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Science Fiction to Real Life: Bing AI as An Investment Advisor

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Abstract

Nowadays, generative artificial intelligence models have extensive applications, including finance. Artificial intelligence models in finance synthesise data to assist analysts in generating financial reports, detecting risks, predicting market trends, and optimising portfolios for managers and investors. However, it is crucial to determine the effectiveness of these financial functions. Therefore, this study aims to explore the financial capabilities of artificial intelligence in the finance domain and evaluate its performance through a case study on investment analysis. Within the scope of the study, a text-based artificial intelligence engine, Bing AI, was utilised to explore the financial capabilities of artificial intelligence. Bing AI was tasked with creating portfolios for companies listed on the BIST100 index based on

their financial statements from 2019-2022, according to modern and traditional portfolio theories. The success of artificial intelligence in the financial field was evaluated by calculating the risk and return of the portfolio recommended by Bing AI for the period January 2023–November 2023. The findings indicate that Bing AI has the potential to partially support individuals with basic financial knowledge, but there is a need for further development in the application of finance.

Keywords: BIST, Portfolio Management, Artificial Intelligence, GPT, Bing AI.

Bilim Kurgudan Gerçek Hayata: Yatırım Danışmanı Olarak Bing AI

Özet

Günümüzde üretken yapay zekâ modelleri finansın da dâhil olduğu oldukça geniş bir kullanım alanına sahiptir. Finans alanında yapay zekâ modelleri verileri sentezleyerek analistlere; finansal rapor oluşturmada, risk tespit etmede, piyasa eğilimlerini tahmin etmede ve portföyleri optimize etmede yöneticilere ve yatırımcılara yardımcı olmaktadır. Ancak bütün bu finansal işlevleri ne derece etkin yerine getirdiğini belirlemek oldukça önemlidir. Bu nedenle çalışmada yapay zekânın finansal yeteneklerinin keşfedilmesi, yatırım analizi örnek olay incelemesi yoluyla performansının değerlendirilmesi amaçlanmıştır. Çalışma kapsamında, yapay zekânın finansal yeteneklerinin keşfedilmesi amacıyla, metin tabanlı bir yapay zekâ motoru olan Bing AI kullanılmıştır. Bing AI'dan BİST100 endeksindeki işletmelerin 2019-2022 dönemindeki finansal tablolarını dikkate alarak, modern ve geleneksel portföy teorilerine göre portföyler

oluşturması istenmiştir. Bing AI'nın önerdiği portföyün Ocak 2023-Kasım 2023 dönemindeki risk ve getirisi hesaplanarak, yapay zekânın finansal alandaki başarısı değerlendirilmiştir. Elde edilen bulgular, Bing AI'nın finansal alanda temel bilgiye sahip kişilere kısmen de olsa destek olabilecek durumda olduğunu; ancak finansın uygulama alanında geliştirilmesine ihtiyaç duyduğunu göstermektedir.

Anahtar Kelimeler: BİST, Portföy Yönetimi, Yapay Zekâ, GPT, Bing AI.

Introduction

Natural Language Processing (NLP) is a subfield of artificial intelligence (AI) in which algorithms capable of understanding, processing, and generating human language are developed (Jurafsky & Martin, 2014). Large language models (LLMs), which can quickly evaluate large amounts of numerical and textual content, solve problems, and provide unique insights, have brought a new breath to NLP (Touvron et al., 2023; Callanan et al., 2023; Wang, Li, Wu, Soon, & Zhang, 2023). Generative Pre-trained Transformer (GPT), which is a type of LLM that can perform various NLP tasks such as answering questions and summarising the given text, is groundbreaking in many areas (George, George & Martin, 2023; Callanan et al., 2023; Fatouros, Soldatos, Kouroumali, Makridis & Kyriazi, 2023).

The company that creates GPT models, OpenAI, keeps refining the architecture by expanding training on more datasets, adding new layers to GPT models, and making technical improvements. So much so that GPT-1, which was first developed in 2018, can be trained on a large dataset and understand and copy patterns in human language (Radford, Narasimhan, Salimans, & Sutskever, 2018). GPT-2, released

in 2019, can create realistic human-like texts (OpenAI, 2019). GPT-3, which was introduced in 2020 and has a customisable structure, provides outstanding results in many tasks such as text completion, translation, and question-answering (OpenAI, 2021). Finally, in March 2023, GPT-4, which can compose songs, write scripts, or create creative and technical writing tasks with users, such as learning the user's writing style and generating safe and useful answers, was introduced as the successor of GPT-3 (OpenAI, 2023).

ChatGPT, a special version of the constantly evolving GPT architecture finely tuned for conversational applications, was released towards the end of 2022. The launch of ChatGPT has attracted a lot of people's attention. ChatGPT is described as the fastest-growing consumer application, as it reached one million users within five days of its launch (Hofert, 2023).

Microsoft introduced Bing AI in early 2023, an AI-powered search engine that uses advanced techniques to provide answers to questions, powered by OpenAI's Prometheus Model 1. Bing AI combines its answers with the creative reasoning abilities of advanced GPT models (Krause, 2023). The most important difference between GPT-4 enabled Bing AI and GPT-3 enabled ChatGPT is that its current data is reliable data obtained from web pages, encyclopaedias, and pictures. The explanation is that it can perform certain specific tasks, such as making weather forecasts.

The reasons why artificial intelligence applications are so widespread today in terms of academia, industry, and individual users are health (Cascella, Montomoli, Bellini & Bignami, 2023; Li, Dada, Kleesiek & Egger, 2023; Biswas, 2023), education (Adeshola &

Adepoju, 2023; Grassini, 2023; Biswas, 2023), business (George et al., 2023; Chu, 2023; Derdiyok, Unal & Doğru, 2023; Ahangar & Fietko, 2023; Dowling & Lucey, 2023; Fatouros et al., 2023; Guo, Xu, & Yang, 2023), etc. This is due to the fact that it offers services in many different areas. Espacially, The capabilities of artificial intelligence are beyond human power in the field of finance and have begun to be described as powerful tools that can improve various aspects of financial analysis (Krause, 2023). Therefore, by synthesising data, artificial intelligence models help analysts, managers, and investors achieve high performance in creating financial reports, detecting risks, predicting market trends, and optimising portfolios (Forbes, 2023). It is important to determine to what extent it fulfils all these functions. Because of this, the study's objectives are to ascertain artificial intelligence's financial aptitude in the domain of finance and assess its effectiveness using a case study on investment analysis. By exposing the advantages and disadvantages of artificial intelligence applications, it seeks to significantly advance the rapidly evolving field of financial analysis backed by AI. Furthermore, when the literature was examined, no similar study examining the investment consultancy of the GPT-4 enabled Bing AI application for BIST data was found, and the study is a first in this respect.

There are four sections to the study. The first section provides general information regarding GPTs and large language models in artificial intelligence, along with an explanation of their applications. In order to uncover the financial capabilities of artificial intelligence and assess its performance through an investment analysis case study, a conceptual framework derived from studies on the application of AI

in finance was created in the second part. In the third part, the risk and return of the portfolio were analysed by building a portfolio using BIST100 data on the Bing AI application. Ultimately, the results are explained in the fourth chapter.

Literature

The dynamic structure of finance has become more understandable and interpretable with artificial intelligence models. In particular, LLMs and generative artificial intelligence applications are among the biggest supporters of the development of finance. Researchers and industries have worked to specialise artificial intelligence in the field of finance with various LLMs regulated in financial NLP fields such as InvestLM (Yang, Tang & Tam, 2023), FinMA (Xie, Han, Zhang, Lai, Peng, Lopez-Lira & Huang, 2023), FinEval (Zhang, Cai, Liu, Yang, Dai, Liao, Qin, Li, Liu, Liu, Zhu, Wu, Guo, & Chen, 2023), FinGPT (Wang, Yang, & Wang, 2023; Yang, Liu, Wang, 2023), Gpt-finRE (Rajpoot & Parikh, 2023), FinVis-GPT (Wang, Li, Wu, Soon & Zhang, 2023), FinBERT (Liu, Huang, Huang, Li, Zhao, 2021; Huang, Wang & Yang, 2023; Araci, 2019) and BloomberGPT (Wu, Irsoy, Lu, Dabravolski, Dredze, Gehrmann, Kambadur, Rosenberg & Mann, 2023).

Although studies have been conducted on a wide range of topics using ChatGPT and Bing AI, two special versions of the GPT architecture finely tuned for speech applications, the studies generally focus on education (Adeshola & Adepoju, 2023; Grassini, 2023; Biswas, 2023a), health (Cascella et al., 2023; Li et al., 2023; Biswas, 2023b; Pradana, Elisa & Syarifuddin, 2023), and finance (Wenzlaff & Spaeth, 2022; Hofert, 2023; Derdiyok et al., 2023; Guo, Xui & Yang, 2023;

Ahangar & Fietko, 2023; Dowling & Lucey, 2023). Some studies using artificial intelligence in the field of finance are summarised below.

Krause (2023) examined the applications of ChatGPT, Bard, and Bing AI language models in the field of finance. According to the findings of the study, these three major language models show significant potential for improving financial analysis, automating tasks, and providing valuable information.

Fatouros et al. (2023) conducted sentiment analysis in the financial field with ChatGPT in their study. They conducted a comprehensive examination by subjecting ChatGPT to various requests on a meticulously curated dataset comprising headlines related to forex news, employing a zero-shot prompting approach. With this study, they shed light on the potential of ChatGPT to significantly increase sentiment analysis in financial applications.

Callanan et al. (2023) used exam questions from the Chartered Financial Analyst (CFA) Programme to make a comprehensive evaluation of ChatGPT1 and GPT-42 in financial analysis, taking into account Zero Shot, Chain of Thought (CoT), and Low Shot, in order to examine whether GPT models are financial analysts or not. They examined whether intelligence models would pass the test. Their study sheds light on the financial foundations of future LLMs.

Derdiyok et al. (2023) investigated ChatGPT's ability to detect the financial status of companies. They aimed to comprehensively analyse the financial statements of the companies traded in Borsa Istanbul by using the capital structure score, profitability score related to the income and expense statement, and cash flow score related to the cash flow statement. To examine how successful the scores

measured by ChatGPT were, they tracked the development of certain performance criteria in the year after the score was calculated. According to their findings, they have found that ChatGPT, which is still in its development stage, can successfully detect the financial situations of publicly traded companies on the stock exchange, provided the necessary data for analysis is provided.

Küçüker (2023) basic-level questions created on financial accounting, cost-management accounting, and auditing themes were directed to the model, and evaluations were done within the scope of the responses received in order to assess ChatGPT's proficiency in fundamental accounting concerns. In accordance with the study's conclusions, he said that ChatGPT might have a lot of chances for use in the accounting industry in the years to come, but that the model's features needed to be developed for accounting applications.

Studies in the literature about the financial success of artificial intelligence show the potential of artificial intelligence to replace humans. However, it is noteworthy that the majority of the studies were carried out via ChatGPT. The fact that ChatGPT cannot access current data and the last training date is January 2022 limits the studies. The fact that there are many artificial intelligence models other than ChatGPT casts doubt on the emphasis of most studies in the literature that artificial intelligence needs to be developed. Accordingly, in order to examine the financial capabilities of artificial intelligence, Bing AI's investment recommendations are examined in the next section.

Case Study

The capabilities of artificial intelligence in the field of finance are beyond human power. Therefore, it is known that artificial intelligence models can help analysts, managers, and investors with superhuman performance in creating financial reports, detecting risks, predicting market trends, and optimising portfolios by synthesising data (Forbes, 2023). One of the questions that needs to be determined is how effectively and correctly it carries out all these functions. For this reason, Bing AI with the GPT-4 feature, which is a text-based artificial intelligence engine that can perform the functions of providing information to users, answering questions, and creating content, was used in the study.

To measure Bing AI's financial investment advisory ability, it was first asked how many stocks an ideal portfolio should consist of. Bing AI answered this question briefly as follows: you can aim for 6-7 stocks in a portfolio up to 100,000 TL, and up to 10 stocks in larger portfolios. Based on this answer, Bing AI was asked to select six stocks in BIST100 according to traditional and modern portfolio theories, taking into account the 2019–2022 balance sheets and income statements. However, it recommended a portfolio consisting of the same stocks, according to both traditional and modern portfolio theories. The portfolio created by Bing AI is given in Table 1.

Table 1: Portfolio created by Bing AI

Notation	Stock's Name
AKBNK	Akbank Inc.
GARAN	Türkiye Garanti Bank Inc.
ASELS	Aselsan Electronic Industry and Trade Inc.
THYAO	Turkish Airlines Inc.
TTKOM	Türk Telecommunication Inc.
KCHOL	Koç Holding Inc.

When the portfolio produced by Bing AI in Table 1 is examined, it is seen that it consists of stocks belonging to businesses operating in the banking, IT, transportation, and industry sectors. When Bing AI was asked about the weight of stocks in the portfolio, it stated that they were of equal weight. However, although it was asked to calculate the risk and return of the portfolio, it stated that it did not have the ability to do this and suggested that it consult a financial advisor.

In order to make a more realistic assessment of the financial success of the portfolio created by Bing AI, the risk and return of the portfolio must be known. For this, first the risks and returns of the stocks included in the portfolio must be determined. The returns of the stocks are determined by eq. (1) (Güçlü & Şekkeli, 2020).

$$E(R) = \frac{P - P_0}{P_0} \quad (1)$$

Here $E(R)$ is the expected return of the stock, P is the future value prediction of the stock, and P_0 is the present value of the stock.

Monthly returns, variance, and standard deviation values for 2023, calculated by substituting the monthly data obtained from investing.com into eq. (1) of the stocks in the portfolio created by Bing AI based on the financial statements of the 2019–2022 period, are given in Table 2.

Table 2: Risk and monthly return values of stocks in 2023*

	AKBNK	GARAN	ASELS	THYAO	TTKOM	KCHOL
January	-0.13	-0.20	-1.00	-0.02	-0.16	-0.09
February	0.03	-0.03	-0.03	0.04	-0.12	0.01
March	0.07	0.20	-0.06	-0.17	-0.08	0.01
April	-0.05	0.06	-0.14	0.08	-0.02	-0.01
May	-0.02	-0.02	0.06	0.13	-0.01	0.04
June	0.28	0.20	0.15	0.35	0.29	0.32
July	0.38	0.37	0.37	0.21	0.03	0.30
August	0.03	0.14	0.03	0.05	0.21	0.05
September	0.16	0.06	0.06	-0.01	-0.09	0.03
October	-0.12	-0.12	0.01	-0.10	-0.18	-0.07
November	0.14	0.15	0.18	0.16	0.24	0.03
Mean	0.07	0.07	-0.03	0.06	0.01	0.05
Variance	0.02	0.02	0.11	0.02	0.03	0.02
Std.Dev.	0.15	0.15	0.33	0.14	0.16	0.13

* Calculated by the authors using data obtained from www.investing.com/

Table 2 includes data on the monthly returns of the stocks recommended by Bing AI for the period January 2023–November 2023 and their risks during this period. When we look at the average returns, it is seen that ASELS has the lowest return, while the average returns of other stocks are positive values that are very close to each other. When the variance and standard deviations of the risk tools are examined, it is seen that the stock with the highest risk is ASELS, and the other stocks have similar risk levels. In Table 2, only the return and risk interpretations of the six stocks included in the portfolio can be made.

Eq. (2) is used to calculate the return of the portfolio consisting of n stocks.

$$R_p = \sum_{i=1}^{n} w_i r_i \qquad (2)$$

Here R_p is the return of the portfolio, w_i is weight of the i. stock in the portfolio, and r_i is the return on the i. stock.

The return of the equally weighted portfolio created by Bing AI is calculated at 3.8% with eq. (2). In addition to the return on the portfolio, the risk level also needs to be calculated (Güçlü, 2022). Accordingly, the formulas used to calculate portfolio risk are included in eqs. (3)-(4). Note that these formulas ignore the asymmetry in the return data (Göktaş & Duran, 2019).

$$COV_{R_i,R_k} = \sum_{j=1}^{n} P_j \left[\left(R_{ij} - E(R_i)\right)\left(R_{kj} - E(R_k)\right)\right] \tag{3}$$

$$\sigma = \sqrt{\sum_{i=1}^{n}\sum_{i=1}^{n} w_i w_k COV_{R_i,R_k}} \tag{4}$$

Here COV_{R_i,R_k} is the covariance of returns of i and k. stocks, P_j probability of occurrence of the j. situation, E(R_k) expected return of the i. stock, σ standard deviation of the portfolio, w_i is the weight of the i. stock in the portfolio. According to eqs. (3) and (4), first the variance-covariances of the stocks included in the portfolio should be calculated.

In order to calculate the risk of the portfolio created by Bing AI, the variance-covariance matrix of the stocks is needed. Accordingly, the variance-covariance matrix is given in Table 3.

Table 3: Variance-Covariance matrix of stocks

	AKBNK	GARAN	ASELS	THYAO	TTKOM	KCHOL
AKBNK	0.02	0.02	0.03	0.01	0.01	0.02
GARAN	0.02	0.02	0.04	0.01	0.01	0.02
ASELS	0.03	0.04	0.11	0.02	0.02	0.03
THYAO	0.01	0.01	0.02	0.02	0.02	0.01
TTKOM	0.01	0.01	0.02	0.02	0.03	0.01
KCHOL	0.02	0.02	0.03	0.01	0.01	0.02

By substituting the variance and covariance values in Table 3 of the equally weighted portfolio created by Bing AI into eq. (4), the risk of the portfolio is calculated as 14.8%. The risk and return values of the portfolio if the stocks are weighted differently are given in Table 4.

Table 4: Risks and returns of Bing AI's and alternative portfolios created with sample weightings

	Bing AI's Suggest	Sample-1	Sample-2	Sample-3
AKBNK	0.167	0.200	0.250	0.250
GARAN	0.167	0.200	0.250	0.250
ASELS	0.167	0.010	0.001	0.099
THYAO	0.167	0.200	0.200	0.200
TTKOM	0.167	0.190	0.099	0.001
KCHOL	0.167	0.200	0.200	0.200
Portfolio				
Risk	0.148	0.128	0.128	0.141
Return	0.038	0.052	0.058	0.054

Table 4 shows the risks and returns of both the equally weighted portfolio of stocks recommended by Bing AI and alternative portfolio samples with different weights. Table 4 shows that Sample-2, among the portfolios offered as an alternative to Bing AI, can offer higher returns with lower risk compared to other portfolios.

Conclusion

Generative Pre-trained Transformer (GPT), which is a type of LLM that can perform various NLP tasks such as answering questions asked in developing technology and summarising the given text, breaks new ground in many areas. Nowadays, safe and helpful GPT models are available to generate responses for co-creating innovative and technical writing tasks with viewers, such as authoring screenplays, songs, or analysing the individual's writing style.

The capabilities of artificial intelligence in many areas are beyond human power in the field of finance. For this reason, they have begun to be described as powerful tools that can improve various aspects of financial analysis (Krause, 2023). Therefore, by synthesising data, generative artificial intelligence models help analysts, managers, and investors achieve high performance in creating financial reports, detecting risks, predicting market trends, and optimising portfolios (Forbes, 2023). The study aims to discover the financial capabilities of artificial intelligence in the field of finance and evaluate its performance through an investment analysis case study. In this regard, Microsoft leveraged Bing AI, an AI-powered search engine that uses advanced techniques to provide answers to questions, powered by OpenAI's Prometheus Model 1. Bing AI was asked to analyse the financial statements of the companies in the BIST100 index for the years 2019–2022 and create two portfolios according to traditional and modern portfolio theories. On the other hand, Bing AI has proposed a single portfolio consisting of AKBNK, GARAN, ASELS, THYAO, TTKOM, and KCHOL stocks, taking into account both modern and traditional portfolio approaches. When Bing AI was asked about the

weight of stocks in the portfolio, it stated that they were of equal weight.

As a case study, the risks and returns of the portfolio proposed by Bing AI in the period January 2023–November 2023 were examined in order to measure the degree of its capabilities in the financial field. Accordingly, the risks and returns of the stocks included in the portfolio were examined, and when the average returns were examined, it was seen that the stock with the lowest return and highest risk was ASELS, and the average returns of the other stocks had very similar risk returns. When the risk and return of the portfolio recommended by Bing AI were calculated, it was found that the portfolio had a return of 3.8% against a risk of 14.8%. It is clear from the Sample-2 portfolio that if the stocks suggested by Bing AI are weighted into different alternatives, there are higher possibilities of achieving them at lower risk.

Although the risk of the portfolio created by Bing AI is relatively high, at least the positive return gives hope for the success of Bing AI's investment consultancy. However, the fact that he only gives literary answers when asked to use both modern portfolio and traditional portfolio methods, and his inability to apply this information when creating a portfolio, casts a shadow on the reliability of the suggestion he offers. In addition, although the portfolio suggested by Bing AI provides positive returns, it is possible to say that there is a need to improve the financial capabilities of Bing AI, as there are more effective portfolios such as Sample 1–3 created with different weighting combinations of the same stocks. In general, when the financial capabilities of Bing AI are evaluated, it is impossible not

to say that it provides support to people who have basic knowledge in the field of finance. In future studies, the financial analysis, evaluation, and interpretation abilities of artificial intelligence models can be examined, the expectations of artificial intelligence in the field of finance can be revealed, and suggestions can be made to artificial intelligence developers.

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