UCI Paul Merage School of Business

Leadership for a Digitally Driven World™

Robo-Advisors in Action:

A Performance Evaluation

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1. Abstract

This project examines the performance of Robo Advisors compared to the S&P 500 over the periods of 2018-2019, 2020-2021, and 2023-2024. Our findings indicate that Robo Advisors generally underperform the S&P 500 in strong markets but outperform during downturns. Regression and ANOVA analyses show a weak and often negative correlation between fees and performance, implying that higher fees do not necessarily result in better returns. Based on factors like fees, investment options, and usability, we recommend specific Robo Advisors tailored to different investor needs that are listed in this report. Additionally, traditional advisors, while achieving higher returns in bull markets, face higher fees and risks that can erode net returns. This study highlights the importance of aligning investment choices with individual financial goals.

2. Motivation

The primary motivation of our study is to assess the annual performance of Robo Advisors relative to S&P 500 returns during three market periods: 2018-2019, 2020-2021, and 2023-2024. We aim to discern any correlations between Robo Advisors' fees and their performance while also examining how different Robo Advisors compare amongst themselves and against traditional financial advisors. Through this we hope to provide insights into the efficacy of Robo Advisors as investment vehicles across diverse market environments.

2.1 Current Understanding

While previous research has examined the performance of Robo Advisors and their fee structures, there is no overall consensus on which are best. When looking only at returns it is clear that performance “will vary significantly depending on the risk profile of the portfolio,

broader market conditions, and the specific Robo Advisor used. Some Robo Advisor portfolios may outperform the S&P 500 in certain years or under specific conditions, while in others, they underperform.[1]" This project seeks to contribute to this body of knowledge by analyzing Robo Advisor performance over multiple periods and the relationship between fees and performance in depth and see if our analysis corroborates these findings.

3. Data Collection

Our data collection process began by compiling a list of 34 Robo Advisors and documenting them in an Excel file. We created columns labeled 'Annual Fees' and 'Minimum Deposit' to record necessary data for each Robo Advisor. This initial data was collected from the website Robo Advisor Pros[2].

The collection of performance data presented a greater challenge due to the scarcity of publicly available return information for each company. Additionally, the data we could find was not consistently available across all companies, leading to a need for aggregation from multiple sources and different years. Our primary resources for this information included Condor Capital[3] and Super Money[4], which provided performance data for over 20 companies. Condor Capital's data covered the period from March 2023 to March 2024, while Super Money provided data from January 2018 to January 2019. We also supplemented our dataset with return information from Asset Builder[5], which offered performance data from select Robo Advisors for the years 2020-2021.We added all of this to our Excel file, creating new columns for the return years and systematically populating these columns with the respective data for each Robo Advisor.

4. Data Analysis Approach

For our Data Analysis approach we started off by creating a Pandas DataFrame within Python. Data cleaning was a critical step where we converted relevant columns to numeric formats and addressed any non-numeric entries by coercing them to NaN. To benchmark the performance of Robo Advisors, we fetched historical performance data for the S&P 500 index using the 'yfinance library' API. We calculated daily and annualized returns for the periods we had data from and matched S&P with the exact timeframe of the returns. This allowed us to have fully cleaned data where we could then begin our analytical approach.

4.1 Analytical Approach

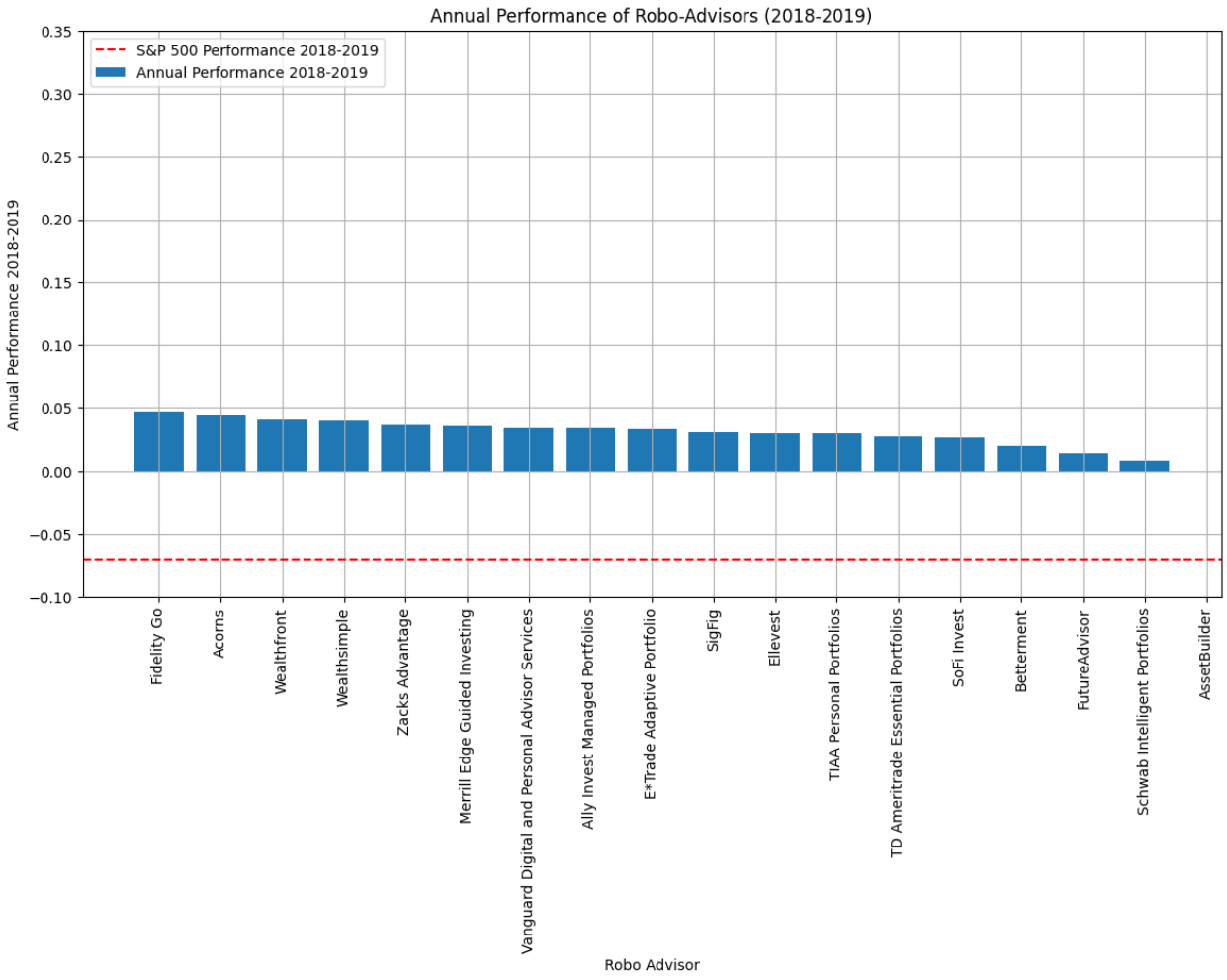
We employed several analytical techniques:

1. **Visualization**: We calculated the Robo Advisors return for each period and compared it to that of S&P 500 via bar chart.
2. **OLS Regression Analysis**: We performed separate regression analyses for each period to explore the relationship between annual fees and performance. This helped us understand how this relationship varied over time.
3. **ANOVA**: We conducted Analysis of Variance to test for significant differences in performance means across different fee groups.
4. **Correlation Analysis**: We computed correlation coefficients to measure the strength and direction of the relationship between fees and performance.
5. **Interaction Terms**: We included interaction terms in our regression models to examine how minimum deposit requirements might influence the fee-performance relationship.

By following this we ensured that we would be able to conduct a thorough analysis of the relationship between annual fees and the annual performance of Robo Advisors.

5. Performance Comparison

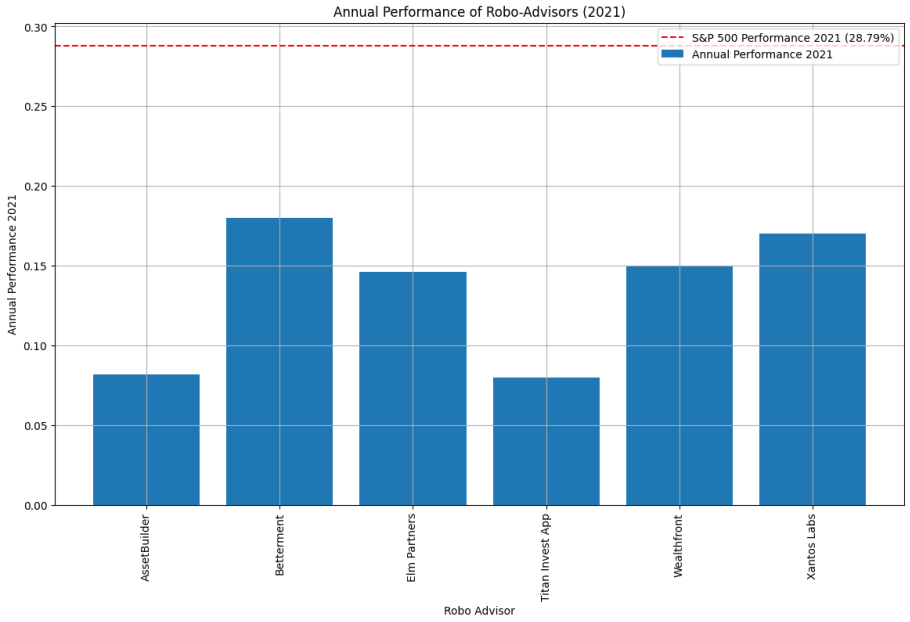
5.1 2018 - 2019 Visualization & OLS Regression



We began our analysis by comparing the annual performance of Robo Advisors to the S&P 500 for 2018-2019. During this period, the S&P 500 posted a negative return of -7.01%, indicating a challenging market. Robo Advisors meanwhile outperformed the benchmark, with AssetBuilder being the worst performer. This suggests that Robo Advisors effectively managed risk and prioritized capital preservation during market volatility.

For 2018-2019, regression analysis indicates no significant relationship between annual fees and performance among Robo Advisors. The adjusted R-squared value of -0.069 shows weak explanatory power, and the p-value of 0.860 suggests that fees are not statistically significant predictors of performance. Thus, there is no clear evidence that higher or lower annual fees correspond to better or worse performance in this period.

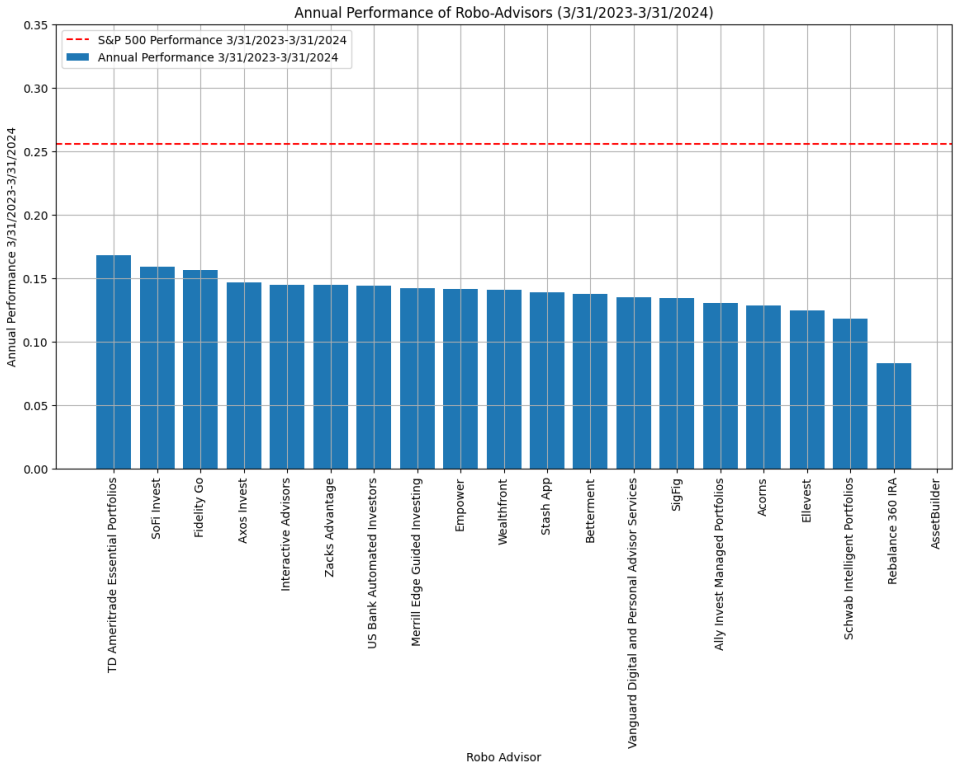
5.2 2020 - 2021 Visualization & OLS Regression



During the period of 2020-2021, the market saw a strong performance. For Robo Advisors we successfully retrieved information from, they did not perform as well as expected with their returns ranging from 8.2% to 18% compared to the S&P 500's annual return of 28.79%. Betterment and Xantos Labs were among the best performers with their returns around 18% yet they still fell short of the S&P 500 benchmark. This timeframe demonstrates that although the Robo Advisors might not fully capture the gains during strong market conditions, they still offer stable returns for the investors.

The 2020-2021 regression analysis provides information on the relationship between annual fees and performance by stating the model only explains 0.2% of the variation in the annual performance (R-squared = 0.002) which indicates that the factors considered in the model are not significant in predicting performance outcomes.

5.3 2023 - 2024 Visualization & OLS Regression



The 2023-2024 period indicates that the S&P 500's performance went well with a return of 27.865%. However, Robo Advisor companies again underperformed with returns ranging from 8.3% to 16.79%. The negative result of outperformance values demonstrates all Robo Advisors performed weakly compared to the S&P 500.

In addition, the regression analysis provides some findings of the relationship between annual fees and performance by stating the model only explains 4.1% of the variation in the annual performance (R-squared = 0.041) which indicates that the factors considered in the model are not very significant in predicting performance outcomes. The regression coefficient for annual fees is -0.0001 which shows a slight negative relationship between fees and performance. In other words, as fees increase, performance tends to decrease. Nevertheless, this relationship is not statistically significant as the p-value results in 0.423. It suggests that the impact of fees on performance is not conclusive.

5.4 ANOVA, Correlation Analysis, and Interaction Term

ANOVA results revealed no statistically significant differences in the annual performance of Robo Advisors across fee categories for 2018-2019, 2020-2021, and 2023-2024. The p-values (2018-2019: 0.856, 2020-2021: 0.622, 2023-2024: 0.114) are all greater than 0.05, indicating that variations in fees do not significantly impact Robo Advisor performance during these periods.

The correlation analysis showed a varying impact of fees on performance across different periods. For 2018-2019, the correlation was very weak and positive (0.057), indicating almost no relationship. In 2021, a moderately strong negative correlation (-0.616) suggested higher fees were associated with lower performance. For 2023-2024, the weak negative correlation (-0.212) also suggested that higher fees were slightly associated with lower performance, though the relationship was not strong.

Interaction Term analyses examined the relationship between annual performance and various factors across different periods. In 2018-2019, the model showed low explanatory power (R-

squared = 0.108) with no significant coefficients for Annual Fees, Minimum Deposit, or their interaction. In 2020-2021, a high R-squared (0.949) indicated strong explanatory power, with the interaction term between Annual Fees and Minimum Deposit significantly influencing performance ($p = 0.042$), although individual predictors were not significant. For 2023-2024, the model had moderate explanatory power (R-squared = 0.617), but none of the predictors or interaction terms were statistically significant. These findings suggest varying impacts of fee structures and account characteristics over time, with 2021 standing out due to the significant interaction effect, though limited data in 2021 calls for a cautious interpretation.

5.7 Analysis Summary

Our analysis revealed during challenging market periods, Robo Advisors demonstrated resilience by outperforming traditional benchmarks. However, regression analyses consistently showed no significant correlation between annual fees and performance, suggesting that fee structures alone do not influence outcomes significantly. In periods of strong market performance, Robo Advisors often underperformed compared to the broader market, indicating their conservative approach may limit gains during market upswings.

ANOVA results indicated that fee variations did not significantly impact annual performance across different years. Correlation analysis revealed varying impacts of fees on performance, with some periods showing weak relationships and others indicating a moderate negative correlation. Further, interaction term modeling revealed that, while fee structures and minimum deposit requirements sometimes influenced performance, the impact varied significantly over time and was not always statistically significant. Overall, our findings highlight that Robo

Advisors tend to have a more conservative approach to investing and that returns aren't dependent on fee structure.

6. Robo Advisor Suggestions & Traditional Advisor Comparison

Robo Advisors have changed the financial advisory landscape by offering automated, algorithm-driven investment management services at lower costs. They provide ease of use, higher accessibility, and generally lower fees compared to traditional financial advisors, making them popular among a broad range of investors. Our analysis revealed that no single Robo Advisor consistently outperforms others. Robo Advisors tend to underperform the S&P 500 during strong market years but outperform during downturns, suggesting more conservative, risk-averse strategies.

Considering factors like fees, investment options, and usability, we recommend Betterment for everyday investors due to its competitive fees and portfolio customization options. SoFi Invest is ideal for cost-conscious investors with no annual advisory fees and access to financial advisors at no additional cost. M1 Finance suits beginners, offering no management or advisory fees and providing flexible investment choices through user-selected investments. Robo Advisors typically charge lower fees, with fee structures varying from flat fees to tiered systems based on investment amounts.

Finally, we would like to add that traditional financial advisors still maintain a strong presence with their personalized strategies and relationship-driven approaches. Traditional advisors often achieve higher returns in bull markets but face higher risks and costs. They typically match or slightly outperform the S&P 500 in strong markets but may underperform during downturns due

to higher fees and management costs. Traditional advisors charge higher fees for their personalized services, which can include management, performance, and administrative fees. While fees can reduce net returns, many investors find value in the personalized advice and comprehensive financial planning provided by traditional advisors.

7. Conclusion

Robo Advisors generally underperformed the S&P 500 during strong market years but outperformed during downturns, indicating better risk management or more conservative strategies during market declines. Higher fees were associated with poorer performance in some years, while in others, fees did not significantly impact performance. Our findings suggest that improving performance in strong market conditions could enhance competitiveness, and strategies could be adjusted to better capture market upswings while maintaining the risk management that benefits performance in downturns.

Additionally, we highlighted how Robo Advisors offer low-cost automated solutions suitable for many investors, while traditional advisors provide personalized services crucial for others. For investors seeking cost-effective solutions, we recommend carefully considering Robo Advisors such as Betterment, SoFi Invest, & M1 Financial, but also to be cautious of higher fees associated with short-term investments. Going forward Robo Advisors should focus on reducing fees or ensuring higher fees are justified by significantly better performance. Traditional advisors, leveraging personalized services and human interaction, can adapt strategies to changing market conditions more rapidly, potentially leading to better outcomes. Understanding these dynamics empowers investors to make informed decisions aligned with their financial goals and preferences.

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