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ADVANCES IN GLOBAL SERVICES AND RETAIL MANAGEMENT

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Decentralized Approach to Deep-Learning Based Asset Allocation

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Abstract

Investment is an artistic science. The study discusses deep learning-based techniques for asset allocation. Deep learning is a subset of machine learning. The majority of the population lacks either the skills or the time to self-analyze the different financial investment options available to them and therefore they seek the help of the portfolio managers who make trading decisions on behalf of their clients depending on their risk appetite. Besides, portfolio managers analyze different assets, compare the strengths and weaknesses of each option before making a decision about which equities are suitable, to optimally balance profit and risks. This makes portfolio management a fairly complex process which eventually becomes one of the primary deterrents for a common person. Artificial intelligence can be a useful technological aid in determining profits and risks. Deep learning is the subset of machine learning and artificial intelligence. There is an essential usage of deep learning algorithms for accurately predicting the risk appetite of users by doing personality and demographic assessments on multiple levels to assist that particular individual in investing decisions. The research study proposes to decentralize the artificial intelligence-based portfolio management and create a shift of power from institutions towards the masses has been done.

Introduction

Investing is a science and art which requires long practice and a deep understanding of the financial markets. However, for a common man of India, who is directly not a part of the finance world, investing can be complicated and very overwhelming. After all, there are so many different options out there, from stocks and bonds to real estate and money market accounts. For the majority of the population, it becomes really difficult to take out the time and develop the expertise to analyze the stocks and then invest accordingly. In this study deep learning-based techniques for asset allocation have been discussed. Deep learning is a subset of machine learning. Artificial intelligence is the superset of machine learning. It has been found that the majority of the population lacks either the skills or the time to self-analyze the different financial investment options available to them. Often it so happens that due to improper induction to the world of the stock market, a large percentage of people stay away from it. This shift causes a great opportunity

for the people since then. they are left with overreliance on traditional investment options which more often than not, have very conservative to moderate return on the principal amount invested. The other challenge is faced by the start-up and innovative organizations of the country since because of the unavailability of public funding, they have to heavily rely on venture capitalism. Another important point of consideration is worth mentioning; to solely design one's portfolio based on recommendations by various investment firms, popular traders or fund managers is also not advisable. Without proper scrutiny of the information flux received from the various sources, it becomes really risky for the investor to infuse the money into the financial markets. Almost all of the information flux available on different media streams is very subjective and if used as it is, rarely proves useful for the individual, since the information flux needs to be sorted, graded, and modified according to the risk appetite of the individual.

The objectives of the study mainly revolve around the aspects like- ascertaining major factors influencing the investing decisions of common people with little to no knowledge of the investing world. How do these decisions change as the family compositions and age change? analyzing the personality traits which can serve as the best indicators for predicting an individual's risk appetite, to research and investigate multiple deep learning algorithms to find the best suited financial investment options in accordance with the overall holistic personality of the individual and to develop a suitable mobile application which can carry out the above-mentioned operations and act as an interface between the trading apps and the person's investment decisions.

The next section of the study discusses the literature review collected from various sources. The third section attempts to formulate the research objectives of the research study based on the gaps and problems found. The next section attempts to mention the methodology implemented to execute the research process. The subsequent section also discusses the analysis and findings of the research study. And finally, last but not least the conclusions section also discusses the future scope of research because this study opens up new avenues of research and development.

Literature Review

An extensive review of literature has been done from various studies of relevance. Despite the volatility in stock prices and the inapplicability of linear logic while predicting and deciding finance portfolios, a large number of big management firms have had a great track record of offering their clients great returns on investment. (Kristina Levišauskait, 2010). Dr. Robert G. Cooper, 2001 defines Portfolio management as, "A dynamic decision process, where, new projects are evaluated, selected and prioritized; existing projects may be accelerated, killed or de-prioritized; and resources are allocated and re-allocated to active projects. The portfolio decision process is characterized by uncertain and changing information, dynamic opportunities, multiple goals and strategic considerations, interdependence among projects, and multiple decision-makers and locations." On the risk of sounding too simplistic, in layman terms, portfolio management is the process of maximizing the return on invested principal. Portfolio managers make trading decisions on behalf of their clients depending on their appetite for risk. They analyze different assets, compare the strengths and weaknesses of each prior to making a decision about which equities are suitable, so as to optimally balance profit and risks. This makes portfolio management a fairly complex process. Which eventually becomes one of the primary deterrents for a common man's participation. (Eric Gilbert, 2010). Making the situation worse, when ordinary people with little to no background in finance begin their investing journey, a large majority of them fall into

the trap of blind-investing, i.e., making investment decisions based on the information collected from mainstream media or random gurus. Roland Benabou 1992, mentioned, "in stock markets, opportunistic individuals manipulate prices repeatedly, without ever being fully found out." When a newbie investor finds herself surrounded by alien-looking stock fundamentals and gets trapped in the false-information loop, she rethinks and reconsiders her decision about financial market investments.

"Investors hardly act reasonably while taking investment decisions. Investors have definite weaknesses like cognitive and poignant which take an important role in making investment decisions of individuals. They have behavioral biases in the event of taking decisions while investing. They just react to the available information with them and act accordingly to the financial environment." (Jeet Singh, 2016). Every investor makes her investing choice depending upon several factors. The factors can be intrinsic or extrinsic in nature. The seemingly irrelevant factors, such as the place of residence, the demographic, or the kind of lifestyle the investor maintains, also affect the investment decisions. Another important factor that determines the investment decision is investment psychology. (Dr. S.Suriyamurthi, 2012).

Francesco Costantino (2015) in their paper, presents, that it is of utmost importance to have a clear identification of threats and opportunities that can arise while investing for the first time. When this happens, a lot of people withdraw from participating in the markets which gradually leads to less liquid money circulation. Raman Nanda (2013) in his paper very lucidly brings out the link between investment cycles and start-up innovation. Due to the absence of liquid money in the market, the start-ups are left with very few funding resources which inhibit the innovation quotient. Through this research, the researchers want to address all the above-mentioned problems simultaneously and create safe and secure avenues, for the common people lacking skills and time, to invest in the financial markets. The biggest problems of humanity like healthcare and food have benefitted hugely from the advent of technology. Brenda Helen, (2014) exhaustively covers in her paper, various challenges in healthcare since the last 100 years and the role of technology in solving those challenges. Similarly, food security and food safety has become possible all over the globe in a big manner with the help of technology. (Jim Gaffney, 2019). Hence the researchers thought it fit to investigate the use of technology as a tool for solving the discussed problems. Artificial intelligence-based deep learning algorithms have been in use by big fund management firms for quite some time. Artificial intelligence supports the decision by analyzing enormous information. Man-Chung Chan, (2002) in his paper, developed a prototype based on the portfolio management process, involving stock selection and asset allocation optimization. "A genetically optimized fuzzy rule-base was developed for stock selection. A genetic algorithm was used to optimize asset allocation according to investor's risk aversion." In a study (Gang Huang,2020) it has been mentioned that the details of the functioning of his deep learning algorithm, "make the agent too short in a continuous action space, design an arbitrage mechanism based on Arbitrage Pricing Theory, and redesign the activation function for acquiring action vectors, in addition, we redesign neural networks for reinforcement learning with reference to deep neural networks that process image data". Hence the use of artificial intelligence as technological aid in determining the profits and risks is well-established. However, most of the research papers have discussed the use of AI and the Deep Learning algorithms for improving the efficiency of the large portfolio management firms, which are centralized in nature, since the individual investor deposits his principal amount to them and on the behalf of thousands and millions of such investors, the fund management firm allocates the total money collected to different portfolios. But there is little or

no research points on the use of Deep Learning algorithms for accurately predicting the risk appetite of the user by doing assessments on multiple levels in order to assist that particular individual to predict the best-suited amount and the category of stocks in order to optimally balance the risks and profits. We believe, that, by augmenting the individual's capability by the use of deep learning algorithms, not only an increase in financial market investments will be observed, but at the same time, decentralization of fund management can take place, which will be highly personalized in nature. The studies helped in extracting the research gaps and problems to formulate the objectives accordingly.

Research Objectives

The objective of this study is for the general mass, who are willing to invest but couldn't, due to time or knowledge constraints.

- To ascertain major factors influencing the investing decisions of common people with little to no knowledge of the investing world. How do these decisions change as the family compositions and age change?
- To analyze the personality traits which can serve as the best indicators for predicting an individual's risk appetite.
- To research and investigate multiple deep learning algorithms in order to find the best suited financial investment options in accordance with the overall holistic personality of the individual.
- To develop a suitable mobile application which can carry out the above-mentioned operations and act as an interface between the trading apps and the person's investment decisions.

Methods

The data used for this study is of a secondary and time series nature. The sampling technique used is convenience sampling. In the place of outsourcing the activity of portfolio management to the investment firms, the plan is to use a mobile application that will use predictive analysis techniques of deep learning to analyze the risk-appetite of the individual and suggest appropriate investment options. The first phase of the study dealt with understanding and identifying the major and minor factors affecting the investment decisions of people with little to no experience in the financing world. To ascertain major factors influencing the investing decisions of common people with little to no knowledge of the investing world. "Investors hardly act reasonably while taking investment decisions. Investors have definite weaknesses like cognitive and poignant which take an important role in making investment decisions of individuals. They have behavioral biases in the event of taking decisions while investing. They just react to the available information with them and act accordingly to the financial environment." (Jeet Singh, 2016). Every investor makes her investing choice depending upon several factors. The factors can be intrinsic or extrinsic in nature. The factors which are seemingly irrelevant, such as the place of residence, the demographic, or the kind of lifestyle the investor maintains, also affect the investment decisions. Another important factor that determines the investment decision is investment psychology. (Dr. S.Suriyamurthi, 2012). The available literature also indicates that the age of the investor, the stage of life, and the number of family members also play a vital role in determining the investment decision avenues. The second

phase of the study involved establishing statistical evidence between different factors such as the family size, income, stage of life, etc, and the investment psychology of the individual investor.

Analysis and Findings

Based on the data collected rigorous analysis was done in the research study to extract the relevant findings. The data analysis and its representation have been shown here in this section. The tables are a statistical representation of the analysis and findings done.

Table 1: Age-Based Distribution of Responses Received

Age	Number	Percentage (%)
20-35	76	76
36-45	16	16
46-50	4	4
50 & Above	4	4
Total	100	100

Table 2: Sex-Based Distribution of Responses Received

Sex	Number	Percentage (%)
Female	55	55
Male	45	45
Total	100	100

Table 3: Education-Based Distribution of Responses Received

Education	Number	Percentage (%)
PG	45	45
Graduate	46	46
Non-Graduate	8	8
Others	1	1
Total	100	100

Table 4: Occupation-Based Distribution of Responses Received

Occupation	Number	Percentage (%)
With Salary	72	72
Self Employed (Skilled)	9	9
Self Employed (Non-Skilled)	11	11
Retired	8	8
Total	100	100

Table 5: Income-Based Distribution of Responses Received

Income	Number	Percentage (%)
Up to 25000	45	45
25000-45000	20	20
45000-60000	15	15
Above 60000	20	20
Total	100	100

Table 6: Investment Experience-Based Distribution of Responses Received

Investment Experience	Number	Percentage (%)
Starting	51	51
Moderate Level	34	34
Knowledgeable	9	9
Experienced	6	6
Total	100	100

Table 7: Saving Percentage-Based Distribution of Responses Received

Savings Percentage	Number	Percentage (%)
0-12	28	28
12-22	22	22
22-32	19	19
32 & Above	31	31
Total	100	100

Table 8: Investment Saving Based Distribution of Responses Received

Investment Savings	Number	Percentage (%)
Yes	76	76
No	24	24
Total	100	100

Table 9: Preferred Avenues-Based Distribution of Responses Received

Avenues	Percentage of Preferred	Rank	Not-Preferred (%)
In Banks	78	1	22
Mutual Funds	67	2	33
In Gold	65	3	35
Post-Office	62	4	38
Insurance	55	5	45
Equities	44	6	56
Government Securities	38	7	62

Table 10: Investment Time-Based Distribution of Responses Received

Investment Time	Number	Percentage (%)
Monthly Basis	48	48
Quaterly Basis	24	24
Half-Yearly	12	12
Yearly	16	16
Total	100	100

Table 11: Saving's Based Distribution of Responses Received

Saving's Objective	Number	Percentage (%)
Children's Education	28	28
Retirement	12	12
Home Purchase	48	48
Children's Purchase	12	12
Total	100	100

Table 12: Investment's Based Distribution of Responses Received

Investment Objective	Number	Percentage (%)
Income & Capital Preservation	20	20
Long-Term Growth	24	24
Growth & Income	32	32
Short-Term Growth	24	24
Total	100	100

Setting up of the Hypothesis for the study:

- Null Hypothesis H_0: There is no association between Age and investment amount.
- Alternate Hypothesis H_1: There is an association between Age and investment amount

Chi-square test - We performed a Chi-Square test to understand the dependence of Investment amount on "Stage of Life" or age.

Table 13: Chi-Square Test

Particulars	Value	DF	Asymp. Sig (2-sided)
Pearson Chi-Square	81.307(a)	6	0.099
Likelihood Ratio	54.509	6	0.000
Linear by Linear Association	34.256	1	0.000
No. of valid cases	100		

The chi-square value is less than the significant value ($0.001 < 0.01$). Therefore, the alternate hypothesis is rejected and it is concluded that there is an association between age and amount of investment. Similar tests were performed for other variables and the relationship between individual investor's investment needs and those variables was established. Using the data thus obtained the research study was able to list down the variables on the basis of which, the risk-appetite and investment options for an individual investor can be determined using deep-learning algorithms. The variables are family size, age, monthly income, demographics, and financial literacy. This analysis helped in procuring the relevant findings needed to ensure the objectivity of the study.

Conclusion and Future Scope of Research

The research study attempted to decentralize the artificial intelligence-based portfolio management and create a shift of power from institutions towards the masses. In the next phase of the research study, identification of the kind of different deep learning algorithms currently is being used in the industry for dynamic personality assessment and asset allocation of funds can be ensured. After thorough analysis, the deep-learning thus selected is used for building the prototype. The mobile application, augmented with the deep-learning algorithm will dynamically assess and update the personality traits of the person using it and accordingly suggest the best kind of finance portfolio for investment. The beta version of the mobile application is in progress and will be put for testing and iteration. This study can open up new avenues of research and development.

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