

A COMPREHENSIVE STUDY OF FINTECH APPROACHES IN INDUSTRIAL REVOLUTION 4.0

Pratyay Chattopadhyay*1, Homak Patel*2, Viral Parmar*3

*1IIT Delhi, India.

*2School Of Technology, Ahmedabad University, India.

*3School Of Technology, Pandit Deendayal Energy University, India.

DOI : <https://www.doi.org/10.56726/IRJMETS45437>

ABSTRACT

Fintech is changing. FinTech replaces FT. 2018 fintech deals totaled \$120 billion. 11,000 fintech companies have received \$380 billion since 2014. Global tech companies are entering finance. Fintech and "big tech" lent \$500 billion in 2017, tenfold more than in 2014. Fintech automates cryptocurrency introduction. Finance technology has improved visibility and analysis. Automation improves team attention and efficiency. It also helped finance. Today, the internet and technology are essential. Finance. Fintech alters how people get financial products. Most tech-driven changes in finance. Booming fintech. Fintech improves financial services. Fintech is a risky yet crucial financial innovation. Global economic growth depends on IT. Market evolution. Management research and methods are insufficient in changing situations. Technology controls modern life. This research addresses financial technology's past and future. The banking industry could not provide as much service without technology. FinTech globalized finance in the late 1990s. FINTECH makes financial transactions cheaper and more accessible. Fintech helps AI companies safeguard online transactions. India adopts 87% of consumer fintech. The CAPM has been established for four decades, but technology can improve its accuracy. Arbitrage theory (APT). This strategy emphasizes economic issues over financial ones because it links expected rewards and risk linearly. It focuses on systematic risk indicators to find incorrectly priced assets and is suitable for value investors or investors in below-market equities. Here's APT. $E(R_i)$ estimated capital asset return R_z risk-free rate of return (n) Premium E_i APT is more adaptable than CAPM and incorporates macroeconomic theory to provide trustworthy results. GNP, GDP, and yield curve variations are APT factors. Arbitrage pricing theory implies market imperfections, notably mispricing, which leads to intrinsic value correction. AI is being used to improve the CAPM's expected returns. AI was taught to interpret and compute stock values using 2013-2019 tech firm closing prices. According to the 2020 study, AI improved cost estimations by 60% and returns by 18%. Simple and accurate, the CAPM is effective. APT predicts returns more accurately when combined with AI. Finance and technology can improve investment decisions by improving financial calculations.

Keywords: Fintech, Finance, Artificial Intelligence, Management, Industrial Revolution 4.0

I. INTRODUCTION

Technology is transforming the financial world into a whole new dimension. Starting from the applications of technology in the fields of education [1], healthcare [2,3], entertainment, it expanded its horizons to finance. The term Financial Technology is now referred to as FinTech. In 2018, total investment activity in fintech amounted to \$120 billion, spanning about 2600 deals. Since 2014, there have been over 11,000 fintech investments totaling about \$380 billion. In addition to that, global technology firms have also been increasing their entry into financial services. Collectively, the total volume of new credit provided by fintech and "big tech" in 2017 exceeded \$500 billion, a tenfold increase from 2014. Technology in finance is enabling automation of long tasks, to introduce a new monetary technology such as cryptocurrencies. Technology in finance has created new visibilities and improved capabilities to provide more accurate insights and analytics. Automation has enabled teams to increase efficiency and focus on key priorities. It has also added stronger and secure foundations of financial transactions.

In the present era, it is impossible to imagine a world without internet and technology as they have become core essential in our lifestyle. Same way, finance industry is a no exception. Fintech is transforming the way customers access financial products. Although there has been an immense change in the finance market most of them are technology driven. Fintech is growing at an exceptional rate. Fintech is the application of technology to

the provisions of new and improved financial services. Fintech is a component of the evolving financial innovation process, which has been shown in theory to be risky, but valuable [4]. Information Technology has become a key element globally in economic development. Today, the market is rapidly changing and developing [5]. Under these conditions, traditional management studies and approaches are insufficient in any organization in these dynamic atmospheres. Technology plays a key role in today's modern environment in all aspects. This report focuses on the relationship of change and technology in the financial industry in, both past and future. Financial industry could not provide the level of service it is providing without the technology [6]. Fintech was first introduced in the late nineties where finance and technology were combined for first financial globalization. Financial transactions for customers and businesses both are simplified by FINTECH by making them more easily accessible and affordable [6] [31]. Fintech is also useful to companies and services regarding AI to facilitate highly secure transactions amongst an internet network. Globally, there is around 87% of Consumer Fintech adoption by India [7].

II. LITERATURE REVIEW

(Rajarajeswari, 2021) conducted a study on "Finance Technology in Indian Finance Market." The focus of study was to discuss the issues such as financial technology drivers, shortcomings of traditional financial services, and the role of technological advancement. The study is based on secondary data for research using various websites, research articles, online journals, news articles, website reports and other internet sources. The researcher has used qualitative method to deliver the report on Fintech and its role in Indian finance market. The researcher concluded his study that, India is a highly distinctive, exciting country that will forge its own path on both domestic and international market scale [8].

(Vijai, 2019) conducted a study on "Fintech in India- Opportunities and Challenges." The focus of the study was to access the opportunities and challenges in the fintech industry. The researcher has done research based on various secondary data available on the internet. Various fintech companies and their funding is compared for analyzing various challenges and future perspectives. Further, the study concludes that Fintech is an emerging concept in the financial industry which is more secure and user-friendly and reduces costs for financial services and is the fastest growing industry in the world [9].

(Pant, 2020) conducted a study on "Fintech-Emerging Trends." The main purpose of the study is to understand fintech and the opportunities it creates in the market. The researcher also studies the emerging trend of fintech. A comprehensive review on fintech, digital money, fintech innovations, cryptocurrency, block chain, and financial technology has been undertaken to define the scope and objectives of the study. Various key data were taken from websites of leading market research organizations. Further, the study concluded that fintech firms struggled a bit due to coronavirus pandemic but still its innovations have transformed the finance business and is also growing faster than ever [10].

(Keke Gai, 2017) conducted a survey on Fintech. The study covers a large scope of techniques of financial service deliveries. The researcher aims to produce a survey on fintech by collecting and reviewing various frameworks of fintech. The paper was concluded on survey of five technical aspects of fintech [11].

Finance is the study of money, assets, and currency. It has an inherent connection with economics, which is the study of the circulation of money in the world varying from produce, consumer goods, capital goods, and the imports and exports of a country. Financial professionals working to calculate the value of a company's assets, liabilities, financial models, or risk assessors can be used to evaluate the outcome of a decision to make an effectively calculated decision about investment in the public and private sectors. The economy of a certain field or area needs to be considered to make an educated financial decision with the possibility of making a profit [12].

The technological revolution in finance has brought great ease of processes in the banking sector. A notable example of this would be mobile banking apps, enabling customers to view their financial data and perform transactions just in a few clicks rather than physically visiting the bank.

Merging tech with finance has enabled generation of huge datasets, allowing AI and predictive algorithms to run on the data for better insights. This has helped users make better educated decisions about cash flow and forecasting. These algorithms deliver neutral, unbiased predictions based on data when it comes to data-based

predictions. Hence, providing enhanced insights and analytics [13].

There are eight FinTech categories where technology has evolved:

1. **Banking:** Net Banking allows us to manage transactions and current, personal or savings accounts and mortgages.
2. **Reg-Tech:** Focusing on risk analysis on reimagining and streamlining risk, credit scoring, and compliance.
3. **InsurTech:** Includes companies selling insurance digitally or introducing new digital business models or reinsurance software.
4. **Lending:** Companies focusing on innovating credit, including commercial to alternative and specialist lenders and platforms that facilitate P2P.
5. **Business banking:** Specifically, we focus on supporting small businesses with services such as accounting, payroll, invoices, and expense management.
6. **Payments:** Businesses that provide money transfer, remittance, and foreign exchange services.
7. **Quote Aggregators:** Provide online comparison systems for consumer quotes such as insurance and mortgages.
8. **Wealth-Tech, the largest** industry, focuses on investment and management platforms, sales and trading analysis tools, personal asset management and crypto exchange.

Technology has applications in the electronics industry which includes robotics [13], IoT and many more. Technology has brought speed, security [14], and agility in the finance sector through shifting the old techniques to current technology such as cloud platforms for scalability and security. Providing better data-based decisions through machine learning and AI. Providing speed and security through online and cashless transactions. Moreover, by introducing the most secure way of buying assets through blockchain [33] technology [34,35] such as cryptocurrencies and crypto platforms. Briefly, all of these transformations would make human life easier and enable them to make more informed decisions on their finances.

III. FINANCIAL MODEL IN THE INDUSTRIAL REVOLUTION 4.0

One of the most well-known models used to calculate risk and predict expected returns is the capital asset pricing model (CAPM). CAPM depicts the ideologies financial markets use to price securities and therefore calculate expected returns on investments. A security is anything that is a fungible asset, such as a stock, bond, or option [15] It shows the relationship between systematic risk and asset for capital assets, more specifically stocks. The model is used not only to determine risk and reward but also to price securities that hold risk and create profits for those assets, keeping risk and costs in mind. The formula of the CAPM is shown below.

$E(R_i) = R_f + \beta_i (E(R_m) - R_f)$
$E(R_i)$ = expected capital asset return R_f = risk-free rate of interest (TVM)
β_i = sensitivity (beta of investment) R_m = expected return of the market $(E(R_m) - R_f)$ = market risk premium

Whenever an investor makes an investment, they expect to be compensated not only for the money they invested but for the time it took for them to earn their money back [16]. This is called the time value of money (TVM) or the potential income. The risk-free rate represents the TVM in the CAPM.

The beta of an investment is the measurement of risk added to an account in comparison to the risk the market holds at the given time. In simpler words, it is the volatility of a stock relative to the entire market. Beta can be used to measure risk and performance; for example, if a given stock holds more risk than the market [17], it will hold a beta higher than one, which will in turn increase the risk of the account. Similarly, if the beta is less than one, CAPM shows that an investment in that stock would decrease the overall risk of that portfolio. Additionally, if the stock price moves in line with the market, the beta would be one, and if the market rose by 20% on a given day, the stock also rose 20%.

The beta can be an issue that investors see with the capital asset model, as it is not consistent over time. There have been discrepancies in beta over a prolonged period and in the correlation between beta and stock returns. However, beta helps investors pick stocks and quantify their risk. An account with high-beta stocks has the

potential to earn more money than an account with low-beta stocks.

The risk premium is a measure of risk and reward as an investor who takes on greater risk will be rewarded with greater return. This scale will be greater when investing in riskier securities such as stocks rather than bonds and mutual funds. The market risk premium is the return or the difference between the expected return $[E(R_i)]$ in an account and the risk-free rate of interest $[R_f]$.

The capital asset pricing model uses risks and returns on securities to help an investor understand whether they should invest in each stock, bond, or fund. The net gain/loss as a fraction of the base capital over a given period is the same as earned dividends and the capital gain/loss during the same period [18]. The risk assessed in the model is the possibility for how much actual returns will fluctuate compared to expected returns. Therefore, the greater this difference increases, the greater risk involved and vice versa.

The main advantage of CAPM yields is that this risk can easily be minimized by a common technique used by investors: diversification. Diversifying a portfolio with risky assets can create a combination to help subside risk and reduce the possibility of loss. Eliminating risk completely is impossible because financial markets sometimes move together and there is no perfect combination to eliminate risk [19]. However, a strategy in which low- and high-risk securities are combined in a portfolio will reduce risk overall.

To understand the capital asset pricing model, one must understand that there are two types of risks investments hold: systematic risk and unsystematic risk as characterized by William Sharpe, the financial economist behind the model [20]. Systematic risk is a risk in the market or the overall movement of it, something which cannot be prevented, for example: the Federal Reserve instituting a new monetary policy or an increase in the Federal Funds Rate. Unsystematic risk, on the other hand, is risk that is much more focused on, such as in individual securities, which can include acquisitions and the introduction of new competitors. Unsystematic risk can easily be eliminated with diversification; however, these two facets reveal that diversification cannot solve the issue with systematic risk making it a principal factor for investors to consider. Based on this information revealed by the model, markets need to consider systematic risk when pricing securities, especially those that carry elevated risk.

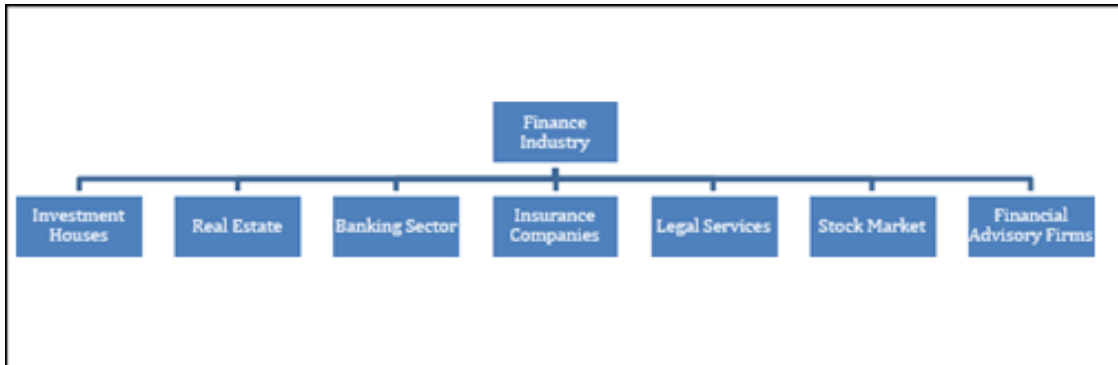
Putting all this together allows investors to understand the risk and return relationship for which the model is used. This relationship is called the security market line (SML). The $E(R_i)$ or expected return on a capital asset is equal to the R_f or risk-free rate plus the market risk premium. On a graph, with axes x and y as the systematic risk and expected return $[E(R_i)]$ the SML would be upwards sloping. This shows that as the systematic risk or risk that cannot be avoided increases the expected returns increase as well, bolstering the assumption and adequacy of the CAPM [21].

CAPM simply makes financial markets more comprehensible, which financial professionals can use to complement their other strategies. However, it cannot be used on its own, investors must use their own techniques and make their own judgment to create practical estimates on the risk of a security. These include analyses that are fundamental and technical, value investing, buying, and holding and growth investing. The CAPM provides an effective way for investors to quantify risk and expected returns to make a well-informed decision.

Economics plays a significant role in financial decisions and the economical reasoning behind decisions considers the relativity to the world and similar capital assets. When the COVID-19 pandemic struck early 2020, the economy took a massive hit. Travel and transportation industries lost tremendous amounts of money and sectors of the private world that were booming plummeted because of the closures of every form of transportation and travel. Airlines, taxi and bus services, and the cruising and boating industries all had a pitfall, and many investors were unsure of when they would recover [22]. When rumors of a vaccine being close to launch in late 2020 were heard, many jumped on these same travel and transportation because of the influx of consumers they would have because the vaccine created a safe way for them to travel. Investors survey what is happening in the real world and in companies specifically as well to make well-informed decisions to invest their money. Taking world economics into account allows investors to logically invest in capital assets.

IV. ARTIFICIAL INTELLIGENCE IN FINANCE INDUSTRY

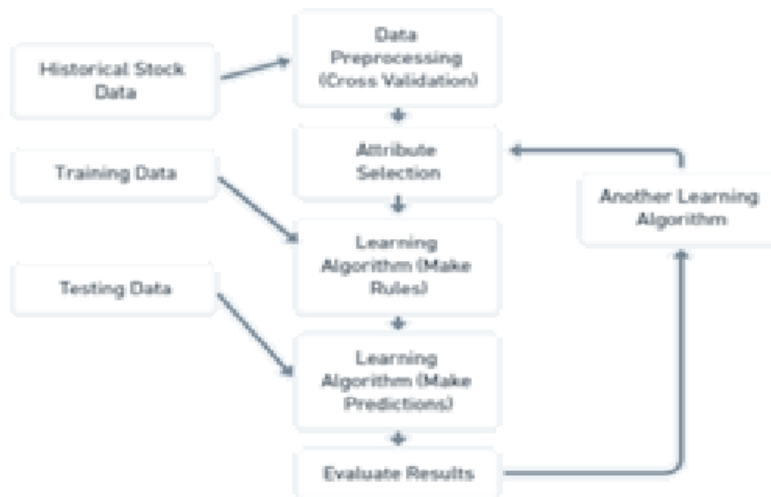
Applications of Artificial Intelligence has expanded its horizons starting from classification algorithms used in healthcare [23] to human cognition. As the technological revolution increases the amount of data generated in the finance sector, the introduction of AI in finance is transforming the finance industry and easing the user experience. So, where, and how has AI emerged in the finance sector. Here are a few areas in finance where AI and machine learning have advanced and provide all together a distinct experience and ease to its users and even the service providers.



A. Stock Market Prediction

Stocks are analyzed in two ways, the the first is fundamental analysis; in this analysis, investors look at the intrinsic values of stocks, and the the performance of the industry, economy, political climates, and many more to decide whether to invest in that stock or not [24] On the other hand, technical analysis is studying past prices and volumes and making decisions based on the pattern and the data.

The general flow diagram for stock market prediction:



Predicting stock market data was time-consuming and difficult a few years or even a decade ago including human efforts and time. Including machine learning algorithms to predict the stock market data has simplified the process and increased efficiency [25]. The predicted results have much more improved by training the computer on the algorithms and predicting just based on facts, figures, and numbers instead of human emotions and prejudice. Although stock market data is a time series data, analyzing that data with such high volume and volatility of market is quite challenging. The data used for analyzing and training the algorithm which is on cloud [32] is the opening value of the stock, the highest and the lowest values of the stock on the same day, also the closing value of the stock at the end of the day. Even 60% accuracy in price prediction can be a game changer [26].

Earlier classical regression methods such as linear regression, polynomial regression, etc. were used to predict stock trends. Also, traditional statistical models which include exponential smoothing, moving average, and ARIMA make their prediction linearly. Support Vector Machine, Artificial Neural Networks are widely used

nowadays for predicting values. ANN is a more popular and more recent method which also incorporates technical analysis to make predictions in financial markets. ANN includes a set of threshold functions. These functions are trained on historical data after connecting each other with adaptive weights and they are used to make future predictions [27].

Some of the AI software used for stock market investments are as follows:

1. **Kavout** - The software uses AI based pattern recognition technology to recommend stocks daily. Its main feature is K-score to score equity between 0-9 [4].
2. **Auquan** - Works on identifying market sentiments and finds online data that might affect investment decisions and prevent catastrophic losses [4].
3. **Equbot** - Another sentiment analysis software for Asset managers to deliver better outcomes for portfolio as a service. It uses machine learning algorithms, knowledge graphs, and IBM watson. It makes data crunching easier and faster [4].

B. Credit Risk Management Models:

Credit risk is the possibility that the lender will default on a loan lent by a bank or financial institution. The use of machine learning models and AI for credit risk management enables banks to predict loan defaults using traditional and alternative data sources [28]. Credit risk modeling is the process of using data from the borrower to determine whether the borrower will be able to repay the loan back or not. Many organizations use credit risk modeling, including insurance, companies, banks, investment firms, and government treasuries [29]. Moreover, also people who earn a living using strategically lending money use credit risk modeling to borrow their money. In the case of credit risk modeling, the machine learning model requires a lot of historical data to determine the default risk of the borrower. It requires target data whether each person defaulted, the feature data consisting of statistics about each person such as income, age, and employment status [30]. The machine learning models in credit risk modeling calculate the probability that the borrower will default on their loan or not using the feature data and training on the historical data to predict the target data.

Some of the commonly used machine learning algorithms for credit risk modeling are as follows.

1. K-Nearest-Neighbor
2. Logistic Regression
3. Decision Trees
4. Neural Networks

V. CONCLUSION

The CAPM has been around for four decades, however the model has been and can be adapted with technology to create more accurate results or representation of expected returns and prices. A model that was introduced in order as an alternative was arbitrage pricing theory (APT). This model relies more on economic variables than financial variables, as it creates a linear relationship between the expected returns on a capital asset and the risk of the asset. It focuses on highlighting systematic risk factors to find securities that have been priced incorrectly or not accurately and is especially useful for investors who engage in value investing or investing in stocks that are perceived to be priced below their market value. The formula for the APT is shown below.

$$E(R_i) = E(R_z) + (E(I) - E(R_z)) \times n$$

$E(R_i)$ = expected capital asset return R_z = risk-free rate of return

n = sensitivity of asset price regarding macroeconomic factor (n)

E_i = risk premium

APT has been proven to be much more flexible than the CAPM, although it is more intricate, the APT does consider multiple facets relating to macroeconomic theory and consider them to provide accurate results. The factors considered by the APT cannot be simply solved by diversification: these factors include the gross national product (GNP), the gross domestic product (GDP), and changes in the yield curve [6]. The arbitrage pricing theory, in addition, assumes the faults of the markets, more specifically its mispricing of securities, which leads to correction to the intrinsic value.

Artificial intelligence (AI) has been used coinciding with the capital asset pricing model to determine whether

AI can be used to create more accurate expected returns. AI was trained to understand and calculate stock prices with recurrent neural networks and CAPM using closing prices of ten tech companies from 2013 to 2019. A study from 2020 revealed that the use of AI increased the precision of cost estimations by more than 60% and returns by 18% [4].

The CAPM has proven to be accurate and very efficient with its simple nature and use. The APT on the other hand, is more complex but even more accurate in predicting returns and combined with technological advances such as artificial intelligence, more accurate. The combination of finance and technology can take the former to new heights and lengths never discovered before and improve the accuracy of financial calculations to make better informed investment decisions.

ACKNOWLEDGEMENT

We would like to acknowledge Pandit Deendayal Energy University, Gandhinagar, Gujarat, India and Center for Cyber and Information Security, ComExpo Cyber Security Foundation, Ahmedabad, Gujarat, India for their support during this study.

VI. REFERENCES

- [1] Sanghvi, H. A., Pandya, T. C., Pandya, S. B., Patel, R. H., & Pandya, A. S. (2021, September). Role of Information Technology in Education System. In 2021 Third International Conference on Inventive Research in Computing Applications (ICIRCA) (pp. 619-627). IEEE.
- [2] Alhalabi, B., Sanghvi, H. A., Patel, R. H., Pandya, A. S., & Torres, E.C. (2022, June). A Cloud Based Novel Framework for Addressing Repetitive Behavior in Autistic Individuals. In 2022 IEEE World Conference on Applied Intelligence and Computing (AIC) (pp. 788- 795). IEEE.
- [3] Alhalabi, B., Taylor, J., Sanghvi, H. A., & Pandya, A. S. (2022, June). A Proposed Framework for Stutter Detection: Implementation on Embedded Systems. In 2022 IEEE World Conference on Applied Intelligence and Computing (AIC) (pp. 829-833). IEEE.
- [4] Sanghvi, H. A., Pandya, S. B., Chattopadhyay, P., Patel, R. H., & Pandya, A. S. (2021, September). Data Science for E-Healthcare, Entertainment and Finance. In 2021 Third International Conference on Inventive Research in Computing Applications (ICIRCA) (pp. 604- 611). IEEE.
- [5] Haskell Garfinkel, Javier Baixas, Jamie Yoder, FinTech: Epicenter of Disruption, insurance thought leadership
- [6] Chishti, Susanne, and Janos Barberis. The Fintech book: The financial technology handbook for investors, entrepreneurs and visionaries. John Wiley & Sons, 2016.
- [7] Wewege, Luigi, Jeo Lee, and Michael C. Thomsett. "Disruptions and digital banking trends." Journal of Applied Finance and Banking 10.6 (2020): 15-56.
- [8] Srinivasan, K., and S. Rajarajeswari. "Financial technology in indian finance market." Available at SSRN 3845245 (2021).
- [9] Vijai, C. "FinTech in India--opportunities and challenges." SAARJ Journal on Banking & Insurance Research (SJBIR) Vol 8 (2019).
- [10] Pant, Sudhir Kumar. "Fintech: Emerging Trends." Telecom Business Review 13.1 (2020).
- [11] Gai, Keke, Meikang Qiu, and Xiaotong Sun. "A survey on FinTech." Journal of Network and Computer Applications 103 (2018): 262-273.
- [12] Patrick, Hugh T. "Financial development and economic growth in underdeveloped countries." Economic development and Cultural change 14.2 (1966): 174-189.
- [13] Patel, R., Sanghvi, H., & Pandya, A. S. (2022). Autonomous robotic system for ultraviolet disinfection. In Cyber-Physical Systems (pp. 231-240). Academic Press.
- [14] Parmar, V., Sanghvi, H. A., Patel, R. H., & Pandya, A. S. (2022, April). A Comprehensive Study on Passwordless Authentication. In 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS) (pp. 1266-1275). IEEE.
- [15] Bollerslev, T., Engle, R. F., & Wooldridge, J. M. (1988). A capital asset pricing model with time-varying

- covariances. *Journal of political Economy*, 96(1), 116-131.
- [16] Kittaneh, Noor. "Time Value of Money and Financial Planning."
- [17] Tofallis, C. (2008). Investment volatility: A critique of standard beta estimation and a simple way forward. *European Journal of Operational Research*, 187(3), 1358-1367.
- [18] Heikal, Jerry. "Investment Decision Using Capital Asset Pricing Model (CAPM) in Indonesia's Banking Sector." *Journal of Economics, Finance and Accounting Studies* 4, no. 4 (2022): 19-27.
- [19] De Santis, Giorgio, and Bruno Gerard. "International asset pricing and portfolio diversification with time-varying risk." *The Journal of Finance* 52, no. 5 (1997): 1881-1912.
- [20] Singh, Preeti. *Investment management*. Himalaya Publishing House, 2012.
- [21] Pristiwantiyasih, P., & Setyawan, M. A. (2020). The Importance Of Investment Decisions Using Capital Asset Pricing Model (CAPM) In Stock Sector Telecommunication. *Media Mahardhika*, 18(3), 387-399.
- [22] Becker, Elizabeth. *Overbooked: The exploding business of travel and tourism*. Simon and Schuster, 2016.
- [23] Sanghvi HA, Patel RH, Agarwal A, Gupta S, Sawhney V, Pandya AS. A deep learning approach for classification of COVID and pneumonia using DenseNet-201. *Int J Imaging Syst Technol*. 2022;1-21. doi:10.1002/ima.22812
- [24] Jones, Charles P. *Investments: analysis and management*. John Wiley & Sons, 2007.
- [25] Bonabeau, Eric, and Christopher Meyer. "Swarm intelligence: A whole new way to think about business." *Harvard business review* 79, no. 5 (2001): 106-115.
- [26] Wuthrich, B, Cho, V., Leung, S., Permunetilleke, D., Sankaran, K., & Zhang, J. (1998, October). Daily stock market forecast from textual web data. In *SMC'98 Conference Proceedings. 1998 IEE International Conference on Systems, Man, and Cybernetics (Cat. No. 98CH36218) (Vol. 3, pp. 2720-2725)*. IEEE
- [27] Bromley, Jane, Isabelle Guyon, Yann LeCun, Eduard Säckinger, and Roopak Shah. "Signature verification using a " siamese" time delay neural network." *Advances in neural information processing systems* 6 (1993).
- [28] Tata, Fidelio. "Investment Banking."
- [29] Emekter, R., Tu, Y., Jirasakuldech, B., & Lu, M. (2015). Evaluating credit risk and loan performance in online Peer-to-Peer (P2P) lending. *Applied Economics*, 47(1), 54-70.
- [30] Khandani, A. E., Kim, A. J., & Lo, A. W. (2010). Consumer credit-risk models via machine-learning algorithms. *Journal of Banking & Finance*, 34(11), 2767-2787.
- [31] Kaushal Shah, Dhruvil Lathiya, Naimish Lukhi, Keyur Parmar, Harshal Sanghvi, A systematic review of decentralized finance protocols, *International Journal of Intelligent Networks* Volume 4, 2023 Pages 171-181, ISSN 2666-6030, <https://doi.org/10.1016/j.ijin.2023.07.002>. (<https://www.sciencedirect.com/science/article/pii/S2666603023000179>)
- [32] Gangwani, D., Sanghvi, H. A., Parmar, V., Patel, R. H., & Pandya, A. S. (2023). A Comprehensive Review on Cloud Security Using Machine Learning Techniques. *Artificial Intelligence in Cyber Security: Theories and Applications*, 1-24.
- [33] Pandya, S. B., Sanghvi, H. A., Patel, R. H., & Pandya, A. S. (2022, May). GPU and FPGA Based Deployment of Blockchain for Cryptocurrency–A Systematic Review. In *2022 International Conference on Computational Intelligence and Sustainable Engineering Solutions (CISES) (pp. 18-25)*. IEEE.
- [34] Zhao, W., Aldyafrah, I. M., Gangwani, P., Joshi, S., Upadhyay, H., & Lagos, L. (2023). A Blockchain-Facilitated Secure Sensing Data Processing and Logging System. *IEEE Access*, 11, 21712-21728.
- [35] Gangwani, P., Perez-Pons, A., Joshi, S., Upadhyay, H., & Lagos, L. (2023). Integration of Data Science and IoT with Blockchain for Industry 4.0. In *Blockchain and its Applications in Industry 4.0 (pp. 139-177)*. Singapore: Springer Nature Singapore.
- [36] Das, S., Gangwani, P., & Upadhyay, H. (2023). Integration of Machine Learning with Cybersecurity: Applications and Challenges. *Artificial Intelligence in Cyber Security: Theories and Applications*, 67-81.