**Brainwave Wealth Management: A Survey of Data-Driven Approaches**

Rudraksh Mishra[[1]](https://word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Fpennstateoffice365-my.sharepoint.com%2Fpersonal%2Frjm7016_psu_edu%2F_vti_bin%2Fwopi.ashx%2Ffiles%2Fb980f00ce7d04c028511dc0bca458849&wdenableroaming=1&mscc=1&wdodb=1&hid=7A085A24-6B74-44E1-BDB9-1880C0994A84&wdorigin=OWA-NT&wdhostclicktime=1650303207951&jsapi=1&jsapiver=v1&newsession=1&corrid=7013e4f3-92f2-41f3-8d29-366fc36659a9&usid=7013e4f3-92f2-41f3-8d29-366fc36659a9&sftc=1&mtf=1&sfp=1&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush&rct=Medium&ctp=LeastProtected" \l "_ftn1)1, Abhay Chamu Haridas1, Nikhitha Khunduru1, Ambika Chundru1, Shaheed Mahbub1, Jesse Gardner1and Dusan Ramljak1

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***Abstract***

Financial instability is one of the dire consequences of the global pandemic Online portfolio management should be personalized, accessible and affordable experience. We surveyed XXX papers to carve the picture of the state of the art and suggest the areas of research to build personalized online portfolio management tools.

**Keywords:** keyword A, keyword B, keyword C, keyword D

**1. Introduction**

During these unprecedented times financial instability might lead to fear and panic and thus irrational decisions. The COVID-19 pandemic has shed light on how important it is to plan for the future and the unexpected. Financial security is possible with the help of financial guidance and service software from wealth management institutions. These institutions should be able to build customer specific guided plans with a higher rate of customer satisfaction. At the same time, online recommender services should be a one-time investment with the flexibility to update and tune the system, which would be more cost effective than hiring consultants for customer based financial advising. Portfolio management is an online wealth management service that uses statistical points of the issue as well as automatized algorithms to optimize the performance of client assets. Customers fill in their financial goals, for example, to save some amount of money during a certain period. The robot advisor then assigns current assets to investment variants and opportunities. We are interested to survey portfolio management solutions that will optimize the performance of client investments leveraging statistical data and Artificial Intelligence (AI) driven algorithms. Those will allow customers to achieve their financial security over a certain length of time. Also, AI driven advisor should suggest allocating current assets to various investment options and prospects.

<https://www.forbes.com/sites/forbesfinancecouncil/2022/03/18/how-to-navigate-financial-instability-during-unprecedented-times/?sh=2b4ea845284f>

<https://skylightfinancialgroup.com/4-easy-financial-steps-you-can-take-in-unprecedented-times-to-prepare-for-the-future/>

Fear is one of the issues that stops a person from investing in businesses and stocks. People are hesitant to do so due to a lack of market experience and a fear of losing money. Another reason being that many of them are not aware of the benefits of small regular investments and hence do not end up saving for the same. This is also due to lack of instant gratification as saving up and long-term investing does not involve instant gratification, hence there is no motivation to do so. Through personalized portfolio management one would not only understand the benefits of regular planned investments or savings, but also be able to see the forecasted results of these regular investments. Another factor according to a recent survey conducted by [GOBankingRates](https://www.gobankingrates.com/investing/strategy/this-is-why-55-of-americans-arent-investing/) is that 55% of Americans believe they do not have the money to do so. With the help of personal monthly spending analyser tool, this problem could be solved by pointing out how to cut monthly expenses by monitoring the spending behaviour. This will help in starting small and creating a habit to invest as small investments over time lead to great wealth accumulation over time.

Portfolio management needs to satisfy the following characteristics which we will explain one by one. One of the services that needs to be offered is the forecasting of stock prices for a prolonged period. This involves stock prices prediction based on past 3 years trends using deep neural networks. The prediction of stocks is done for all top fortune 500 companies from different sectors as well as index funds. The estimate of the prediction of stock prices should be the parameter to motivate the end user by highlighting the amount of forecasted interest earned over the years by investing their desired amount. Another component to this should be based on the risk tolerance of the user, the recommended investment options (stocks, bonds, index funds) should be based on the risk tolerance of the customer. Since the risk tolerance of a customer is not easy to quantify by the customer itself, their behaviour could be monitored during investing. In that way the sentiments of the customers could be detected automatically, while they see a change in their financial portfolios. For example, if the algorithm records a constant sense of fear from its user, it should be able to tell that the risk tolerance of this particular consumer can be reduced by some margin.

[[1]](https://word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Fpennstateoffice365-my.sharepoint.com%2Fpersonal%2Frjm7016_psu_edu%2F_vti_bin%2Fwopi.ashx%2Ffiles%2Fb980f00ce7d04c028511dc0bca458849&wdenableroaming=1&mscc=1&wdodb=1&hid=7A085A24-6B74-44E1-BDB9-1880C0994A84&wdorigin=OWA-NT&wdhostclicktime=1650303207951&jsapi=1&jsapiver=v1&newsession=1&corrid=7013e4f3-92f2-41f3-8d29-366fc36659a9&usid=7013e4f3-92f2-41f3-8d29-366fc36659a9&sftc=1&mtf=1&sfp=1&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush&rct=Medium&ctp=LeastProtected" \l "_ftnref1) Corresponding author: E-mail: [rudraksh.mishra@psu.edu](mailto:rudraksh.mishra@psu.edu)

Another feature that products come equipped with is an automatic monthly expense analyser. Through this feature the users can track their monthly expenditures and also analyse this data to identify their spending patterns, followed by recommendations of the areas where they can save. This model should be dynamic and used on a daily basis. Here the users input their account details or the bank statements and get user friendly visualization of spending patterns with recommendations of areas that can potentially lead to cost cutting. Apart from this, the system also should create a personalized portfolio specific to the needs of the end user. For example, it takes into account the user’s diversity (age, gender, race, dependents, marital status, partner planning, pension, social security, etc.) and if they are a veteran (401-B) or physically challenged (ABLE). This helps to tailor a customized plan based on the user's current assets, income, estimated savings, background, and financial goals. Users also have access to customized recommended financial plans to reach their desired retirement goals. For example, a person with 100k income of age 35 wants to retire by 55 will be recommended how much they can save based on their expenditure history and where they can invest those savings.

We are looking for tools that not only display the recommended paths to achieve financial goals but also give an estimated confidence level on the probability of success of the plan. Apart from these parameters the ideal financial plan considers the current liabilities of the user (their current loans/debts, mortgages, etc.). Additionally, the cyber-security team deals with the security of all the customers' data and documents.

  This paper focuses on finding how data-driven techniques helped resolving the described portfolion management issues PUTWHATARETHOSEISSUES. After performing a systematic review of $X$ %numberOfPapers works dealing with the above mentioned issues, we present here $Y$ %filteredNumberOfPapers the most relevant ones. This review revealed that most papers using data-driven techniques are focusing on one of the identified issues while only $Z$ %numberOfPapersUsingCOForBoth use data-driven techniques to deal with both. The results also indicate that data-driven techniques have been extensively used for $P$ %whatHasBeenCOMostUsedIn in $Q$ %numberOfPapersUsingCOinWhatHasBeenCOMostUsedIn selected studies. Distinctively, only $R$ %numberOfPapersUsingCommunityDetection use DEFINEWHATWEAREAFTER, which may indicate a path for future developments.

The remainder of the text is organized as follows. Related work is reviewed in Section 2. Section 3 details the research method used in literature review. The data-driven techniques research into two main topics of interest is described in Section 4 along with potential improvements of the existing techniques, and suggestions for new methodology that may resolve the considered portfolio management issues. Section 5 concludes the paper.

**2. Related Work**

Although a number of studies focus on addressing the issues with portfolio management, there is no comprehensive survey on all identified perspectives. To fill this gap, we conduct a comprehensive survey on the two critical issues faced while building portfolio management tools which is connected to data-driven techniques.

**3. Research Methodology**

This paper uses a systematic mapping study approach to conduct a literature evaluation of research works that looked into the personalization of portfolio management, including data-driven techniques and dealing with, processing overhead, scaling, consistency, security, and privacy concerns. Also, discuss how data-driven techniques can be used to address issues like security and inefficient resource utilization. The systematic mapping used the following procedures, which were based on the instructions offered by Pinciroli et al.: Research questions; research methodology; results screening criteria

***3.1. Research Questions***

Please put RESEARCHQUESTIONS.

***3.2. Research Methodology***

Please put RESEARCHMETHODOLOGY.

***3.3. Results Screening Criteria***

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**4. Results**

Survey results come here.

**5. Conclusions**

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<https://link.springer.com/chapter/10.1007/978-3-030-13929-2_15>

**Financial Brainwave**

**Introduction**

Financial Brainwave is an online wealth management solution that will optimize the performance of client investments leveraging statistical data and Artificial Intelligence (AI) driven algorithm. Brainwave will allow customers to achieve their financial objectives such as saving a certain amount of money over a certain length of time. After that, the AI driven advisor allocates current assets to various investment options and prospects. Our target audience are financial institutions like Betterment and Wealthfront. With the help of our financial guidance and service software these institutions will be able to build better customer guided plans with a higher rate of customer satisfaction. At the same time, these online recommender services will be a one-time investment with the flexibility to update and tune the system, which will be more cost effective than hiring consultants for customer based financial advising.

**Rationale**

Fear is one of the issues that stops a person from investing in businesses and stocks. People are hesitant to do so due to a lack of market experience and a fear of losing money. Another reason being that many of them are not aware of the benefits of small regular investments and hence do not end up saving for the same. This is also due to lack of instant gratification as saving up and long-term investing does not involve instant gratification, hence there is no motivation to do so. Through our system one would not only understand the benefits of regular planned investments or savings, but also be able to see the forecasted results of these regular investments. Another factor according to a recent survey conducted by [GOBankingRates](https://www.gobankingrates.com/investing/strategy/this-is-why-55-of-americans-arent-investing/) is that 55% of Americans believe they do not have the money to do so. With the help of our monthly spending analyzer tool, we will be able to solve this problem by pointing out how to cut monthly expenses by monitoring the spending behavior. This will help in starting small and creating a habit to invest as small investments over time lead to great wealth accumulation over time.

**Project Description**

The main objective of the product is to help individuals manage their wealth allocation using automated targeted financial advice and guidance. Users fill in their financial goals, for example, to save some amount of money during a certain period. The automated advisor then assigns current assets to investment variants and opportunities based on the customer’s goal. Concisely, it is an automated portfolio manager which provides financial guidance and service based on everyone’s risk tolerance and financial capability. This proposed product has several subcomponents/tools offered within the system. We will be going through each one of them one by one. One of our services offered is the forecasting of stock prices for a prolonged period. This involves stock prices prediction based on past 3 years trends using deep neural networks. The prediction of stocks is done for all top fortune 500 companies from different sectors as well as index funds. The estimate of the prediction of stock prices will be on the parameter to motivate the end user by highlighting the amount of forecasted interest earned over the years by investing their desired amount. Another component to this will be based on the risk tolerance of the user, the recommended investment options (stocks, bonds, index funds) will be based on the risk tolerance of the customer. Since the risk tolerance of a customer is not easy to quantify by the customer itself, we propose a method where customers can give permission to allow their behavior to be monitored during investing. In that way we will be able to detect the sentiments of the customers while they see a change in their financial portfolios. For example, if the algorithm records a constant sense of fear from its user, it will be able to tell that the risk tolerance of this particular consumer can be reduced by some margin.

Another feature that our products come equipped with is an automatic monthly expense analyzer. Through this feature the users can track their monthly expenditures and also analyze this data to identify their spending patterns, followed by recommendations of the areas where they can save. This model will be dynamic and can be used on a daily basis. Here the users input their account details or the bank statements and get user friendly visualization of spending patterns with recommendations of areas that can potentially lead to cost cutting. Apart from this, the system also creates a personalized portfolio specific to the needs of the end user, this approach is quite unique and not followed by huge financial advising firms in their automatic advising software. For example, it takes into account the user’s diversity (age, gender, race, dependents, marital status, partner planning, pension, social security, etc.) and if they are a veteran (401-B) or physically challenged (ABLE). This helps to tailor a customized plan based on the user's current assets, income, estimated savings, background, and financial goals. Users also have access to customized recommended financial plans to reach their desired retirement goals. For example, a person with 100k income of age 35 wants to retire by 55 will be recommended how much they can save based on their expenditure history and where they can invest those savings.

It not only displays the recommended paths to achieve financial goals but also gives an estimated confidence level on the probability of success of the plan. Apart from these parameters the suggested financial plan considers the current liabilities of the user (their current loans/debts, mortgages, etc.). Additionally, the cyber-security team deals with the security of all the customers' data and documents.

This proposed system is completely self-explanatory, it does not need a planner or interpreter to interpret the recommendations as it gives a clear understanding of why particular plans/solutions have been recommended.

**Outcomes (Broader Impacts)**

These digital investment platforms simplify the investment process which can be daunting for many people. Our automatic portfolio management helps in creating and overseeing selected investments that align with the investor's long-term financial goals and risk tolerance and allows them to monitor and periodically rebalance their portfolio.

**Support (Budget) -**

To be decided

**Personnel**

Rudraksh Mishra will serve as the project idea developer and lead developer. He is a full-time student at Pennsylvania State University, pursuing a master's in data analytics and working as a machine learning research assistant. He has interned at three different companies in the past (Toyota, Wipro Technologies and GND solutions) as a data scientist and data analyst. During his latest data science internship at Toyota, he successfully built a computer vision system that analyzed and evaluated 160 employees’ performance to attain data for mishandling of product assemblies and predicted peak faults using machine learning algorithms, which improved the work efficiency by 14% and resulted in estimated annual savings of $85K.

Dr. Dusan will serve as the project manager and functional manager (PLEASE ADD OTHER ROLES – I could think of these two for now) …... Dr. Dusan’s Introduction.