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# Artificial Intelligence in Fund Management

Bachelor thesis 15 hp  
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# Abstract

This thesis aims to contribute to the understanding of the benefits, limitations and future improvements of AI in fund management, it also tries to understand to what degree AI can substitute the human element. By conducting an extensive literature study and conducting interviews with professionals in the field this research shows how AI has many benefits that are already being implored but improvement is still needed until it will replace the human element. Ultimately our findings point towards that AI should be viewed as a tool rather than a complete substitution of humans.

**Keywords:** Artificial Intelligence, Fund Management, Behavioural Finance, Black-Box

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# 1. Introduction

In recent years, the investment management industry has undergone a significant transformation due to intensifying challenges such as limited organic growth, volatile capital market returns, and fee and margin compression. These challenges have made it increasingly difficult for fund managers to operate effectively and deliver value to their clients [16]. At the same time, the investment management industry has seen a rise in the development and application of artificial intelligence (AI) technologies. AI applications, such as algorithmic trading, portfolio composition, robo-advising, and stress testing, have become increasingly diverse and sophisticated [8]. However, as Fernández [22] highlights, AI is not a new phenomenon as it was first introduced in the 1950s. Its recent surge in popularity begs the question: what factors have contributed to this upswing? According to her, three primary reasons account for this trend: the growing volume of data available, increased data storage and computational processing capacity. The heightened interest in AI's transformative potential is evident from the actions of industry leaders. For instance, BlackRock, the world's largest asset manager, established the "BlackRock Lab for Artificial Intelligence" in 2018, indicating their commitment to AI research [16].

Given the mentioned challenges faced by the investment management industry, coupled with the rapid advancement of AI technologies, investigating the impact of AI on fund management becomes a compelling and timely research topic. The integration of AI in fund management has the potential to transform the way investment decisions are made, transforming traditional methods and offering innovative solutions to the industry's existing challenges. As financial markets continue to evolve in complexity, understanding the potential benefits and limitations of AI in investment management will be crucial for industry professionals, investors, and policymakers, making this thesis both interesting and highly relevant in today's dynamic financial landscape. The applications of AI, specifically in fund management, include a range of powerful tools and techniques: conducting sophisticated fundamental text analysis, optimizing asset allocation in financial portfolios, and providing more accurate estimates of returns compared to conventional methods. These improved estimates can be integrated into traditional portfolio optimization frameworks, enhancing their effectiveness and overall performance [4]. To fully understand the impact of AI in fund management, it is crucial to assess the extent to which AI can replace human expertise. While AI technologies have made significant advancements and brought numerous applications to the industry, the question remains: Can AI completely replace human judgment and intuition in fund management? AI excels at data analysis, pattern recognition, and algorithmic decision-making, offering advantages in terms of speed and accuracy. However, it is important to recognize that intuition, judgment, and qualitative assessments, are rooted in human experience and expertise [41].

In addition, the Swedish government published a guideline in 2018, which outlines Sweden's ambition to become a leader in AI adoption. This ambition demonstrates Sweden's commitment to promoting a thriving AI ecosystem and positions Sweden at the forefront of AI innovation [44]. Given this context, the Swedish investment management industry provides a unique and valuable case study to examine the implementation and impact of AI on fund management. By focusing on Sweden, our research can offer insights into the challenges and opportunities faced by Swedish fund managers as they navigate the rapidly changing landscape. This thesis will not only contribute to a deeper understanding of AI's role in the Swedish fund management industry but also shed light on the broader implications of AI adoption for the global fund management industry.

## **1.1 Aim of the Study**

The primary aim of this study is to examine the impact of artificial intelligence (AI) on fund management. The focus is on understanding how AI is currently used, as well as exploring the benefits, limitations, and potential areas for improvement in its application within the fund management industry. Additionally, this research aims to investigate the degree to which AI can substitute the human element in fund management. The insights gained from this study can help fund managers better understand the benefits and limitations of incorporating AI technologies into their investment strategies. This understanding can potentially lead to more efficient fund management, ultimately improving investment outcomes for their clients. Furthermore, this study can offer valuable insights to policy-makers and regulators regarding the implications of AI adoption in the fund management industry.

## **1.2 Problem Analysis**

The integration of AI in fund management creates a lot of new implications and potential challenges to the traditional decision-making process [4]. This section aims to provide a deeper analysis of the challenges that fund managers are facing and how the implementations of AI might provide a solution, discussing its impact on decision-making, potential benefits, and limitations, as well as the possible substitution of human involvement.

A challenge that fund managers face is dealing with the enormous amount of data available today and utilizing it effectively to make informed investment decisions. Given the abundance of data, this is not an easy task [38]. The available data includes crucial information, such as market trends, economic indicators, and company-specific risks, all of which are vital for making informed investment decisions. Traditional fund management approaches are often unable to process this data in a timely and efficient manner [15]. With the aid of advanced AI algorithms, large volumes of data can be processed at remarkable speeds, offering insights that were previously unattainable through human analysis alone [23]. AI-powered tools can automate repetitive tasks, freeing up time for fund managers to focus on higher-value activities. Additionally, AI algorithms can identify patterns and trends that could lead to optimized investment strategies, which may result in higher returns and reduced risk [4].

However, there are also potential drawbacks to consider. Over-reliance on AI technolo-

gies could lead to a sense of security among fund managers, reducing their critical thinking and decision-making capabilities [10]. Furthermore, AI systems can be vulnerable to cyber-attacks or data breaches, which may compromise sensitive information and disrupt operations [17]. Additionally, there are concerns regarding the interpretability of AI algorithms, which could limit the understanding of how these systems arrive at certain recommendations or predictions [26]. There are also questions regarding the reliance on AI-generated recommendations and the potential for biases or inaccuracies in the algorithms [37]. As a result, there may be concerns about the transparency and accountability of AI-driven decisions especially when they deviate from traditional methods or human intuition [1].

While AI-powered tools can offer valuable insights and perform complex analyses, they are still limited by their underlying algorithms and the data they are fed [18]. Human intuition, creativity, and experience play a crucial role in fund management, particularly in dealing with unprecedented market conditions, ethical considerations, and strategic decision-making [11]. Moreover, the financial market is constantly evolving, and fund managers must adapt their strategies accordingly, and as Bessen describes [5], The human ability to learn from experience, adjust to new information, and comprehend intricate market dynamics is difficult to replicate in machines.

### **1.3 Research Questions**

To achieve the purpose of the study, the following questions will be explored in-depth:

- To what extent is AI used today in fund management and, what are the potential benefits, limitations, and areas for future improvements of AI in this field?
- To what degree is AI capable of substituting the human element in fund management?

## **2. Methodology**

The study has adopted an exploratory approach. This approach is particularly relevant as it acknowledges the limited expertise in AI among the participants and the authors prior knowledge about the subject. As highlighted by Patel and Davidson [39] exploratory investigations aim to gather as much information as possible about a specific problem domain. They acknowledge the potential limitations in existing knowledge and endeavor to explore the problem area comprehensively. These exploratory studies play a vital role in establishing a solid foundation for further research, while also emphasizing the significance of creativity and innovation in their execution. To achieve this, an exploratory interview study was conducted with Swedish fund managers. Additionally, a literature review was conducted to support and complement the findings derived from the interviews. An exploratory approach was preferred over a quantitative study in this case due to the nature of the research and its emphasis on gaining in-depth insights and understanding the nuances of the research problem.

### **2.1 Literature Review**

The literature review includes a theoretical framework and previous similar research. The process involved searches on several relevant academic databases, including Web of Science, ResearchGate and Google Scholar. A combination of keywords and phrases, such as "artificial intelligence in fund management," "artificial intelligence in investment management," and "machine learning in asset allocation," were used to identify potentially relevant articles. Subsequently, the search generated a considerable number of articles, which were then subjected to screening based on their title and abstract. After the initial screening process, a select number of articles were chosen for review, with a focus on their relevance to the research questions and that they were peer reviewed. The review provides valuable insights into the current state of research on AI in fund management. The selected articles cover a range of topics, including the benefits and drawbacks of using AI in fund management. The purpose of the literature review was to gather a diverse range of sources and perspectives, enabling us to analyze the subject comprehensively. By drawing on a wide range of sources, the literature review informed our analysis and provided a comprehensive understanding of the field.



<b>Respondent:</b>	<b>Date:</b>	<b>Length:</b>	<b>Experience:</b>
1	5/5	45 min	Big Private Bank
2	4/18	50 min	Government Owned Pension Fund
3	5/4	30 min	Independent Fund, AUM < 100B SEK
4	4/6	50 min	Independent Fund, AUM < 100B SEK

Table 2.1: Interviews Information

## 2.2 Exploratory Interview Study

To gather interviews, we reached out to fund managers through email. Our initial contact list was compiled by conducting comprehensive searches on company websites and LinkedIn profiles. Out of the fifty individuals we contacted, we successfully secured four interviews. This response rate suggests that only a small proportion of the fund managers we reached out to ultimately participated in the interviews. To ensure that the interviewed individuals had significant experience in fund management, a minimum requirement of 5 years of experience in fund management was set. The participants were selected based on their relevance to the research questions through purposive sampling [9].

To gather the necessary data for this study, the method of exploratory interviews was utilized. The interviews were conducted via video call, with each session lasting about 30-60 minutes. A predetermined set of questions was used to guide the conversation, but follow-up questions were also asked to gain further insights and clarification from the participants. This approach provided valuable information, as exploratory interviews allow for a balance between structure and flexibility. They enable the exploration of research questions in-depth while still giving the participants the chance to express their unique perspectives and experiences [2].

The interviews were transcribed, with one of the authors asking questions and the other transcribing the responses. To interpret the results, a thematic analysis was employed as described by Braun and Clarke [6]. Overall, this involved identifying sections of the text to establish themes. Several themes emerged and were subsequently categorized, analyzed, and interpreted. Finally, the final results were summarized.

*The authors had no prior relationship with the respondents, and there were no incentives for the respondents to respond in any particular manner.*

## 2.3 Combining Results with Literature

To answer the research questions, the themes that emerged from the interviews were combined with the literature review. The literature review identified key themes related to the research questions and interviews which provided a broader understanding of the topic. By combining the themes identified from the interviews with the literature review, we aimed to provide a more nuanced understanding of the research topic and address the research questions.

The identified themes from the interviews were compared and contrasted with the existing

literature on the topic. This process involved examining the similarities and differences between the themes that emerged from the interviews and the themes that had been previously identified in the literature. Where there was a convergence between the themes from the interviews and the literature, we strengthened our confidence in the findings.

## **2.4 Ethical Considerations**

The interviews were conducted anonymously to ensure honest and open responses from the participants. Participants were informed of the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any time. They also provided informed agreement before the interview. The answers collected from the interviews were kept confidential and secure, accessible only by the researcher.

## **2.5 Limitations**

This thesis is subject to certain limitations, which should be considered in the interpretation of the results. First and foremost, the time constraints of this study impose restrictions on the amount of information that can be gathered. Additionally, the sample size for the study is limited to a specific number of interviews, and this could make it difficult to apply the findings of the study to a larger population. It is important to note that the participants do not possess specialized expertise in the field of AI and that the responses provided by the participants may not be entirely accurate or complete due to their non-expert status. Furthermore, their responses are based on their own opinions and experiences which could lead to a potential bias problem in our research. Therefore, the information and insights gathered from them should be interpreted with caution, considering their level of expertise. One limitation of the transcribed approach used was the potential for subjective interpretation. Nonverbal cues like gestures and facial expressions may be lost, and transcribers may unintentionally alter the text [39]. The focus of this thesis lies in the application of machine learning algorithms, particularly neural networks, deep learning and large language models, within the context of fund management. Consequently, other machine learning algorithms, such as linear regression models, logistic regressions, decision trees, and random forests, will not be extensively discussed. This limitation is imposed to maintain a clear and targeted focus on the research objectives and may influence the scope and depth of the analysis.

## **3. Theoretical Framework**

The theoretical framework examines key areas, including standard finance, behavioral finance, and artificial intelligence (AI). The purpose of this theoretical framework is to provide a strong foundation for the thesis and guide the investigation of the research questions. The theoretical framework is essential for the study, as it helps to understand the main ideas in the analysis sections.

### **3.1 Artificial Intelligence (AI)**

To fully comprehend the benefits and limitations of AI in fund management, it is essential to understand the mechanics behind AI. By exploring the underlying algorithms and decision-making processes used by AI systems, we can evaluate the reliability and effectiveness of AI-based approaches in fund management. Understanding the mechanics behind AI also enables us to address concerns related to transparency, interpretability, and ethical considerations associated with the use of AI in finance.

AI can be defined as an activity aimed at making machines intelligent. Intelligence is the quality that enables an entity to function appropriately and with foresight in its environment. The difference between an arithmetic calculator and a human brain is not one of a kind, but of scale, speed, degree of autonomy, and generality. The AI field always aims to advance machine intelligence by enhancing and scaling up the current capabilities of machines. The lack of a precise, universally accepted definition of AI has allowed the field to grow, blossom, and advance at an ever-accelerating pace [43]. In their study, Choi et al. [14] mention that AI is primarily focused on automating intellectual processes, utilizing techniques such as machine learning and deep learning to achieve its goals.

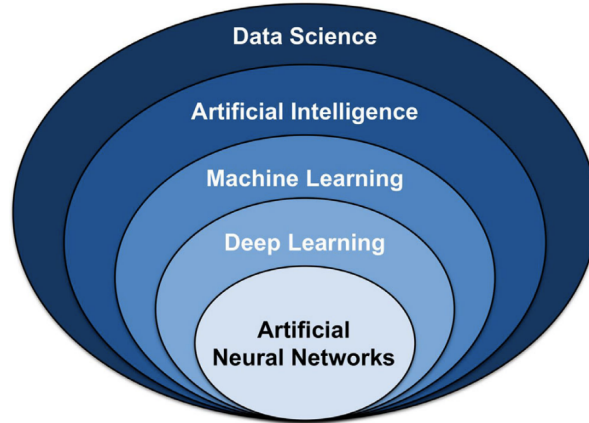


Figure 3.1: “Umbrella of select data science techniques. Artificial intelligence (AI) falls within the realm of data science, and includes classical programming and machine learning (ML). ML contains many models and methods, including deep learning (DL) and artificial neural networks (ANN).” [14]

### 3.1.1 Machine Learning

According to Park Wolf’s research [48], machine learning is a field that focuses on enabling computers to learn and improve automatically from data, without the need for explicit programming. Instead of giving computers specific instructions, machine learning allows them to acquire knowledge and make predictions or decisions based on patterns and examples they observe in the data. Machine learning includes a diverse range of algorithms, including Linear Regression models, Logistic Regression models, Decision Trees, and Random Forests. Within the field of Machine learning, two particularly powerful areas are Artificial Neural Networks (ANNs) and Deep Neural Networks (DNNs) [14].

### 3.1.2 Artificial Neural Networks

Artificial Neural Networks (ANNs) are computing systems inspired by the structure and functioning of the human brain. They consist of interconnected nodes, similar to neurons, that perform computations. Connections between nodes transmit signals, characterized by weights or connection strengths [19]. In their work, Bartram et al. [4] explain that ANNs are structured as feedforward layers. The input data is first passed to an input layer, and then it goes through several hidden layers before reaching the output layer. The weights of the connection are adjusted to minimize the errors between the predicted data and target data. After undergoing sufficient training, the network becomes capable of making predictions, even when it has not encountered the input data beforehand.

### 3.1.3 Deep Neural Network (DL)

Deep learning (DL) focuses on utilizing artificial neural networks. Deep networks are more complex and require more computational power compared to other neural networks. Not only do deep networks have a greater number of connections and neurons, but they also possess specific neurons that can actively influence the environment by triggering actions [42]. By employing multiple layers of interconnected nodes, deep learning models can learn to recognize intricate patterns and relationships within vast amounts of data [4]. In her analysis, Buchanan [8] highlights two benefits associated with deep learning. Firstly, DL is more resilient to overfitting compared to traditional machine learning approaches. Additionally, she exemplifies DL's unique ability to tackle non-linear events by citing market volatility as an illustrative example where conventional quantitative models necessitate manual adjustments.

Figure 3.2. Shows the difference between Artificial Neural Networks (ANN) and Deep Neural networks (DNN). As can be seen, DNN contains much more hidden layers than ANN.

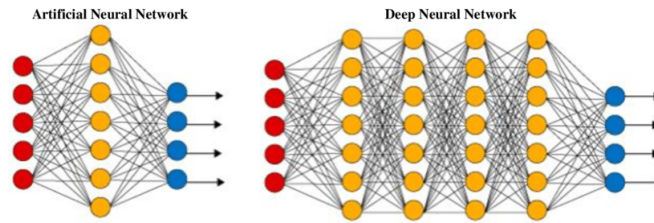


Figure 3.2: [35]

### 3.1.4 Natural Language Processing (NLP)

Natural Language Processing as described by Manning and Schütze [32] and Mitkov [34] in Bartram et al. [4] is a collection of computational methods designed to process or generate human natural language, encompassing both written text and spoken speech. These methods enable the processing and generation of human natural language in various forms, including converting spoken language to text, transforming text into audible speech, extracting meaning from spoken or written text, and producing natural language content from different data sources. To achieve their goals, many NLPs utilize the power of artificial neural networks, specifically deep learning techniques [4]. Large Language model (LLM) is a type of NLPs, designed to understand and generate human-like text. They are trained on vast amounts of text data, enabling them to generate responses, answer questions, and complete tasks in a context-aware manner. OpenAI's ChatGPT is an example of an LLM, showcasing the potential for LLMs in applications such as customer support and content generation [7].

## **3.2 Limitations to AI**

### **3.2.1 Black-box problem**

The black box problem in AI, as described by Arrieta et al., [1] refers to the lack of transparency and interpretability in the decision-making process of some AI models, particularly deep learning models. These models have complex structures with multiple layers of interconnected nodes and numerous parameters, making it difficult to understand their internal workings and trace back the factors that led to specific decisions or outputs. This lack of interpretability raises concerns about trustworthiness, bias, fairness, accountability, responsibility, debugging and improvement. Users may be less likely to trust AI models they don't understand. The inability to scrutinize decision-making processes makes it challenging to identify and mitigate biases or hold AI systems accountable for their consequences. Additionally, the black-box nature of these models complicates the identification and fixing of errors and model performance improvement. Arrieta et al., [1] emphasize the importance of explainable AI (XAI) in addressing these concerns and ensuring responsible AI development.

### **3.2.2 Ethical considerations**

The GDPR is a comprehensive data protection regulation that applies to all organizations processing personal data of EU citizens. Its primary aim is to safeguard privacy and personal data while giving individuals greater control over their information. The regulation poses challenges for organizations utilizing AI systems, particularly in ensuring transparency and explainability. Complex AI systems, such as deep learning algorithms, can be difficult to interpret, making it challenging for individuals to understand how their personal data is being used [25].

### **3.2.3 Limitations in Processing and Utilizing Data**

AI encounters certain limitations when it comes to comprehending large volumes of data. The complexity arises from the multitude of factors that need to be considered during information processing, making it challenging to identify the most relevant data points. Additionally, the systems may face limitations in accessing all the necessary information, which can hinder their ability to generate accurate predictions or make informed decisions. Furthermore, biases or errors in the data used can hinder the effectiveness of AI, further limiting their capabilities [47]. Another concern related to data is overfitting. Overfitting is a common challenge that can arise when dealing with AI. Described by Mutasa et al. [36], overfitting is when an AI model learns too many specific examples it was trained on and loses its ability to apply that knowledge to new, unseen data from the wider population.

## **3.3 Standard Finance**

Standard finance theory has been fundamental in shaping traditional portfolio management theories and practices [28]. The dominant theories in academic finance, known as standard or traditional finance, are based on the modern portfolio theory and the efficient market hypothesis [40]. Gaining a solid understanding of standard finance concepts helps acquire valuable insights into the methods that have shaped the field.

### **3.3.1 The Efficient Market Hypothesis**

The efficient market hypothesis, developed by economist Eugene Fama, posits that financial markets are highly efficient and that stock prices fully reflect all available information. According to this theory, it is impossible for investors to consistently earn above-average returns by using any sort of information or analysis that is publicly available because all such information is already reflected in the stock prices [20].

### **3.3.2 Modern Portfolio Theory**

Modern portfolio theory, introduced by Harry Markowitz in 1952 [33], is a framework for constructing investment portfolios that aim to maximize expected return for a given level of risk. The theory emphasizes the importance of diversification and suggests that by selecting assets with different risk and return characteristics, investors can potentially achieve higher returns while reducing overall risk. He introduces the concept of the efficient frontier which is a set of optimal portfolios that offer the highest expected return for a given level of risk [33]. The modern portfolio theory assumes that investors are risk-averse when choosing portfolios and that they only care about the mean and variance of their investment return. Markowitz claims that investors choose a portfolio to minimize the variance, given the expected return, and maximize the expected return, given variance. The portfolio model gives a mathematical requirement for the distribution of asset weights in a portfolio [21].

### **3.3.3 Critique of Standard Finance**

As mentioned, standard finance has always been considered the foundation of financial theory, offering a structure to analyze markets. However, it is important to carefully examine the limitations of standard finance given the complex nature of the global economy. This critique presents a different viewpoint that questions conventional wisdom, with the goal of enhancing our understanding of financial markets. By exploring alternative theories and challenging established beliefs, the aim is to provide another point of view of standard finance and its implications in a world where the global economy is more intricate than ever.

### **3.3.4 Adaptive Market Hypothesis**

According to the Adaptive Markets Hypothesis (AMH), financial markets are not always efficient and may exhibit periods of instability or volatility. Market participants are not always rational and may be influenced by psychological biases or emotions, leading to suboptimal decision-making and market inefficiencies. This is in contrast to the Efficient Market Theory, which posits that financial markets are highly efficient and that stock prices fully reflect all available information. The AMH suggests that markets are complex systems that evolve over time, and that market participants are constantly adapting to new information and changing conditions. The theory combines insights from traditional finance theory and behavioral finance and proposes that markets are not always in equilibrium and may exhibit periods of instability or irrational behavior [30].

### **3.3.5 Black Swan Event**

A Black Swan event is a rare and unpredictable event that can have a huge impact on society or an organization. According to Taleb [45], a Black Swan event has three main characteristics: it has a disproportionately large impact, its probability is difficult to predict, and it is often surprising because there are no obvious warning signs. Even if the likelihood of a Black Swan event is low, it can still have a significant effect. Because the probability of a Black Swan event is hard to calculate, it is difficult to prepare for it in advance. And since there are usually no warning signs, the event often takes people by surprise. Taleb mentions the terrorist attack on the World Trade Center, September 11, as an example of a black swan [45].

Traditional finance models assume rational behavior and efficient markets, and rely on historical data to make predictions about future market performance. However, Black Swan events are rare and unpredictable, and cannot be predicted using standard financial analysis. Alternative approaches such as behavioral finance and complexity theory recognize the influence of human behavior and non-linear market behavior, and may better account for rare and unpredictable events.



## **3.4 Behavioral finance**

Behavioral finance aims to shed light on how investors think and make decisions, taking into account emotional processes and biases that can influence their behavior. The field seeks to explain the human perspective of finance and investing, addressing questions such as what drives investors' choices, why they sometimes deviate from rational decision-making, and how these behaviors can affect financial outcomes [40]. Discussing behavioral finance in the theoretical framework allows us to better understand the influence of human behavior on investment decisions. This knowledge can help identify areas where AI can potentially mitigate the impact of human biases on investment decisions.

### **3.4.1 Confirmation bias**

Individuals often become emotionally attached to their investment beliefs and are resistant to accepting evidence that contradicts their beliefs. As a result, they may take risky bets and hold onto them even as the investments begin to decline. This behavior can be attributed to confirmation bias, which occurs when people seek out and prioritize information that supports their existing beliefs while disregarding or discounting information that challenges their beliefs [13].

### **3.4.2 Overconfidence**

A lot of studies have shown that people often are overconfident, particularly when it comes to the precision of their knowledge [24]. Research has shown that overconfident behavior is associated with excessive trading and can result in poor investment returns. In addition, it can cause investors to neglect the proper diversification of their portfolios [3]. In addition to excessive trading, overconfidence contributes to an increase in investors' confidence in their own opinions. This heightened self-assurance can sometimes lead them to disregard or undervalue the viewpoints of others, ultimately resulting in a greater heterogeneity of beliefs among investors [46].

### 3.5 Previous Research

Similar research has been conducted in the field of artificial intelligence and its potential impact on financial management. A study by Lopez-Lira and Tang [31] focused on the potential of ChatGPT, a large language model, to accurately forecast stock market returns using sentiment analysis of news headlines. They used ChatGPT to determine whether a headline is good, bad, or irrelevant news for firms' stock prices and computed a numerical score. The results showed a positive correlation between these "ChatGPT scores" and subsequent daily stock market returns.

The study also compared ChatGPT's performance with traditional sentiment analysis methods from a leading vendor, finding that ChatGPT outperformed these methods in predicting stock market returns. This suggests that advanced language models like ChatGPT can provide more accurate insights into market dynamics and enhance the performance of quantitative trading strategies.

Another study by Hansen and Kazinnik [27] investigated the ability of GPT models to classify the policy stance of Federal Open Market Committee (FOMC) announcements, which are known for their technical language or "Fedspeak." The authors found that GPT models demonstrate strong performance in classifying Fedspeak sentences, especially when fine-tuned, surpassing the performance of other popular classification methods.

However, the paper also notes that GPT-3 is not flawless and may still misclassify sentences or fail to capture nuances that a human evaluator with field expertise might capture. Despite this limitation, the authors suggest that GPT models can serve as a highly valuable tool for assisting researchers and analysts in this domain, providing a means for analyzing complex financial language and improving classification accuracy.

The research paper by Hyungjin Ko and Jaewook Lee [29] investigates the capacity of ChatGPT, a sophisticated language model, to assist portfolio management regarding asset allocation and diversification. The authors use Modern Portfolio Theory (MPT) as the basis for their quantitative methodology and assess the diversification effect of the model's choices. They find that ChatGPT's selections show a statistically significant improvement in the diversity index compared to randomly selected assets.

The study suggests that ChatGPT has the potential to function as a valuable assistant for portfolio management in the financial industry, offering relevant insights into its flexibility as a tool for portfolio management and emphasizing its ability to improve investment decision-making. However, the authors concede that their findings rely on historical data and may not necessarily be predictive of future outcomes. As such, they recommend additional research focusing on the long-term validation of ChatGPT's use in portfolio management and exploring its potential impact on asset pricing determinism.

This paper represents an important advancement in the exploration of AI applications in finance and lays the groundwork for future research on the subject matter, particularly in relation to the long-term effectiveness of ChatGPT in portfolio management and its connection with Modern Portfolio Theory.

By demonstrating the value of large language models in financial economics, these studies together contribute to the growing body of literature on the applications of artificial intelligence and natural language processing in finance.

The literature review by Bartram, Branke, and Motahari [4] provides a comprehensive overview of the current state of AI in asset management. The authors highlight that AI has the potential to significantly improve investment decision-making and portfolio management. They discuss various AI techniques such as machine learning, natural language processing, and deep learning, and their applications in asset management.

The review finds that AI, particularly artificial neural networks (ANNs), can be used to analyze large amounts of data quickly and accurately, which can help identify patterns and trends that may not be apparent through traditional analysis methods. They list this to be one of the reasons why ANNs is such a popular technique to estimate stock returns and company fundamentals. Moreover, they find that ANNs are also useful for constructing asset allocations with highly complex constraints, and they can effectively solve what are known as multi-objective optimization problems. Additionally, AI can help automate certain tasks such as data collection and analysis, which can save time and reduce costs. Overall the authors agree that AI is a tool that can automate certain workloads of portfolio management, leading to more informed investment decisions and improved portfolio management.

However, the authors also discuss the challenges associated with implementing AI in asset management. One major challenge is ensuring the quality of data used for analysis. Another challenge is addressing ethical concerns related to using AI in investment decision-making. They also conclude that AI is far away from replacing the human factor completely.

Buchanan [8] provides a comprehensive review of the current state of artificial intelligence (AI) in the financial services industry. The paper discusses how AI, including machine learning and deep learning, has the potential to disrupt and refine the existing financial services industry. The author reviews the existing academic, professional, and policy-related AI literature.

The paper highlights four ways in which AI is changing the financial services industry: fraud detection, banking chatbots, algorithmic trading, and regulatory and policy aspects. The author notes that AI can be used to detect fraudulent activities by analyzing large amounts of data in real time. Banking chatbots can provide customers with personalized assistance and improve customer satisfaction. Algorithmic trading can help investors make better decisions by analyzing market trends and predicting future prices. Finally, regulatory and policy aspects are important considerations for financial institutions as they adopt new technologies.

The paper also discusses various challenges associated with using AI in finance, such as data quality issues, ethical concerns related to privacy and bias, and regulatory compliance requirements. The author notes that these challenges must be addressed to ensure that AI is used responsibly in the financial services industry.

## 4. Results

This chapter presents the results of the interviews we conducted with four professionals in the field of fund management, as described in the method we approached the interview with a exploratory method and the questionnaire used to guide the interviews can be found in the appendix. To ensure the anonymity of the respondents, a gender-neutral approach has been adopted by referring to them as "they" and "their" instead of using gender-specific pronouns such as "he" or "she".

### 4.1 Respondent 1

This person has a five-year background as an asset manager, specializing in the valuation of various asset classes, including listed and OTC derivatives. Currently, focus is on managing portfolios of listed stocks in the Swedish and Nordic markets working at one of the bigger private banks in Sweden.

**Experience with working with AI:** Currently, the firm that the fund manager works for does not generally utilize generative AI or LLMs in their day-to-day work. Most of their operations are conducted on an individual level. While curious fund managers may choose to use such technologies, some more traditional individuals prefer not to adopt them. The respondent is using ChatGPT to handle news flow. The respondent also uses Neural Networks to analyze text from quarterly reports, which aids in generating insights, but mentions it's just a piece of the puzzle of fund management. The respondent has managed more quantitative top-down portfolios in the past without the use of AI, which was also just a piece of the puzzle. According to the respondent's viewpoint, the focus lies on optimizing tracking error rather than the Sharpe ratio, particularly in the context of bottom-up fundamental funds. Notably, they highlight that portfolio optimization and weight adjustments are carried out without the use of computer algorithms or automated processes. Instead, a more traditional approach is followed, emphasizing fundamental analysis and human decision-making in managing the portfolio.

**Benefits of AI:** The respondent sees the clear benefits of AI as being able to handle more work with the same time resources, comparing it to the transition from washing clothes by hand to using a washing machine. "Employing more niche models is considered advantageous for achieving better results in data and news analysis, as it leads to more accurate and tailored outputs." According to the manager's perspective, there are specific use cases where AI can provide significant benefits. One such example is when there is a major macroeconomic release of an obscure figure from the United States, and the reported value deviates by 10% from the predicted value. "Understanding the underlying factors

that contribute to this deviation can be complex and time-consuming.” However, the manager believes that employing generative AI models can offer a distinct advantage in such scenarios. These AI models have the capability to swiftly comprehend and analyze the implications of the unexpected deviation

**Limitations of AI:** The downside, according to the respondent, is that AI is a black-box. As fund management is a trust business, it’s important for investors and authorities to understand what the manager is doing. ”It’s challenging to sell an investment model when no one understands how it works. Even models that have won the Nobel Prize may not be good enough to be understandable and sellable to clients.” The manager identifies a potential issue with utilizing AI in direct customer data analysis, which could present even greater challenges in light of GDPR regulations. The respondent gives an example about the regulatory limitation that they see. They explain that in the financial industry, especially in Sweden, regulatory bodies demand extensive documentation for significant investments. However, if AI is employed in the process, there is a risk of not being able to produce the required documentation promptly upon request. For instance, let’s consider a case involving the pension fund Alecta and Silicon Valley Bank. In this scenario, the financial regulator demanded comprehensive documentation from Alecta regarding their investment decision. They needed to know who made the decision, why it was made, and when it was made. If the necessary documentation cannot be produced and archived using AI, there is a potential risk of being unable to provide satisfactory answers to these inquiries. Moreover, the regulatory authority requires responses within a stringent 24-hour timeframe.

**General thoughts:** According to the respondent’s perspective, in portfolio construction, AI is not required at present. They believe that the human factor plays a crucial role. From their viewpoint, incorporating AI in this process is not currently necessary, especially in the short term. According to the respondent, the next steps in making AI better suited for fund management involve the introduction of specialized LLMs, such as Bloomberg GPT. They believe that leveraging these dedicated LLMs will significantly enhance the capabilities of AI in fund management practices. The manager believes that in the future, there may be better alternatives than solely relying on traditional metrics like Beta and P/E ratios. They think that machine learning models could potentially uncover other models that provide superior insights and decision-making capabilities. The respondent believes that the industry as a whole is slow-moving and conservative. The respondent notes that individuals holding top positions in the industry are generally over 50 years old. The respondent believes that the reluctance and lower interest in adopting AI may be rooted in a generational gap. They anticipate that the willingness and interest to invest resources in understanding and implementing AI will increase with the arrival of new generations.

## 4.2 Respondent 2

The respondent is experienced in utilizing quantitative methods for fund management. Their expertise lies in applying quantitative analysis techniques to optimize portfolio strategies, assess risk, and make informed investment decisions. The respondent has been working in the industry for over 20 years. The respondent works at a government owned pension fund.

**Experience with working with AI:** The respondent work extensively with strategy, algorithmic strategies, and various types of logic. They have experimented with different AI approaches in capital management, including partially developed ones in Python, Anaconda, Orange, and various types of code. They have also used ToggleAI and simple algorithms. Additionally, they have utilized ChatGPT to write all text and draw conclusions, leveraging a significant amount of data. Additionally, they have invested in various strategies developed by asset managers who have also explored the application of AI. However, the respondent has not witnessed notable traction or significant results from their AI undertakings in the field of capital management. In their fund management approach, the respondent primarily utilizes Modern Portfolio Theory (MPT) as the cornerstone, minimizing variance as a key objective. In their portfolio management process, the respondent calculates the returns and risks of each portfolio. They analyze the efficient frontier and they select a risk level from the range of efficient frontier portfolios that aligns with their investment objectives.

**Benefits of AI:** AI can provide valuable assistance in analyzing data, helping us uncover insights that may not be readily noticeable according to the respondent. They also think it can help us identify important data points and highlight relevant aspects that are worth investigating. Additionally, the respondent finds Language Models (LLMs) and specifically ChatGPT to be highly valuable tools. The respondent believes that in the future, AI will have the capability to identify all patterns within the data and examine it in a much more comprehensive manner. They anticipate that AI will provide remarkable degrees of flexibility and freedom in data analysis. AI will also provide excellent support in personal decision-making, according to the respondent's perspective. In the future, the respondent believes that AI will be able to handle the strategic allocation process and optimization. They envision a comprehensive AI system that can oversee and integrate all the necessary components. Although it may be difficult to achieve this level of integration at present, the respondent expects it to be the solution in the future.

**Limitations of AI:** One big challenge that they see is that a substantial amount of data is required for AI to function effectively. The respondent explains there is data available dating back to 1948 for macro-level analysis, and there is also longer-term data for the S&P 500, among other sources. However, overall, there is a scarcity of data to utilize and derive meaningful insights from which give biased solutions. They emphasize the need for more detailed data, such as tick data (data recorded at regular intervals like every hour, second or every minute), which is not readily accessible to many. Eventually, as this data becomes more widely available, the respondent believes we will witness significant advancements. They mention that currently, the "big three" investment banks have access to this data (tics data), but access to such data is not widely available. The overfitting problem remains a challenging issue to solve. They highlight the need for more robust methods to prevent algorithms from overfitting and to incorporate penalties that keep them

in check.

Furthermore, the respondent believes how the reliance on Chat GPT for generating insights introduces the risk of providing inaccurate responses, necessitating thorough fact-checking. "If one solely relies on an algorithm that objectively examines unbiased data, it may explore all possible solutions and experiment without knowing which one is the correct solution, resulting in a corner solution." They proceed and say that the risk arises when everyone operates under the same assumptions and is aware of the presence of overfitting bias. In such cases, since the data is the same for everyone using it, there is a possibility that everyone will end up converging on the same answer. This can lead to a situation where everyone is essentially chasing the same opportunity, as AI technology produces identical conclusions that everyone tries to implement as quickly as possible. The respondent thinks that AI will not be able to imitate specific aspects of human thinking that involve emotions, which have some influence on the market, particularly during the fast changes and short time periods that happen in daily trading. The complex interaction between human thoughts, personal experiences, and emotional reactions introduces a level of difficulty in capturing it accurately within AI systems.

**General thoughts:** The respondent holds a strong optimism towards the future of AI, acknowledging that while the technical aspects are continuously evolving, the current state of AI is not yet fully mature. The respondent envisions a future where AI systems will greatly enhance decision-making processes, leverage vast amounts of data, and deliver valuable insights.

### 4.3 Respondent 3

This Respondent has 20+ years of experience working as a fund manager and portfolio manager with focus on Swedish markets. The respondent is working at an independent fund.

**Experience with working with AI:** "Regarding AI, there isn't a fixed strategy. Each person uses it in their own way, based on their individual requirements." The respondents' usage mostly includes platforms like Bloomberg and other systems. The respondent leverages data similar to other entities, as is the norm. The respondent firm, in their day-to-day work as fund managers, does not prioritize metrics like the Sharpe ratio. Instead, they focus on optimizing their active share. The respondent has explored the use of ChatGPT in the early stages, however to a limited extent, recognizing its potential without complete certainty.

**Benefits of AI:** The respondent believes AI can be helpful but doesn't see it as a complete solution. They favor a combination of human and machine. They saw the advantage of AI as providing access to pure information that would be impossible for them to gather manually, such as insights obtained from large data sets. A major part of the respondent's work in fund management involves gathering relevant information and using it effectively. With advancements in data management, there is now a wealth of data accessible to everyone. In this regard, the respondent highlights the importance of utilizing the right information among the abundance of data. They emphasize the need to extract meaningful insights and make informed decisions based on the most relevant and valuable information available. When asked about whether he considers himself prone to cognitive biases when extracting

the information, the respondent acknowledges that cognitive bias is a valid concern and a challenge they face. While extensive experience can be advantageous, it can also present disadvantages. This is where AI could potentially offer assistance. They often engage with analysts who hold entirely different opinions, and the respondent thinks that AI would be a valuable tool in mitigating biases and enhancing decision-making processes. They also highlighted the significance of learning to ask AI the correct questions and acknowledged that there will be a learning curve involved. The respondent believes that those who can acquire this skill will gain a notable advantage.

**Limitations of AI:** The respondent brings attention to the skillful process of uncovering promising companies to invest in, emphasizing that it involves a blend of art and expertise. They believe that the market operates in a complex manner that cannot be completely controlled by either AI or humans. In their view, as more people attempt to solve the mysteries of AI, there is a risk of AI identifying patterns that mistakenly suggest certain outcomes based on past events. However, the respondent argues that the current landscape differs significantly from historical norms, especially during times of crisis.

When it comes to implementing AI, the respondent points out the significant challenge posed by regulatory constraints. “Introducing a computer system to the Financial Supervisory Authority is not as simple as it may seem, as the authority requires detailed information about a person’s identity, work history, and tax compliance. Following regulations is crucial when using AI for regulated activities.” The respondent also notes the lack of clear guidelines currently, which makes the use of AI more complicated.

In addition, the respondent highlights a potential drawback related to data quality. They express concern that incorrect or flawed data may be obtained, and many models may not meet the necessary quality standards. This could lead to fund managers relying on ineffective functionality. Furthermore, the respondent acknowledges the presence of internal regulations regarding data handling and storage. Although these measures have not been utilized yet, the respondent believes that they will be implemented in the future to ensure responsible data management practices.

**General thoughts:** In fund management, the respondent believes that some roles will disappear. They think that certain funds have poor structures and are inefficient, often due to having too many employees. Additionally, the respondent anticipates that AI potentially will take over these jobs with excessive staffing, leading to a more efficient operation. The respondent sees the potential for AI to influence the fees they can charge and foresees the disappearance of some roles due to AI, but they didn’t seem overly concerned due to their organization’s efficient structure. They concluded by stating that while it is early days, they believe AI will improve the quality of their work. Regarding the topic of fees on managed funds, the respondent highlights that there are existing indices that set a minimum fee level. In this regard, the respondent argues that some people prefer human-led management and are willing to pay higher fees for it. This preference arises from the understanding that human decision-making is not always as rational as often believed.



## 4.4 Respondent 4

This respondent has 10+ years of experience working as a fund manager with focus on Swedish and Nordic markets. The respondent is working at an independent fund.

**Experience working with AI:** AI is not yet included in the investment process. The respondent believes that there are now tools emerging that are applicable and can have the potential to be utilized effectively. They currently employ traditional quantitative screening, which has been in use for a long time. However, they have started exploring AI but have not made any conclusive decisions. OpenAI is the first AI tool they have been able to utilize. Their company is actively involved in developing their own AI models specifically tailored to analyze company-specific data related to sustainability.

**Benefits of AI:** The respondent recognizes several advantages of AI in the context of fund management. They believe that AI is not only capable of reading, processing, and connecting historical events but also excels in solving complex puzzles by linking various sources of information, such as company news, macroeconomic factors, and more. This puzzle-solving ability of AI allows it to uncover patterns and insights that greatly contribute to informed decision-making. Additionally, the respondent emphasizes that AI can significantly benefit risk functions and copyrighting within the industry. Furthermore, they acknowledge AI's capacity to efficiently sort and organize text and information, making it more accessible and actionable. According to their perspective, these capabilities closely align with the needs and requirements of the fund management industry.

**Limitations of AI:** As of now, the respondent considers AI to be in a very immature state. They note that the training data for ChatGPT only goes up until 2021, highlighting the limitation of real-time usage which is the data they need. This is viewed as a significant disadvantage. The respondent also raises concerns about source credibility and confidentiality, identifying them as two other drawbacks.

Furthermore, the respondent points out that the available data is quite limited and noisy, leading to questions about how well AI can sort through and analyze such data. While the respondent strives to avoid bias in their personal decision-making process when selecting a company to invest in, there remains a concern about the potential for bias introduced through the programming of the AI system itself. Although the respondent may make conscious efforts to overcome biases such as confirmation bias by using AI, it is important to recognize that the AI's algorithms and models are developed by individuals who may unintentionally introduce their own biases during the programming phase. The respondent is doubtful about how well AI performs in fully managing investment funds within fund management. They mention several cases where funds using AI have tried but failed to achieve long-term success.

**General Thoughts:** The respondent recognizes that AI is a concept that combines both new and old technologies, with recent advancements offering more widely applicable tools. However, they believe that AI is still in its early stages. Within the broader context of fund management, the respondent highlights that it encompasses much more than simply buying stocks. "It involves various tasks such as bookkeeping, reporting, and risk management functions." In particular, the respondent believes that AI will greatly benefit risk functions, enabling more efficient and effective risk assessment and mitigation strategies. Furthermore, the respondent predicts that the copyrighting function within a

fund company will witness significant changes due to the influence of AI. They anticipate that AI will gradually replace human involvement in writing texts related to the fund's activities, such as marketing materials, reports, and other content. They primarily view AI as a tool rather than a complete replacement for human decision-making. They emphasize that human behavior and decision-making, especially within companies, are factors that AI might not fully capture. Therefore, active management will still require human interaction.

## 5. Analysis

This chapter examines the interview results and connects them with the literature review to answer our research questions. By combining these sources, we aim to provide a comprehensive analysis for this thesis.

### 5.1 To What Extent is AI Used in Fund Management Today?

The extent to which AI is utilized in fund management varies among different respondents. The literature review by Bartram, Branke, and Motahari [4] provides a comprehensive overview of the current state of AI in asset management, highlighting its potential to improve investment decision-making and fund management. It discusses various AI techniques such as machine learning, natural language processing, and deep learning, which align with the experimentation and exploration mentioned by respondent 2. Respondent 1 mentions that their firm primarily relies on traditional methods and does not extensively use generative AI or LLMs. However, the respondent do use Neural Networks for analyzing text from quarterly reports as a complementary tool in fund management.

Respondent 2 has experimented with various AI approaches, including Python, Anaconda, and ToggleAI, but has not witnessed significant results of using it. Respondent 3 highlights that the usage of AI varies from person to person. They have explored the use of ChatGPT in the early stages but to a limited extent, acknowledging its potential without complete certainty. Respondent 4 acknowledges that AI is not yet integrated into their investment process. However, they have started exploring AI and have not reached conclusive decisions. They have been able to utilize OpenAI ChatGPT as their first AI tool. Additionally, their company is actively involved in developing AI models that are specifically designed to analyze company-specific data related to sustainability. In light of these perspectives, it can be inferred that while some fund managers have embraced certain AI techniques, the overall adoption and integration of AI in fund management appear to be limited at present.

## **5.2 The Potential Benefits of AI in Fund Management:**

This subsection will present the benefits of using AI based on insights gathered from the interviews and literature review. The identified areas include extracting meaningful context, portfolio optimization, and addressing cognitive biases.

### **5.2.1 Extracting Meaningful Context**

It appears that there is a consensus among the respondents and the previous research regarding the advantages of AI in extracting meaningful information from big data and drawing meaningful conclusions. Respondent 1 emphasizes the ability of AI to handle more work with the same time resources. In addition they also see AI as particularly advantageous for understanding underlying factors. Respondent 2 and Respondent 3 highlight the advantage of accessing and utilizing large datasets that would be difficult to gather manually. Respondent 4 further supports the notion that AI can solve complex puzzles and uncover patterns and insights, contributing to informed decision-making. The previous research mentioned also aligns with these perspectives. The study by Hansen and Kazinnik [27] demonstrates the strong performance of GPT models in classifying technical language, surpassing other classification methods. The literature review by Bartram, Branke, and Motahari [4] highlights the use of artificial neural networks (ANNs) for analyzing large amounts of data quickly and accurately, enabling the identification of patterns and trends that may not be apparent through traditional analysis methods.

### **5.2.2 Portfolio Optimization / Construction**

Research by Bartram, Branke, and Motahari [4] suggests that Artificial Neural Networks (ANNs) can be valuable for constructing asset allocations with complex constraints and solving multi-objective optimization problems. Respondent 2, in line with this view, analyzes the efficient frontier and selects a risk level from the range of efficient frontier portfolios that aligns with their investment objectives. They believe that in the future, AI will play a crucial role in handling the strategic allocation process and optimization, envisioning a comprehensive AI system that integrates all necessary components. Supporting this perspective, a recent research paper by Hyungjin Ko and Jaewook Lee [29] highlights the potential of AI, specifically ChatGPT, as a valuable assistant for fund management. The study demonstrates that ChatGPT's selections improve the diversity index significantly compared to randomly selected assets, enhancing investment decision-making. This suggests that AI tools like ChatGPT can provide relevant insights and flexibility in fund management.

### **5.2.3 Cognitive Bias**

Respondent 3 acknowledges their vulnerability to cognitive bias during the process of extracting information. They recognize cognitive bias as a genuine concern and a personal challenge they confront. While extensive experience can offer advantages, it can also present disadvantages when evaluating investments. This experience can be associated with overconfidence, as described by Gervais and Odean [24], particularly in terms of the precision of their knowledge, which has been found to result in poor investment returns.

Additionally, this highlights the connection to confirmation bias, as explained by Cheng and Chu [13], wherein individuals tend to seek and prioritize information that aligns with their existing beliefs while disregarding or discounting contradictory information. Respondent 3 believes that this is an area where AI could provide valuable assistance. The respondent finds value in actively engaging with analysts who hold diverse opinions, and they perceive AI as a valuable tool for mitigating biases and improving decision-making processes.

Respondent 4 provides an alternative perspective, suggesting that while AI has the potential to mitigate bias, it is important to consider that the algorithms and models employed in AI are developed by individuals who may unintentionally introduce their own biases during the programming phase. Despite the respondent's conscious efforts to overcome biases such as confirmation bias through the use of AI, the presence of potential biases within AI systems cannot be overlooked. Furthermore, Respondent 2 underscores the risk that arises when all individuals operate under the same assumptions and are aware of the presence of overfitting bias. In such cases, where the data is identical for all users, there is a possibility that convergence on a single answer will occur. This situation can lead to a scenario where everyone essentially pursues the same opportunity, as AI technology generates identical conclusions that everyone seeks to implement rapidly. In line with this, Trehan [46] suggests that heightened self-assurance resulting from overconfidence can lead individuals to disregard or undervalue the perspectives of others, ultimately contributing to greater heterogeneity of beliefs among investors.

## **5.3 The Limitations of AI in Fund Management:**

This subsection will present the limitations of using AI according to the interviews and literature review. The identified areas include: black-box problem, limited by data and black swan.

### **5.3.1 Black-Box Problem**

The black-box problem is a significant concern in the field of artificial intelligence (AI), as revealed in the results interview study. This problem is particularly relevant to Deep Neural Networks, where the increasing complexity due to additional hidden layers makes it difficult to comprehend how these models arrive at their outcomes. Respondent 1 emphasized the trust-based nature of the business and the stringent regulatory policies that govern it. Fund managers are required not only to comprehend their actions and rationales but also to articulate them to investors and regulators promptly. These regulations often demand the provision of detailed information within tight deadlines, such as individuals' identities, employment histories, and tax compliance. Such regulatory constraints make it challenging for fund managers to rely on processes they cannot fully understand and explain to the regulators.

Furthermore, the conservative nature of the fund management industry, as described by respondent 1, can impede the timely adaptation of regulations to address these concerns. This observation is supported by Buchanan's comprehensive review of the current state of AI, which underscores the importance of regulatory and policy aspects for financial institutions as they adopt new technologies. Another obstacle arising from the lack of

complete understanding of AI models is the compliance with regulatory frameworks like the General Data Protection Regulation (GDPR), as noted by respondent 1. Specifically, respondent 1 mentions potential issues with utilizing AI in the analysis of direct customer data, as the complexity and interpretability challenges of deep learning systems make it arduous to discern how personal data is being utilized which is supported by Goodman and Flaxman in their paper “European Union Regulations on Algorithmic Decision-Making and a ‘Right to Explanation’” [25].

### **5.3.2 Limited by Data**

Respondents 2, 3, and 4 collectively emphasize the crucial importance of data as a critical factor to consider. Respondent 2 expresses concern about the scarcity of data available to derive meaningful insights from and the bias that can result from limited data. They highlight the need for more detailed data, such as tick data, which is not widely accessible to many. This poses a new challenge of determining which data to utilize and ensuring its accuracy. This uncertainty about the correct solution can result in a corner solution, where decision-makers struggle to make informed choices. They also raise the issue of overfitting, emphasizing the need for robust methods to prevent algorithms from overfitting and the incorporation of penalties to keep them in check. This concern is strengthened by the issue of overfitting, described by Mutasa et al [36]. Respondents 3 and 4 raise concerns about the data quality, expressing the possibility of obtaining incorrect or flawed data that may not meet the necessary quality standards. Respondent 4 highlights the noisy nature of the available data and raises questions about AI’s ability to effectively sort through and analyze such data. This observation can be somewhat contradictory to the earlier mention of AI’s ability to uncover patterns and insights, which can be crucial for informed decision-making. The contradictory viewpoint likely stems from a recognition of the inherent challenges in working with real-world data. While AI possesses the potential to derive meaningful insights from high-quality data, the presence of noisy data introduces uncertainties and potential biases. In line with this, Walton [47] also provides arguments for the limitations of AI in handling large volumes of data due to complexity, limited access to information, and potential biases/errors, hindering accuracy and decision-making. The consensus is that the quality of data and the appropriate data type are essential for AI to function properly. However, as described by Bartram, Branke, and Motahari [4], achieving this is not an easy task.

### **5.3.3 Black Swan:**

Respondent 3 expresses the belief that the market operates in a complex manner, acknowledging the challenges posed by the Adaptive Market Hypothesis proposed by Lo [30]. According to Lo, financial markets can experience periods of instability or volatility, challenging the notion of market efficiency. Respondent 2 further contributes to this discussion by emphasizing that they believe that AI will struggle to imitate specific aspects of human thinking, such as emotions, which can influence market behavior, particularly during fast changes and short time periods in daily trading. The complex interaction between human thoughts, experiences, and emotional reactions poses difficulties in accurately capturing these dynamics within AI systems. Respondent 3 continues by highlighting the risks associated with relying solely on AI to solve market mysteries. They argue that AI’s reliance on historical data patterns can lead to mistaken outcomes, especially

in the current landscape that may deviate significantly from historical norms, particularly during times of crisis. Drawing a connection to the Black Swan problem [45], AI's reliance on historical data can become a significant limitation. The Black Swan problem refers to unforeseen events with severe consequences, which are difficult to predict based on historical patterns. Since AI is based on historical data and struggles to calculate for situations it has never encountered before, relying solely on AI poses a substantial risk.

## **5.4 Areas for Future Improvements:**

Respondent 1 highlights the advantages of employing niche models for data and news analysis, emphasizing the potential for more accurate and tailored outputs. They advocate for the introduction of specialized Language Models (LLMs), such as Bloomberg GPT, to enhance AI's capabilities in fund management, enabling superior insights and decision-making capabilities.

Respondent 2 shares a positive outlook on the future impact of AI. They believe that AI will evolve to identify patterns comprehensively and offer remarkable flexibility in data analysis. They also emphasize the need for more detailed data, such as tick data recorded at regular intervals, which is currently not readily accessible to many. However, they anticipate significant advancements as this data becomes more widely available.

Furthermore, both respondents express optimism about the future of AI. Respondent 2 envisions a future where AI can support personal decision-making, oversee strategic allocation processes, and integrate all necessary components. While acknowledging that AI is not yet fully mature, they believe that AI systems will greatly enhance decision-making processes and deliver valuable insights by leveraging vast amounts of data.

Additionally, respondents 3 and 4 touch on specific aspects related to the influence of AI. Respondent 3 acknowledges the potential impact on fees and job roles, but remains confident in their organization's efficient structure and believes AI will ultimately improve the quality of their work. Respondent 4 predicts that AI will gradually replace human involvement in tasks like writing marketing materials and reports related to fund activities, transforming the copywriting function within fund companies.

In summary, the respondents collectively anticipate a future where AI, including specialized AI models, will greatly enhance data analysis, decision-making processes, and the quality of work in fund management. They recognize the evolving nature of AI and its potential to transform various aspects of the industry, including the need for more detailed data and advancements in accessibility. Despite the changes AI may bring, there is an overall sense of optimism about its ability to drive positive outcomes in the field.

## **5.5 To What Degree is AI Capable of Substituting The Human Element in Fund Management?**

Respondents 4 view AI as a tool rather than a complete replacement for human decision-making. Hyungjin Ko and Jaewook Lee [29] support the view that AI can serve as a valuable assistant in fund management. They acknowledge that AI has the potential to improve investment decision-making and offer flexibility as a fund management tool. However, they also stress that AI should be viewed as a tool rather than a complete replacement for human decision-making. Factors related to human behavior and decision-making, especially within companies, may not be fully captured by AI. Therefore, active management will still necessitate human interaction. All respondents concur that human judgment, expertise, and understanding of complex market dynamics remain crucial in the decision-making process; this is also supported by the report “Investment Firm of the Future” by CFA [11]. Respondent 3 specifically emphasizes that AI may not fully capture specific aspects of human thinking, such as emotions, which can have a significant influence on the market, especially during fast-changing and volatile periods. This is also strengthened by Hansen and Kazinnik paper which underscores the limitations of GPT models. While AI can assist in analyzing complex financial language and improve classification accuracy, it is not flawless and may still struggle to capture certain nuances that a human evaluator with field expertise would grasp. But as Respondent 4 highlights, fund management involves more than stock selection, including tasks like bookkeeping, reporting, and risk management. Furthermore, they predict AI will gradually replace human involvement in copywriting activities, such as writing marketing materials and reports. Supporting this perspective, the study “Artificial Intelligence in Asset Management” by Bartram, Branke, and Motahari [4] suggests that AI can automate certain tasks in fund management, including data collection and analysis, resulting in time and cost savings. This aligns with respondent 3 that anticipates AI has the potential to take over jobs that require excessive staffing, leading to a more efficient operation.



## 6. Conclusions

The purpose of this thesis has been to answer our two research questions: To what extent is AI used today in fund management and, what are the potential benefits, limitations, and areas for future improvements of AI in this field? Secondly, to what degree is AI capable of substituting the human element in fund management?

The first question has been thoroughly discussed, and by combining the findings of the literature study and the interview study, the thesis has found that the use of AI today is limited, although it is gaining more traction. All of our respondents have already started trying out different AI tools, including LLMs specifically ChatGPT. This connects to the limitations discussed in the methodology, where our respondents do not possess specialized expertise in the field of AI. This reason is likely due to ChatGPT being one of the first AI models to gain traction in the public eye [12]. While AI is indeed being utilized to some extent today, its implementation does not reach the level discussed in the previous research reviewed. This discrepancy could potentially be attributed to the respondents' limited expertise in the field of AI. Moreover, it is important to note that the research conducted by Bartram et al. [4] focuses primarily on the "how" aspect of AI usage, neglecting the equally crucial "by whom" aspect."

The thesis has found that there are already numerous benefits to using AI today. These include data extraction, identification of complex patterns, portfolio optimization, and drawing conclusions. Furthermore, the findings indicate that AI can help mitigate biases.

However, the study reveals that there are still many limitations, many of which are grounded in the relative immaturity of AI and the insufficient quality of regulations and data. The black-box problem, attributed to the increasing complexity of Deep Neural Networks, presents a significant challenge. The issue is further worsened by the lack of knowledge and understanding in the field. The black box problem also raises regulatory and ethical questions related to transparency and accountability. Additionally, the bias mitigation that our research has found as a benefit could also be seen as a limitation. This is because the AI models are developed by individuals who may unintentionally introduce their own biases during the programming phase. The integration of AI into fund managers' daily work will require improvements in data quality, regulatory frameworks, and a deeper understanding of the technology. Furthermore, the regulatory landscape and conservative nature of the industry compound the black-box problem, potentially hindered by a generational gap, there may be resistance from decision-makers to adapt and stay updated with industry transformations as described by respondent 1. Compliance with regulations such as GDPR is also complicated by the lack of transparency of deep learning systems, making it difficult to comprehend the utilization of personal data. These findings em-

phasize the necessity for a comprehensive understanding and regulatory adaptation to address the complexities of AI in the fund management sector. Although the respondents expressed optimism about the future of AI, these necessary enhancements must occur before widespread integration can take place.

Regarding the second question, there is still a lot of development needed before we potentially can witness a complete replacement of humans by AI. Our study finds that while there are tasks within the profession that AI can already substitute, there is still a need for human oversight. The thesis concludes that AI should be viewed more as a tool rather than a complete substitute for the human element.

Our thesis has contributed a framework for researchers to further investigate and expand upon our findings. It is evident from the abundance of academic papers released during the course of our research that AI is a rapidly evolving field. These ongoing developments emphasize the significance of further research. Some limitations of the thesis include the small sample size of only four conducted interviews. Although we received a variety of answers from individuals with different backgrounds working at different firms, the sample size is still too small to claim that this represents a comprehensive overview of AI in the entire industry. It is worth noting that if we had interviewed a fund that utilizes AI to a greater extent, the findings would likely have been different. This would have provided a more representative picture of the actual AI usage in line with the findings from the literature review. Nonetheless, the inclusion of Respondent 2's insights carries particular significance within the context of this study. Unlike the other respondents who primarily focus on top-down fundamental approaches, respondent 2 specializes in quantitative portfolio construction. This distinction sheds light on an intriguing contrast between their perspectives on AI. Exploring this discrepancy in greater depth could uncover valuable insights. By delving deeper into these differences, we can gain a more comprehensive understanding of the strengths and limitations of both fundamental and quantitative approaches, shedding light on the optimal utilization of AI in this context.

In summary, this thesis explores the extent of AI usage in fund management and its potential benefits, limitations, and areas for improvement. The findings reveal limited current usage, but a growing interest in AI tools. Benefits include data extraction, pattern identification, portfolio optimization, and bias mitigation. However, challenges arise from immaturity, the black-box problem, regulations, and data quality. Ultimately, finding the right balance between AI and human involvement in fund management is crucial for harnessing the benefits of AI while retaining the value of human expertise and decision-making. Further research is needed to address these challenges and optimize AI utilization in fund management.

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# Appendix

## Questionnaire

As the interviews were conducted with swedish fund managers our interviews were conducted in swedish.

- Hur har ni implementerat AI i er portföljhantering, och vilken typ av data använder ni?
- Vilka potentiella fördelar ser ni med att använda AI i portföljhantering, och vad är de största utmaningarna ni har stött på hittills?
- Vilka potentiella nackdelar ser ni med att använda AI i portföljhantering, och hur hanterar ni eventuella risker som kan uppstå?
- Hur ser ni på förhållandet mellan AI och den mänskliga faktorn i portföljhantering? Kan AI ersätta helt och hållet den mänskliga expertisen i beslutsprocessen, eller finns det en gräns för vad AI kan åstadkomma?
- Hur tror du AI kommer att påverka yrken inom fondförvaltningen i framtiden?
- Hur tror ni att AI kommer att utvecklas inom portföljhantering på kort och lång sikt, och vilka nya möjligheter eller utmaningar kan detta medföra?
- Hade du kunnat tänka dig av att använda AI inom din förvaltning? Varför?
- Vad är er strategi i förvaltningen?

## Questionnaire in English

- How have you implemented AI in your portfolio management, and what type of data do you use?
- What potential benefits do you see in using AI in portfolio management, and what are the biggest challenges you have encountered so far?
- What potential drawbacks do you see in using AI in portfolio management, and how do you manage any risks that may arise?
- What is your view on the relationship between AI and the human factor in portfolio management? Can AI completely replace human expertise in the decision-making process, or is there a limit to what AI can achieve?

- How do you think AI will impact professions in fund management in the future?
- How do you think AI will develop in portfolio management in the short and long term, and what new opportunities or challenges may arise?
- Would you consider using AI in your management? Why?
- What is your strategy in portfolio management?