. Because of this, he considers company accounts with a more jaundiced and pessimistic eye than his colleague.

Even an analyst who bends over backwards to avoid the biases rooted in their career history cannot elude one inescapable problem: they are a human being, subject to common human frailties. The only certainties in life are death, taxes and bias. A common failing is projection bias, where an analyst is excessively optimistic or pessimistic when making an investment decision because they happen to be in a good or bad mood. Investors are also prone to disposition bias: when they need to release cash from a portfolio, they tend to sell an asset that has gone up in value rather than one that has declined, because they hate losing money on an investment. Instead of keeping a poorly performing stock in the hope of stronger performance in the future, they should be considering the characteristics of each stock in the here and now when deciding which asset to liquidate. The gains and losses up until the present moment should be irrelevant to this decision.

Machines are neither greedy nor fearful

Machine learning has none of these biases. Instead, it surveys information with the clear and cold eye of a desiccated calculating machine. In contrast to the maxim of Warren Buffett, it is not greedy when others are fearful, or fearful when others are greedy, because it does not feel either emotion. It is also more open-minded than most humans. Take the 2017 chess match between two machines, in which the winner, Google's AlphaZero, won after a series of moves that began with what looked like the pointless sacrifice of a bishop – something that few chess players, even at grandmaster level, would have contemplated[1].

Detractors of relying on AI often acknowledge these strengths, but argue that AI does not have the intellectual flexibility of human intelligence: unlike humans, it cannot educate itself. But this is precisely why machine learning is so exciting.

Like humans, it can grow wiser with experience. The difference is that to educate itself, it can digest data, and use it to modify judgements, at a pace that no human can manage.

AI is also getting better at educating itself. Firstly, it has more data to use as a learning resource, as the amount of digital data in the world grows exponentially: experts estimate that about 90% of all such data has been generated in the last two years[2]. Secondly, it is growing ever bigger teeth to crunch this information: Moore's Law, commonly cited by computer scientists, states that computer chip performance, a yardstick of the cost-efficiency of computational power, doubles every two years[3].

To sum up, machine learning is intelligent, flexible, unflappable and a quick learner. Because of these qualities, it deserves careful study by investment managers.

David Wickham
Global Head of Quantitative Investment Solutions

1 https://www.ft.com/content/ea707a24-f6b7-11e7-8715-e94187b3017e
2 https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/straight-talk-about-big-data
3 https://moneyweek.com/how-asml-is-profiting-from-moores-law/

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