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Carl Heinz Daube¹

Artificial intelligence in financial and investment decision-making

Abstract

The aim of this working paper is to provide a brief introduction to artificial intelligence and highlight specific potential applications in financial and investment decision-making. On the one hand, it is about where AI is already being used today in many areas of the financial industry. On the other hand, the aim is to show examples of what will be possible in the near future and where AI might lead to better, more sound decisions.

Zusammenfassung

Ziel dieses Working Papers ist es, eine kurze Einführung in die Künstliche Intelligenz zu geben und konkrete Einsatzmöglichkeiten in der Finanz- und Investitionsentscheidung aufzuzeigen. Dabei geht es zum einen darum, wo KI heute schon in vielen Bereichen der Finanzindustrie zum Einsatz kommt. Zum anderen geht es darum exemplarisch aufzuzeigen, was in naher Zukunft möglich sein wird und wo es auf der Basis von KI zu besseren, fundierteren Entscheidungen kommen könnte.

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1. Introduction and definition of terms

Artificial intelligence (AI) has been the subject of real hype ever since the San Francisco-based company OpenAI LP launched its ChatGPT product in November 2022. Just two months later, the application generated around 100 million monthly visitors, and within a year it had reached 1.5 billion.² With this growth, ChatGPT not only quickly entered the top 20 most used websites worldwide, but also became the fastest growing online application in history.³ Therefore, after about more than one year, it seems interesting to take a closer look at what AI can really do - especially for financial and investment decisions.

Artificial intelligence is a field of computer science that deals with the development of systems and technologies that have human-like cognitive abilities or can exhibit human-like behavior. The aim of artificial intelligence is to give machines and computers the ability to learn, solve problems, make decisions and perform tasks that would normally require human intelligence.⁴ The truth is, however, that following the general hype, many applications that were previously referred to as classical mathematics or conventional programme logic are now referred to as AI.

There are various approaches and techniques used in artificial intelligence, including machine learning, neural networks, natural language processing, expert systems and many others.⁵ These techniques enable AI systems to analyse large volumes of data, recognise patterns and correlations, acquire knowledge, generalise it and apply it to new situations.⁶

At this point, we will briefly discuss machine learning (ML). ML is an innovative approach in computer science that makes it possible to develop algorithms and models that can learn from experience. By analysing data, ML systems can recognise patterns and make predictions without being explicitly programmed. This interdisciplinary field combines concepts from statistics, computer science and mathematics to solve

²Cf. Reuters, 2023

³Cf. UBS Wealth Management, 2023

⁴Cf. Boming Huang, 2019, pp. 3-4

⁵Cf. McKinsey & Company, 2023

⁶Cf. Zhang & Lu, 2021, pp. 1-2

complex problems. Academic research in the field of machine learning focuses on the further development of algorithms, optimisation of models and application to diverse domains such as image recognition, speech processing and medical diagnosis. Ongoing research in this area is helping to improve the performance of ML systems and open up new areas of application, deepening our understanding of machine learning.⁷

Artificial intelligence has a broad definition that encompasses various disciplines and concepts. One discipline that already has various applications in the current state of the art is machine learning (ML). Machine learning attempts to emulate experiential learning in order to predict future outcomes. AI models are trained with large amounts of data to gain the ability to recognise patterns. This training can be done in a "supervised" form, by implementing an expected data output from the model, or in an "unsupervised" form, where the model learns without an extrinsic response. A special form of machine learning is deep learning, which uses neural networks with many layers (deep neural networks). This technology has made spectacular progress in recent years in areas such as image and speech recognition.⁸

Artificial intelligence is already being used in many areas of our daily lives. 9% of German companies actively use AI in their organisation, 25% are thinking about it.⁹ While AI systems can already perform impressively, they are currently still limited in their ability to mimic human intelligence in all aspects and face challenges such as ethics, privacy and security.¹⁰ AI systems do not have a comprehensive general intelligence like the human mind. The transfer of human ethical principles to AI systems is an important research question. The development of AI is progressing at a rapid pace.

Looking at financial and investment decisions at banks and companies, areas can be identified where AI can support and improve the quality of decision-making, but AI must

⁷Cf. Domingos, 2012

⁸Cf. Mahesh, 2020, pp. 1-3

⁹Cf. Bitkom Research, 2022

¹⁰Cf. Beck, 2019, pp. 3-15

be used responsibly and human oversight and expertise must be maintained to minimise potential risks.

2. Potential use cases and challenges

2.1 Risk management

AI can be used to develop risk models and identify potential risks in financial markets, credit portfolios or investment strategies. AI (machine learning) can analyse large amounts of data to identify patterns and correlations and create risk forecasts.¹¹

Investment firms are already using unsupervised algorithms to recognise new patterns and market networks. These algorithms often also show interconnections that were not previously in the awareness of the employees, which leads to a deeper investigation. Market impact costs or an over-networked portfolio could be prevented in this way.¹²

2.2 Automated trading systems

AI is used in algorithmic trading systems to analyse financial markets in real time and make automated trading decisions. These systems can generate trading signals and execute transactions based on AI algorithms.

For financial institutions: Increasing efficiency through automation for higher quality utilisation of customer information. This could enable a stronger focus on core tasks as a financial organisation while at the same time ensuring the best possible customer interaction at reduced capital costs.¹³

Artificial intelligence can provide support for high-frequency share trading. Machine learning can be used to evaluate information more quickly, categorise its implications and provide impetus for action.¹⁴

¹¹Cf. OECD, 2021, p. 22

¹²Cf. Lynn, Mooney, Rosati, & Cummins, 2019, pp. 41-43

¹³Cf. Arslanian & Fischer, 2019, pp. 180-181

¹⁴Cf. Arifovic, He, & Wei, 2019, p. 40

2.3 Lending and credit analysis

Additional regulatory requirements, increased complexity and the different weighting of risk factors have made lending more difficult in recent years. AI can support the evaluation of credit applications and credit risk assessment. By analysing financial data, payment histories and other relevant information, AI can help to make informed decisions about the granting of loans.¹⁵¹⁶ It has already been proven that machine learning can be very effective in this environment. In 2010, algorithms were able to lead to cost savings of 25% in tests.¹⁷ Recent tests with internal data from medium-sized banks continued to show machine learning as an effective tool for credit decisions and a way to save costs.¹⁸

2.4 Fraud detection

AI can help recognise fraudulent transactions and activities in real time. By learning patterns and deviations, AI can identify suspicious transactions and take appropriate action.

AI-based text models could be used for accounting purposes to analyse contracts and predict their expected tax types and recommend closer investigation in case of deviations. The UK Serious Fraud Office uncovered a case of corruption in this way. Artificial intelligence could translate, summarise and analyse up to 600,000 contracts a day.¹⁹

However, this possible application of AI is not yet problem-free. Large and stable amounts of data are required to train algorithms. The cases of fraud recognised each year (e.g. credit card fraud) are not yet sufficient to apply machine learning consistently. In addition, fraud cases usually involve non-standardised approaches, which requires an even larger amount of data.²⁰

¹⁵Cf. Arslanian & Fischer, 2019, p. 183

¹⁶Cf. Ralph, Weinland, & Arnold, 2018

¹⁷Cf. Khandani, Kim, & Lo, 2010, p. 11

¹⁸Cf. Figini, Bonelli, & Giovannini, 2017, pp. 91-97

¹⁹Cf. Bao, Hilary, & Ke, 2022, p. 242

²⁰Cf. Bao, Hilary, & Ke, 2022, pp. 226-227

2.5 Financial planning and analysis

AI-driven analysis tools can support companies with financial planning and forecasting. They can analyse historical data, model scenarios and provide well-founded forecasts of sales, costs and other key financial figures.²¹ Financial planners can also use Advance Analytics software without expert knowledge, as it is already integrated into individual Business Intelligence (BI) software solutions - for example, Jedox since 2020.²²

2.6 Data analysis

AI can analyse large volumes of financial data, while at the same time data needs to be fed into the system in a less structured way. Structures and correlation analyses are created automatically and are less subject to human interference. This factor in particular can reveal new impulses or patterns that are not recognised by conventional analysis methods, including historical price data, balance sheets, annual reports and news. By using algorithms and machine learning, AI can recognise patterns, trends and correlations that may be relevant for investment decisions.²³

2.7 Forecast models

AI can be used to develop forecasting models that attempt to predict future developments and performance of securities or markets. By analysing historical data and other factors, AI can help make informed predictions about the value of investments. Such predictions can be achieved through different AI models.

2.8 Sentiment analysis

AI can analyse social media posts, news articles and other information to understand the sentiment of market participants. By capturing positive or negative sentiment, AI

²¹Cf. Kögel, Spindler, & Wasserbacher, 2022

²²Cf. Gegenmantel, 2020, p. 45

²³Cf. Arslanian & Fischer, 2019, p. 181

can help to better assess the impact of news and public opinion on the value of investments.²⁴

2.9 Portfolio optimisation

AI can help optimise investment portfolios by taking into account various factors such as return, risk, diversification and liquidity. By analysing historical data and using optimisation algorithms, AI can help to find the best possible combination of investments. In contrast to the current possibilities of automated portfolio optimisation, the application of AI can not only execute "if-then" applications to optimise investment portfolios against predetermined rules, but can also learn from previous "positive" or "negative" transactions.²⁵

3. Conclusion and outlook

These examples may give a small insight into what is already possible with the support of AI in financial and investment decisions. The possible applications will improve and expand significantly in the near future. The current and future potential applications of AI ultimately affect all areas of life.

This will require further research. In 2023, research at the IUCF was clearly focused on AI and specific applications;²⁶ this path will also be consistently pursued in 2024. In addition, 2024 will be the year of productive AI use. Achieving the highest possible productivity effects by having many cognitive (routine) tasks performed by AI. The potential is huge: around a third of all office tasks can already be automated with today's technology. The impact of AI is going arrive to the labour market this year. For most office workers, this development primarily means a steep learning curve in order to learn how to use AI and increase their own productivity.²⁷

²⁴Cf. Liu, 2012, pp. 91-97

²⁵Cf. Aichele & Herrmann, 2021, pp. 172-174

²⁶Cf. Reinking & Becker, 2023

²⁷Cf. Schmidt, 2024

The German Federal Ministry of Education and Research is currently funding the research, development and application of AI as part of 50 ongoing measures. These will now be supplemented by at least 20 further initiatives in a targeted manner. In the current legislative period, the Federal Ministry of Education and Research will invest over 1.6 billion euros in AI.²⁸

²⁸Cf. BMBF, 2023

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