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Artificial Intelligence in Stock Analysis and Portfolio Building

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Artificial Intelligence in Stock Analysis and Portfolio Building

By

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Abstract

The emergence of artificial intelligence (AI) investment analysts, often referred to as “robo-advisors”, has the potential to change traditional portfolio management. These systems access vast amounts of data and make portfolio management decisions and stock market predictions. In this study, I compared AI-generated portfolios with portfolios that were created manually. Surprisingly, the human-generated portfolios outperformed the AI portfolios. However, the prompt used in the AI application affects these results. The subset of AI portfolios that were created with specific objectives specified in the prompts outperformed those that were created with more generic prompts. Overall, this research sheds light on the future of stock selection and portfolio management in the AI era.
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**Introduction**

AI-assisted investment analysis has been explored in previous publications that highlight the different ways the technology can access information to make informed decisions on portfolio management (Buczynski, 2021). This is what financial advisors and other professionals in the finance field have been doing manually for decades (Flandreau, 2005; Umadevi, 2023), but the emergence of AI is likely to alter the traditional financial advising process. With AI being able to process more information and make decisions in a fraction of the time it takes their human counterparts to do the same (Wang, 2008). To examine the efficacy of “robo-advisors” I ran an experiment to provide evidence on whether AI investment applications outperform investment professionals. Specifically, I used an AI-based investment website called Magnifi to create 3 stock portfolios of differing sizes. I then hand-picked portfolios of the same size using traditional stock analysis techniques. While stock selection is just one of many tasks performed by a financial advisor, markets benefit from the efficient distribution of capital, and many people, regardless of status, hold a good chunk of their net worth in stocks, making stock selection a very critical part of a financial advisor’s job (Brown, 2008)

The portfolios created by an investment professional outperformed the portfolios created by Magnifi. The differences were greatest for the small portfolios. The portfolio built for short-term gains performed extremely well, with more variation in their day-to-day performance, while the long-term portfolios saw smaller gains but a more consistent day-to-day pattern of gains. Additional analyses show performance varies when the application is asked to create portfolios with either a long-term or short-term growth objective. Additional analyses also examine temporal
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changes in the portfolios generated by the application and whether the S&P 500 Index outperformed the applications.

In the extant literature, many studies look at the performance of stock selection algorithms (Xu, Hoos, & Leyton-Brown, 2010; Yang, 2023; Chou). While these studies are important, the average investor is more likely to turn to the user-friendly applications I examine in this study. If someone wanted to utilize AI to assist with their holdings in the stock market they would likely turn to these services for help and not the complex systems used by prior experiments (Rather, 2017; Adebiyi, 2020; Mazraeh, 2022). As a result, this manuscript makes a significant contribution to the extant literature.

In addition to presenting the performance of user-friendly applications, this study is the first to compare the relative performance of user and AI generated portfolios. Multiple studies examine AI portfolio construction, but these focus solely on the performance of the AI advisors (Mazraeh, 2022; Adebiyi, 2020). Many studies have suggested the proliferation of AI applications could lead to a change in the way most positions across most fields (Dwivedi, 2023; Peres, 2023). The finance field likely will not be safe as uses of the technology in the field has already been discovered and implemented (Hilpisch, 2021). This puts pressure on human advisors to better adapt their own decision making process, stock selection, and portfolio building. A comparison of human and AI-created portfolio performance contributes to a better understanding of whether AI applications are an immediate threat to financial advisors.

**Background**

The increased availability of artificial intelligence (AI) applications over the last few years has been an exciting development and the focus of significant media attention (Thomas, 2024;
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Wegner, 2024; Uppal, 2023). The applications that have become publicly available include ChatGPT, Azure AI, and Google AI. These are forms of Generative AI, artificial intelligence capable of generating text, images, and other media using generative models. Generative AI can learn the patterns and structure of their input data and then generate new data with similar characteristics. Generative AI has been used across various fields, including art, writing, script writing, software development, product design, healthcare, finance, gaming, marketing, fashion, and others (Dwivedi, 2023).

The financial sector is likely to be disrupted by artificial intelligence (AI), which has a number of advantages including cost reductions, increased productivity, and better service options (Tyagi, 2023; Hilpisch, 2021; Kaur, 2020). The anticipated uses for AI include robotic financial advisors, automated systems that use formulas as well as machine learning to deliver investment guidance, automated trading, trading algorithms fueled by artificial intelligence, and AI-driven risk management, algorithms that evaluate and mitigate risks in the financial sector (Shanmuganathan, 2020). Robo-advisors analyze immense data sets, such as trends in the market, financial indicators, as well as individual risk identities in order to produce individual investment plans. Automated trading has also signified a tectonic shift in the financial market’s dynamics. Machine learning algorithms evaluate historic market information, spot trends, and facilitate transactions much faster than human traders. AI algorithms based on machine learning also evaluate and mitigate risk by perpetually tracking and evaluating a wide range of factors, including financial markets and geopolitical events. Risk management systems powered by artificial intelligence not only improve the precision of risk evaluations, but also offer real-time insights, enabling organizations to quickly adapt to changing circumstances (G & Pahuja, 2023).
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Despite the relative newness of AI applications, many studies have examined the performance of these applications. For example, manuscripts have examined AI-assisted portfolio decision-making under uncertainty and risk (Yang, 2023). Experiments have evaluated the efficiency and performance of the algorithms AI uses to build portfolios (Hsu, 2020; Koratamaddi, 2021). Some of these experiments have included building portfolios on spectral clustering (SC) based to the stock complex network (Zhang, 2017). Others have used a complex algorithm named Hydra, a system that combines automated algorithm configuration and portfolio-based algorithm selection to design high-performance solver for hard combinatorial problems. The results the author found suggest that the Hydra system outperformed 17 state-of-the-art SLS (SATenstein-LS, a well-studied and challenging domain) algorithms and portfolios generated using them (Xu, Hoos, & Leyton-Brown, 2010). Some have focus on more widely used and readily available systems to examine the capabilities of AI in investing. Jacques St-Pierre of Laval University used Equbot, which is powered by IBM’s Waston AI to build a portfolio. Waston AI uses cognitive computing where systems understand the world the same way humans do: through senses, learning, and experience. With their new technology at hand, Equbot’s model is even used for a ETF which has been trading on the New York Stock Exchange (NYSE) since 2017 (St-Pierre, 2017).

In an era where many positions have become automated (Barbieri, 2019), it is important to understand the effect artificial intelligence applications will have on the decisions made by financial professionals. Research has shown that investors can benefit from receiving unbiased advice that helps them make more rational decisions (Nazir, 2010; Umadevi, 2023). The increased availability of AI application might enable investors to obtain advisory services at a lower cost (Santos, 2022). In this environment, the value of an AI investment application is a function of
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whether it provides more effective advice than an investment professional. If an AI application outperforms a traditional financial advisor, there would likely be a significant reduction in the demand for traditional financial advisory services. To provide evidence on whether current versions of AI investment applications outperform their human counterparts, I examine the following research question:

Do equity portfolios generated by AI investment applications earn better returns than equity portfolios generated by a finance professional?

**Methodology**

To address the research question, I utilize an AI-powered investment platform called Magnifi. Magnifi was launched in 2018 and currently has 45,000 users with about $500 million in assets under management. Magnifi has an AI assistant that provides recommendations, feedback, and decision making based on Magnifi’s algorithm. I utilized this assistant to create Magnifi’s portfolios. I provided the application with an open-ended prompt, “please create an equally weighted stock portfolio”. The prompt was altered so the portfolio generated included either five, ten, or twenty-five stocks. I then created my own portfolios using traditional analysis techniques. Overlap between the portfolios was not prohibited, but certain financial products were prohibited, including mutual funds, ETFs, and bonds to narrow the scope of the experiment. Given that Magnifi’s portfolios were created without goals in mind, I also asked it to create 2 extra 10-stock portfolios with both long-term and short-term gains as the focus. These portfolios featured very different stocks. Each holding of a company was set at $1,000 to ensure an equal weight to all, which was then divided by the closing numbers on January 31st to set the number of shares of each
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company which were tracked over the month of February. I did not sell or change the holdings of the portfolios over the month.

Magnifi is just one of thousands of AI services currently on the market and as a result, additional analysis was performed using alternative applications. Each Friday in February I would use a different AI service to create a new 5-stock portfolio to be tracked over 1 week of time. The AI applications included: Microsoft Copilot, Chatsonic, and Perplexity AI, three large language models (LLMs). Again, each company holding was $1,000 which was divided into the previous Friday’s closing numbers to be tracked over the 1 week. In addition to examining inter-application differences in performance, I also compared the performance of the portfolios to the performance of the S&P 500, the index that includes 500 of the largest publicly traded companies. Also, at the beginning of March I went back to Magnifi to ask it to recreate 5, 10, and 25 stock portfolios in order to see how their choices have changed over the course of the month and compare them to the original portfolios created in January.

Results

(Figure 1 Here)

The research question asks about the performance of equity portfolios generated by AI investment applications relative to equity portfolios generated by a financial advisor. The results suggest AI applications do not outperform financial advisors. Magnifi’s 5-stock portfolio was only up 2.57% over the course of the month while the financial advisor’s 5-stock portfolio was up
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10.86%. Magnifi’s portfolio was brought down by unimpressive months from Apple and Alphabet, both were down over the month while the advisors portfolio was bolstered by very strong months by Nvidia and GE. However the performance of individual stocks in both portfolios varied. For example, Magnifi was helped by solid months from JP Morgan and Tesla, while the advisor’s include performance was hurt by a poor month from Haliburton.

(Figure 2 Here)

The same difference exists when comparing the 10-stock portfolios. Magnifi’s 10-stock portfolio was only up 0.26%, aided by Amazon’s strong month but hurt by terrible performances from Palo Alto Networks and BHP Group. The advisor’s 10-stock portfolio was up 5.47%, helped by Nvidia and Uber, but hurt by Gen Digital. While Magnifi’s 10-stock portfolio performed worse than its 5-stock portfolio, the gap between the application and the advisor for the 10-stock portfolios was smaller than it was for the 5-stock portfolios. In addition, unlike the 5-stock portfolios where the advisor’s performed better than Magnifi’s for the entirety of the month, there were periods where Magnifi’s 10-stock portfolio performed best. For example, from the 6th through the 13th Magnifi’s portfolio outperformed the advisor’s portfolio by $100 each day. The final difference was driven by a massive collapse in Palo Alto Network’s stock (from $366 to $261 in one day), a security included in the AI application’s portfolio. My portfolio continued to expand the gap with a big rise on the 22nd coinciding with a big rise in Nvidia’s price. The results suggest AI-assisted portfolios perform better when the portfolios are diversified, a question that could be explored by future studies.

(Figure 3 Here)
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The same conclusions can be drawn from an examination of the twenty-five stock portfolios. Magnifi’s twenty-five stock portfolio was up 3.93% over the investment period, while the advisor’s was up 5.25%. While, again, the advisor’s portfolio outperformed Magnifi’s, this was the smallest gap across the three different portfolio types and, on 14 out of 20 days, Magnifi’s portfolio outperformed that advisor’s portfolio. Once again, the poor performance of Palo Alto Networks and the strong performance of Nvidia, explain the differences. Strongly performing stocks in Magnifi’s portfolio include Eli Lilly, Advanced Micro Devices, and Caterpillar all of which gained more than 10% over the month. Magnifi’s twenty-five stock portfolio outperformed its five and ten-stock portfolios.

(Figure 4 Here)

Additional Analyses

One explanation for Magnifi’s relatively poor performance is the prompt used to generate the portfolios lacked specificity. The prompt failed to specify an objective and investment period. With this information, Magnifi might have been able to create a better portfolio. To provide initial evidence on this issue, I asked Magnifi create to create two additional portfolios with long-term and short-term performance objectives. Results show the short-term portfolio outperformed the long-term. The short-term portfolio gained 17.31% over the investment period (the best of any of the portfolios), while the long-term portfolio gained 2.15%. The short-term portfolio outperformed
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the long-term portfolio each day of the month, some days by as much as $1500 (15% of the portfolio). The short-term portfolio was helped by 7 of the 10 stocks rising by 10% or more over the course of the month, lead by Super Micro Computer’s (SMCI) monster 63% rise over the course of the month. The value of Nvidia, Meta and Vertiv also increased by 20% or more. While the short-term portfolio did see tremendous daily gains, it also had erratic day-to-day performance. The long-term portfolio, by comparison, was very consistent with small daily gains or losses. This is consistent with its objective to maximize long-term performance. With the exception of the 1st and 13th, every day the gain or loss was approximately 1%. The long-term portfolio did see some outliers including a 17% rise from CRH PLC and a 8% fall from Cheniere Energy. However, every other holding either rose or fell by less than 5%. Taken as a whole, the results suggest changing the prompt given to an AI investment application can alter its stock selection process in a manner consistent with its human counterpart. Magnifi selected more volatile stocks with a higher upside when pursuing a short-term objective.

(Figure 5 Here)

While the returns were positive and a great indicator of the capabilities of AI advisors, there was a certain degree of risk involved, as there is with any investment. The risk was heightened due to the limited number of shares and the presence of an automated advisor. Two widely used methods for determining the riskiness of a portfolio are the Sharpe Ratio and the Treynor Ratio. The calculations differ but they essentially seek to determine how much return a portfolio generates per unit of risk. The calculations differ in what they use to determine this unit of risk. The Sharpe Ratio takes the return of the portfolio subtracted from the risk-free rate which for February was 2.22%, then dividing by the portfolio’s standard deviation. The Treynor ratio
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also takes the risk-adjusted return then divides by the portfolio’s beta. A good Sharpe ratio for a portfolio is considered above 1 while any positive number is a good Treynor ratio (van Dyk, 2014). This provides an interesting examination of the portfolio’s risk-adjusted performance.

With regards to the Sharpe Ratio, none of the portfolios examined had a Sharpe ratio above 1. The Short-term minded portfolio had the highest at 0.73, followed by my 5-stock portfolio at 0.69. The best performing portfolios did feature the highest standard deviations, thanks to varied performances from the individual stocks. Magnifi’s portfolios had the lowest standard deviations but also performed the worst, Magnifi’s 10-stock portfolio performing the worst at -0.30. The Treynor ratio tells a different story as all of the portfolios but Magnifi’s 10-stock portfolio had a positive Treynor ratio, indicating an ideal investment. Again, the short-term portfolio had the highest Treynor ratio at 0.09 while Magnifi’s 10-stock portfolio had the lowest at -0.02. Again, the best performing portfolios had the highest risk or, in this case, beta, but brought the most return. While the Sharpe and Treynor ratios are a good means of determining return vs risk, all of the portfolios did have a positive return on investment. The portfolios also had higher standard deviations and betas than normal because of the limited number of shares and the lack of diversification in their composition.

(Tables 2 & 3 Here)

Investment applications like Magnifi are expected to incorporate up-to-date information into their analysis. Interestingly, when asked to create portfolios one week after the start of the experiment, Magnifi generated portfolios that were identical to those it had initially created. A program creating portfolios using up-to-date information would likely be expected to provide different recommendations after this amount of time elapses. To provide additional evidence on
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In this issue, I examined how the portfolios selected by multiple advisory applications changed over a month. Specifically, at the conclusion of the experiment, I asked Magnifi to generate new five, ten, and twenty-five stock portfolio. For the new five-stock portfolio, Magnifi only re-selected one stock from the original portfolio, Tesla. However, for the ten-stock portfolio Magnifi created a portfolio with 8 stocks remaining from the original portfolio. Only Disney and Novartis were new selections, surprising given the ten-stock portfolio was the worst performer out of the original three Magnifi portfolios. Magnifi even re-selected Palo Alto Networks after an underwhelming month. The twenty-five stock portfolio features eight stocks from the original portfolio and seventeen new additions. Overall, the differences in temporal change highlight an issue with AI applications like Magnifi; the inability to assess the applications decision criteria makes it hard to determine the criteria that guide its decisions.

In addition to comparing the application’s performance to that of a human advisor, it’s important to compare AI applications against other benchmarks like the S&P 500, a measure of the overall stock market’s performance. In February the S&P 500 rose 5.17%, more than all of Magnifi’s portfolios, except for the short-term portfolio. All of my portfolios outperformed the S&P 500. Taken as a whole, this result suggest the advantages of active portfolio management might not exist when that active management is done by an AI application.

(Tables 1, 5, 6 Here)

Conclusion

The emergence of “robo-advisors” like Magnifi have the potential to produce a radical shift in traditional portfolio management and stock market prediction. These types of applications are able to access and analyze vast amounts of data and in a fraction of the time it takes their human
counterparts. Despite their potential, my results suggest in their current form, these applications can’t replace human advisors. My own portfolios were able to outperform the portfolios created by AI. While the portfolio designed towards short-term gains was the best overall performer, it also displayed erratic and inconsistent growth day-to-day, while the portfolio designed for long-term gains only made small overall gains, but the day-to-day results were consistent. Comparisons to the S&P 500 offered insight into overall market performance and allowed us to gauge how these portfolios compared to the market. Post-experiment, revisiting AI services revealed many changes in portfolio composition, showing the technology’s adaptability to market shifts and news updates. This reveals the evolving role of AI in financial advising, prompting reflection on its efficacy compared to human expertise.

My experiment, while similar to others in the field, is distinguished through its simplicity, offering results that are easily interpretable and applicable to a wide audience. Unlike the complexity found in other studies, which involves intricate mathematical formulas, my experiment is accessible and comprehensible. By utilizing widely available AI systems instead of obscure and confusing algorithms, I aimed to mirror a real-world scenario where individuals would use accessible AI services for financial guidance. Additionally, my experiment incorporates a human advisor, providing a unique comparison between human and AI-generated portfolios. This comparison is particularly pertinent given the increasing automation of various industries, including finance, with the advancement of AI technology like ChatGPT. As AI capabilities continue to evolve, there is growing pressure for human advisors to adapt their decision-making processes. By examining the performance of human and AI-created portfolios, my experiment sheds a light on the future of stock selection and portfolio management in the AI era.
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References


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Figure 1: Each Portfolio's overall performance

Figure 2: Comparison of 5-Stock Portfolio Performance
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Figure 3: Comparison of 10-Stock Portfolio Performance

Figure 4: Comparison of 25-Stock Portfolio Performance
<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Return</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sean 5</td>
<td>10.49%</td>
<td>1.23</td>
</tr>
<tr>
<td>Sean 10</td>
<td>5.47%</td>
<td>0.19</td>
</tr>
<tr>
<td>Sean 25</td>
<td>5.21%</td>
<td>0.14</td>
</tr>
<tr>
<td>Magnifi 5</td>
<td>2.60%</td>
<td>-0.40</td>
</tr>
<tr>
<td>Magnifi 10</td>
<td>0.37%</td>
<td>-0.86</td>
</tr>
<tr>
<td>Magnifi 25</td>
<td>3.93%</td>
<td>-0.13</td>
</tr>
<tr>
<td>L-T</td>
<td>2.17%</td>
<td>-0.49</td>
</tr>
<tr>
<td>S-T</td>
<td>16.66%</td>
<td>2.51</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>5.11%</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Mean        | 4.53%  |
SD          | 4.84%  |

Table 1 presents the returns of each of the portfolios created for this experiment. A mean and standard deviation was calculated from these results to then produce a z-stat or significance, \((\text{Return} - \text{Mean})/\text{SD})\).
Table 2 presents the results of mine and Magnifi’s portfolios. Significance is shown in the z-stat, which were calculated in Table 1. SHARP Ratio (Return−Rf/SD) and Treynor Ratio (Return−Rf/Beta) were calculated using Feb 2024’s risk-free return of 2.22% to assess the portfolio’s risk-adjusted return. A good SHARP Ratio is over 1 while a positive Treynor ratio is more suitable.

Table 3 presents the returns of all 5 of the portfolios created by Magnifi. The SHARP Ratio, Treynor Ratio, and Significance are calculated the same as in Table 2.

Table 5 presents the differences between my portfolios and the S&P 500’s performance over the month of February, otherwise known as the excess return.
Table 6 presents the excess return for Magnifi's portfolios, calculated the same as in Table 5.

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Return</th>
<th>Excess Return</th>
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</thead>
<tbody>
<tr>
<td>Magnifi 5</td>
<td>2.57%</td>
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<tr>
<td>Magnifi 10</td>
<td>0.26%</td>
<td>-4.91%</td>
</tr>
<tr>
<td>Magnifi 25</td>
<td>3.93%</td>
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</tr>
<tr>
<td>S-T</td>
<td>17.31%</td>
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<tr>
<td>L-T</td>
<td>2.15%</td>
<td>-3.02%</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>5.17%</td>
<td></td>
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</table>

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