Original Article

Integrating AI Techniques for Enhanced Financial Forecasting and Budgeting Strategies

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Abstract - In the realm of modern business decision-making, the integration of Artificial Intelligence (AI) techniques into Financial Forecasting and Budgeting is reshaping traditional paradigms. This paper uncovers the profound impact of AI on these crucial practices. By leveraging historical data and advanced algorithms, AI-driven forecasts transcend the limitations of conventional methods, adapting seamlessly to evolving market dynamics. Simultaneously, AI-powered budgeting optimizes resource allocation and enables swift adjustments, aligning financial strategies with real-time requirements. The paper's exploration of key AI techniques amplifies forecasting accuracy and enhances the depth of variance analysis. Acknowledging challenges surrounding computational complexity and interpretability, this study underscores AI's transformative potential and addresses concerns. The convergence of AI and financial practices is underscored through illuminating case studies, collectively revealing AI's prowess in enhancing operational efficiency and strategic decision-making. Ultimately, this integration embodies a paradigm shift, empowering businesses to navigate uncertainties with data-driven confidence.

Keywords - Artificial Intelligence, Budgeting & Forecasting, FP&A, Financial forecasting, Machine learning.

1. Introduction

Forecasting and budgeting play a critical role in organizational decision-making. In the current fast-evolving business environment, accurate predictions and well-structured budgets are vital for organizations to navigate challenges and capitalize on opportunities. These practices provide a systematic approach to foreseeing future financial outcomes, allocating resources efficiently, and aligning strategic objectives with practical implementation. Financial Forecasting is a process through which an organization can assess the past, present, and future state of where it is heading [1]. As businesses aim for growth, sustainability, and competitiveness, the ability to make informed decisions based on reliable forecasts and budgets becomes paramount.

Financial Forecasting involves analyzing historical data and applying statistical methods to predict future financial trends. Organizations can anticipate revenues, expenses, and cash flows by identifying patterns, extrapolating trends, and assessing potential risks, enabling more informed decisions. Studies have shown evidence-based proof that artificial intelligence-based forecasting and budgeting methods provide superior results and accuracy compared to traditional statistical methods in dealing with financial problems, especially regarding nonlinear patterns [2]. Effective financial forecasting not only helps set achievable goals but also enables organizations to prepare for uncertainties and allocate resources wisely. For instance, accurate sales forecasts allow companies to adjust production levels, manage inventory effectively, and align marketing strategies with market demand. This adaptability facilitated by precise forecasts enables businesses to respond swiftly and capitalize on emerging opportunities while minimizing risks. Budgeting, on the other hand, complements financial forecasting by translating projected financial outcomes into practical plans. A budget serves as a detailed guide, allocating resources across different functions and projects. This ensures that expenses are aligned with revenue projections and strategic objectives. By setting clear spending limits and performance targets, budgeting helps organizations maintain financial discipline, avoid unnecessary expenses, and prioritize investments that drive growth. A well-structured budget also provides a framework for accountability and assessment, enabling managers to monitor actual performance against forecasts, identify deviations, and take corrective measures promptly.

In recent years, integrating Artificial Intelligence (AI) techniques has triggered a profound transformation in the landscape of financial forecasting and budgeting. Also, there has been evidence of machine learning being applied successfully to various predictive tasks, such as fraud detection and financial forecasting [3, p. 64]. Fueled by advanced Machine Learning algorithms and Neural Networks, AI brings the capability to handle large volumes of data, uncover intricate patterns, and adapt nimbly to

changing scenarios – abilities that often pose challenges for conventional approaches. This infusion of AI not only sharpens the precision of forecasts but also fine-tunes budget allocations, leading to insights that were previously hard to uncover. As AI techniques evolve, organizations are presented with an opportunity to attain higher levels of predictive accuracy, optimize resource allocation, and make informed decisions attuned to the intricate fabric of the modern business landscape.[4] "Machine Learning methods appear especially suitable for the core FP&A task of forecasting because of their focus on predictive performance" [3, p. 67]. This rise of AI in elevating forecasting precision marks a pivotal shift in how data-driven insights are harnessed for decision-making. AI's potential to uncover complex patterns and relationships within extensive datasets, an arena often untouched by traditional forecasting methods, is underpinned by its ability to learn from past or historical data and adapt to shifting trends. Some tools use AI and Machine Learning, predictive analytics, and even user feedback to predict future outcomes [5, p. 24]. The outcome of forecasts is marked not only by increased precision but also by adaptability to market dynamics.

Moreover, AI-powered forecasting can seamlessly incorporate a diverse range of data sources – from social media sentiment to news articles and sensor data – thus enhancing the accuracy of predictions. This transition from deterministic models to probabilistic ones equips decision-makers to embrace a spectrum of potential outcomes. "CFOs and senior management require financial models that feed business strategy at the speed and insight of true innovation as finance enters a new era of digital transformation" [1, p. 4]. As AI's trajectory advances, its role in forecasting is poised to redefine business strategies by offering novel insights, facilitating timely adjustments, and empowering organizations to navigate uncertainties.

This research paper thoroughly explores the practical implications of integrating artificial intelligence methods and techniques into processes related to financial forecasting and budgeting. It provides a review of the impact of integrating artificial intelligence with traditional techniques, such as time series analysis and linear regression. This in-depth exploration of techniques aims to provide a comprehensive understanding of how AI enhances the accuracy, adaptability, and effectiveness of financial forecasts and budgets. Additionally, this paper assesses the benefits, challenges, and broader impacts of incorporating AI into decision-making processes, optimizing resource allocation, and shaping business strategies. Real-world instances and case studies are presented to underscore AI's transformative influence. Overall, the paper emphasizes the symbiotic relationship between AI and financial forecasting, highlighting AI's pivotal role in modernizing decision-making within the financial context.

2. Literature Review

Financial Forecasting and Budgeting, a cornerstone of business decision-making, has traditionally relied on well-established methods that draw insights from historical data and statistical analyses. These techniques encompass a spectrum of approaches, including time series analysis, use simple moving averages, exponential averages, and linear regression. "Financial Planning is used to figure out where a company has been, where it is now, and where it is heading. It also calculates deviations from the most likely result" [1, p. 3]. While these methods have been instrumental in predicting future trends, they are not immune to limitations hindering their efficacy in addressing the complexities of contemporary business landscapes.

2.1. Limitations of Traditional Forecasting Approaches

"Conventional and traditional mathematical model-based techniques can effectively address linear, time-invariant problems, and model-based techniques can also solve more complex nonlinear time-variant problems, but only in a limited way" [2, p. 1187]. Time Series Analysis, a mainstay of traditional forecasting, extrapolates future values based on past patterns. However, this method hinges on the presumption that historical patterns will persist unchanged into the future, a premise that often proves inadequate when faced with disruptions or paradigm shifts.

Moving Averages and Exponential Smoothing, while effectively mitigating data noise, fall short of capturing abrupt changes or nonlinear trends, leading to inaccuracies during periods of rapid change. Linear regression, commonly utilized to establish relationships between variables, assumes a static linear correlation, neglecting the significance of potential nonlinear interactions inherent in intricate financial scenarios. Furthermore, these methods thrive in stable historical patterns but falter when grappling with sudden shifts, seasonal variations, and nuanced relationships pervasive within financial markets.

"High percentage of previous studies reported that the accuracy of the artificial intelligence methods is superior to that of traditional and statistical methods in dealing with financial problems" [2, p. 1188]. Limitations extend to data handling and adaptability. Traditional methods struggle to process voluminous datasets, particularly when incorporating diverse and unstructured data sources.

As organizations increasingly rely on multifaceted data streams for decision-making, the inadequacy of conventional methods in accommodating these data types can result in incomplete insights. Moreover, their rigidity and oversimplified models hinder their agility in fast-paced and volatile markets, jeopardizing the timeliness and accuracy of predictions.
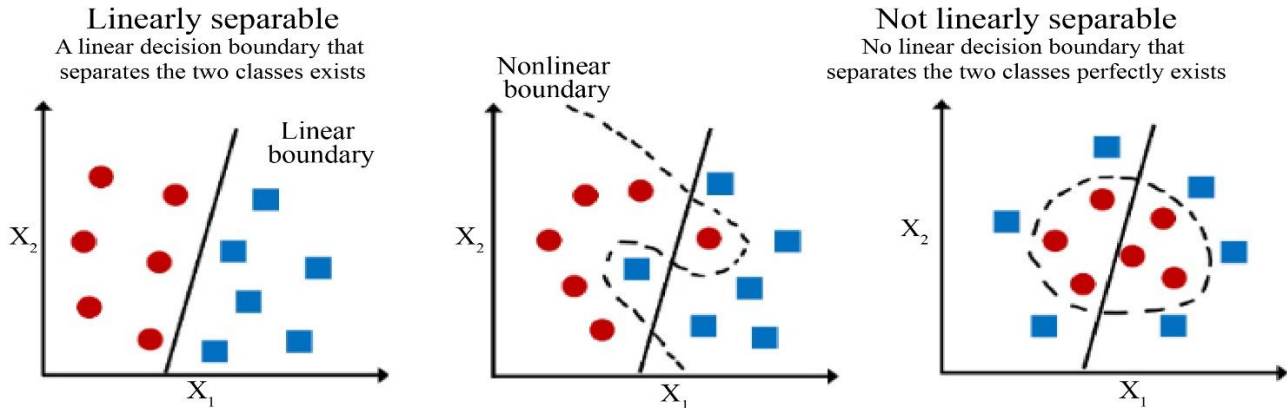
Fig. 1 [5]

2.2. The Emergence of AI as a Solution

The need for more sophisticated forecasting techniques becomes apparent in light of these limitations. The rise of Artificial Intelligence (AI) and machine learning presents an opportune avenue to address these challenges. AI techniques hold the potential to learn from extensive datasets, unveil intricate relationships, and adapt to evolving conditions and diverse data types. In order to address budget-related challenges, organizations must adopt solution-oriented budgeting approaches. These challenges include issues such as diminishing managers' motivation and creativity while simultaneously striving for agility and precise alignment with corporate objectives [7, p. 1]. Acknowledging these constraints inherent in traditional forecasting methods, this paper underscores how AI techniques are positioned to overhaul financial forecasting.

2.3. Application of AI and Machine Learning Algorithms in Financial Forecasting, Budgeting, and Analysis

The infusion of AI and Machine Learning algorithms into financial forecasting, budgeting, analysis, and variance commentary marks a paradigm shift in the domain of Financial Planning and Analysis (FP&A). These advanced methodologies have the capacity to reshape conventional approaches, offering unique avenues for precision, automation, adaptability, and strategic decision-making.

2.3.1. Financial Forecasting

Leveraging Machine Learning algorithms for AI-driven financial forecasting involves analyzing historical data to unveil intricate patterns that traditional methods might overlook. AI-powered time series analysis can capture complex relationships, seasonal trends, and irregular patterns, resulting in more accurate short- and long-term forecasts. Notably, Neural Networks like Long Short-Term Memory (LSTM) networks excel in deciphering sequential dependencies, rendering them well-suited for finance-based forecasting tasks[8, 9]. If the trends are nonlinear, AI technologies like Machine Learning (ML) and Deep Learning can be used [10, 2023, p. 1]. These AI models exhibit the flexibility to adapt to shifting market conditions, facilitating timely strategic adjustments.

2.3.2. Budgeting and Analysis

Utilizing AI for budgeting has the potential to bring forth various advantages in enhancing the allocation processes. These processes stand as fundamental aspects of budgets, serving as tools for benchmarking, facilitating communication, enabling monitoring, and facilitating performance evaluation [7, p. 8]. AI and Machine Learning enhance budgeting processes by automating data collection, preprocessing, and allocation. These techniques enable organizations to optimize resource allocation by analyzing historical expenditure patterns, identifying cost-saving opportunities, and predicting future spending needs. Moreover, AI-driven sentiment analysis of unstructured data sources such as news or blog articles and posts in social media can offer valuable insights for budgeting decisions. Automating budgeting via AI expedites the process and facilitates more frequent updates, empowering businesses to respond swiftly to evolving financial scenarios.

2.3.3. Variance Analysis

AI plays a pivotal role in furnishing meaningful commentary on variance analysis. Conventional variance commentary often hinges on manual interpretation, which proves time-consuming and subjective. AI can automate the identification of key drivers behind variances, categorize them, and generate insightful explanations. Through Natural Language Processing (NLP) techniques, AI can generate coherent and contextually relevant explanations for deviations from forecasts and budgets. To support evidence-based decision-making, these techniques can be used to extract information from textual data [Gandomi & Haider, 2015, pp. 137-138, as cited in 7, p. 8]. This automation saves time and augments the accuracy and depth of variance commentary, enabling finance professionals to concentrate on strategic insights rather than mundane data interpretation.

Data Flow for Financial Forecasting with AI Technologies

Fig. 2 Data flow for financial forecasting

Fig. 3 Natural language processing [8]

2.4. Key Studies, Models, and Algorithms for Improved Accuracy

2.4.1. AI-Infused Time Series Models

Research demonstrates that marrying traditional time series analysis with AI techniques, like LSTM Neural Networks, can significantly enhance forecasting precision. These models have gained significant attention in the financial industry for improving the accuracy of financial forecasts. These models leverage the power of artificial intelligence to capture complex patterns and relationships within financial time series data, leading to better predictions of stock prices, market trends, and other financial indicators. For instance, Fischer and Krauss (2018) [12] showcased the superiority of LSTMs over traditional methods in forecasting stock market indices and can be deployed to other time series prediction tasks with large training datasets [12]

2.4.2. Ensemble Methods for Budgeting

Ensemble methods, including Random Forest and Gradient Boosting, have found success in budgeting contexts. These methods combine the predictions of multiple models, augmenting accuracy. Per Fischer and Krauss (2018) exemplified that most of the time - except for the global financial crisis - the random forest method also outperformed.

2.4.3. NLP-Powered Variance Commentary

NLP techniques are employed to automate commentary for variance reporting. Models trained on historical data generate coherent explanations for variances between actuals and forecasts or budgets. Using NLP to automate variance explanation will curtail the manual effort in commentary writing and elevate the accuracy of insights.

2.4.4. Bayesian Neural Networks for Uncertainty Estimation

Bayesian Neural Networks (BNNs), amalgamating Neural Networks with Bayesian inference, offer uncertainty estimates alongside predictions. This proves particularly beneficial in financial forecasting, where uncertainty looms large. Per [13, 14], BNN outperformed other NL methods.

2.4.5. Reinforcement Learning for Adaptive Forecasting

Reinforcement Learning (RL) algorithms tailor forecasting strategies to shifting market conditions. Through trial and error, these algorithms discern optimal actions. Li et al. (2022) employed RL for dynamic portfolio optimization, spotlighting the potential of AI-driven adaptive strategies in forecasting and decision-making [15].

2.4.6. AutoML for Budgeting and Forecasting

Automated Machine Learning (AutoML) platforms like Google's AutoML and H2O.ai automate the process of selecting and tuning models for budgeting and forecasting tasks. These platforms allow non-experts to leverage AI without in-depth technical knowledge. A study by [16] evaluated AutoML tools and highlighted their effectiveness in improving model performance.

Incorporating these models and techniques into financial forecasting, budgeting, and variance analysis has yielded improved accuracy, automation, and adaptability. However, it is essential to note that the success of AI applications depends on the quality and relevance of data, appropriate model selection, and careful validation against domain expertise. As AI continues to evolve, further research and development will likely unveil new models and algorithms that contribute to even more accurate and efficient FP&A practices.

2.5. Advantages, Challenges, and Future Directions

The integration of AI into financial forecasting, budgeting, and variance commentary carries several advantages. These techniques are well-equipped to manage extensive datasets, including structured and unstructured data, permitting organizations to account for a broader spectrum of factors in their predictions and analyses. The automation component reduces the risk of manual errors, heightens efficiency, and liberates finance professionals to concentrate on strategic analysis and decision-making.

Furthermore, the adaptability of AI models ensures forecasts and budgets remain pertinent in swiftly evolving business landscapes. However, it is paramount to acknowledge the potential challenges. AI models may demand substantial computational resources and rigorous training. Ensuring transparency, interpretability, and ethical considerations in AI-derived insights is imperative. As AI continues to evolve, bridging the chasm between AI's potential and the intelligibility of outcomes will stand as a pivotal focus. According to past studies, soft factors play an important role in budget setting.

Consequently, moving to a budgeting approach based on AI should not disregard these factors, like how humans feel. As a result of budget constraints and fixed targets, AI activities may make people feel undervalued [7, p. 11]. The amalgamation of AI and Machine Learning into financial forecasting, budgeting, analysis, and variance commentary ushers in a new era of data-driven decision-making.

By harnessing these advanced techniques, organizations can harness enhanced predictions, optimize resource allocation, and amplify the quality and celerity of financial insights. Ultimately, this contributes to more enlightened and efficacious business strategies within the FP&A domain.

2.6. Comparative Analysis of Traditional vs AI-Driven Budgeting and Forecasting

2.6.1. Forecasting Accuracy

A multitude of empirical studies consistently demonstrates AI models' superiority, particularly when leveraging neural networks and AI-enhanced time series methods, for forecasting accuracy. However, Makridakis et al.'s 2018 research compared AI models to traditional models and identified the room for improvement in ML-based models. Because they have the ability to learn, it is anticipated that machine learning methods will have better performance than simple benchmarks like exponential smoothing. Recognizing the problem is the first step in coming up with effective solutions, and it is hoped that those working in the field of AI and ML will acknowledge the real-world results and make efforts to improve the accuracy of their forecasting methods [13, p. 20]. AI's adaptability to market dynamics and aptitude for capturing intricate relationships are clear advantages. In contrast, conventional methods like exponential smoothing and moving averages falter with nonlinear dynamics and abrupt pattern shifts.

2.6.2. Budgeting Accuracy

AI's transformative impact on budgeting is evident, especially through ensemble strategies and Automated Machine Learning (AutoML). These tools analyze historical spending patterns, identifying cost management opportunities. Empirical research consistently supports AI-enhanced budgeting models for precise resource allocation recommendations. "Through the use of artificial intelligence technology, it can help the accounting department to establish a more effective system" [17, p. 2]. Conventional budgeting relying on historical data and human estimations often yields inaccuracies due to biases and dataset limitations. Fixed-budget approaches often hinder responsiveness to changing circumstances.

3. Case Studies

American Express has strategically embraced Artificial Intelligence (AI) to reshape financial forecasting and budgeting practices. This initiative is exemplified by introducing an advanced expense report management system, which leverages cutting-edge machine learning and AI technologies. This integration has led to a streamlined automation process for generating and approving expense reports. By infusing machine learning and AI technologies, the system intelligently automates the intricate processes of expense reporting and approvals. It introduces an AI-powered decision engine that comprehends the company's travel and expense policies while factoring in variables like purchase history to allocate risk scores for each transaction. Employees conveniently capture receipts, enabling the system to efficiently categorize expenses with color-coded risk scores - red, yellow, or green - streamlining the approval workflow. This innovative solution not only ensures adherence to corporate policies but also optimizes time and resource allocation. This case study underscores how AI can significantly enhance efficiency, reduce complexities, and expedite decision-making in corporate expense management, offering American Express a competitive edge through automation [18].

American Express employs AI-driven fraud detection, exemplifying its commitment to proactive security while maintaining a seamless customer experience. Facing a surge in credit card fraud instances, American Express capitalizes on AI's capabilities to evaluate about 8 billion transactions annually, significantly more efficient than manual review. The advanced Gen X model employs complex algorithms, analyzing transaction histories and customer behaviors to detect potential fraud. The model minimizes false positives and negatives by continually refining its methods and optimizing analysts' productivity. This AI-driven approach maximizes accuracy, minimizing the risk of credit card fraud for customers and reducing the number of legitimate

transactions subjected to unnecessary scrutiny. American Express successfully benefits from AI by simultaneously bolstering security and refining operational efficiency, a significant achievement in the financial industry [19].

HSBC's pioneering move involves AI for Forecasting and Budgeting through the innovative AI Powered Multi Asset Index (AiMAX) family. By leveraging historical data and adapting to new information, AiMAX constructs diversified portfolios across 15 asset classes and five types. This approach achieves a balanced risk-return dynamic by combining advanced AI techniques with proven diversification tactics.

Notably, AiMAX's performance simulations and historical data show superior returns compared to the S&P 500 Price Return Index, characterized by reduced volatility and heightened diversification. HSBC's exclusive licensure underscores its dedication to innovation. This case study underscores how AI-driven index creation enhances financial institutions' capabilities in delivering cutting-edge asset allocation solutions that cater to various client needs [20].

JP Morgan Chase & Co., a prominent US bank, has harnessed AI for Forecasting and Budgeting in a groundbreaking case study. With an immense workforce of over 240,000, the company utilized COIN (Contract Intelligence), an AI-powered machine learning system, to revolutionize finance operations. COIN drastically reduces the time spent on interpreting commercial loan agreements from 360,000 hours to seconds, enhancing efficiency and reducing errors.

This innovative approach aligns with JP Morgan's broader strategy of automating filing tasks and developing advanced tools for the parties involved. This transformative adoption of AI optimizes resource allocation, diminishes human error, and exemplifies the potential for AI to empower employees to focus on higher-value tasks. JP Morgan's proactive embrace of AI showcases its commitment to enhancing productivity and innovation while setting a precedent for other financial institutions [21].

4. Conclusion

The integration of Artificial Intelligence (AI) into Financial Forecasting and Budgeting stands as a significant evolution within the realm of business decision-making. This transformative progression is rooted in AI's capability to transcend the boundaries of traditional methods, ushering in a new era of precision, adaptability, and efficiency within financial practices. Our exploration throughout this paper has illuminated the profound impact of AI-driven forecasts. Fueled by historical data and advanced algorithms, these forecasts introduce a paradigm shift in predictive accuracy. The ability to discern intricate patterns and swiftly adapt to dynamic market shifts redefines the very essence of forecasting, equipping businesses with the insight needed to make well-informed decisions. Concurrently, the impact of AI on budgeting is undeniably transformative. Automating resource allocation and real-time adjustments showcases AI's intrinsic adaptability to financial planning. By simplifying processes, AI empowers financial professionals to concentrate their efforts on strategic analysis, aligning financial strategies seamlessly with organizational objectives. While AI's integration presents great promise, addressing associated challenges, such as computational demands and interpretability concerns, is important.

Confronting these challenges is pivotal in fully harnessing AI's potential while upholding transparency and ethical utilization values. Our examination of real-world case studies affirms the tangible advantages that AI introduces across diverse financial aspects. These instances underscore AI's role in amplifying operational efficiency, enhancing decision-making, and cultivating competitive advantages. The symbiotic connection between AI and Financial Forecasting and Budgeting ushers in a new epoch of data-driven decision-making. This synergy encapsulates the adaptability and foresight imperative for thriving in a dynamic business environment, metamorphosing financial practices into pivotal pillars of organizational triumph. As AI's evolution continues, its trajectory within financial decision-making promises transformation, reshaping the future of how businesses navigate complexities and seize opportunities with resolute assurance.

References

[1] N. Kunnathuvalappil Hariharan, and Naveen "Artificial Intelligence and Human Collab oration in Financial Planning," *Journal of Emerging Technologies and Innovative Research*, vol. 5, no. 7, pp. 1348–1355, 2018. [Google Scholar] [Publisher Link]

[2] Arash Bahrammirzaee, "A Comparative Survey of Artificial Intelligence Applications in Finance: Artificial Neural Networks, Expert System and Hybrid Intelligent Systems," *Neural Computing and Applications,* vol. 19, no. 8, pp. 1165–1195, 2010. [CrossRef] [Google Scholar] [Publisher Link]

[3] Helmut Wasserbacher, and Martin Spindler, "Machine Learning for Financial Forecasting, Planning and Analysis: Recent Developments and Pitfalls," *Digital Finance*, vol. 4, no. 1, pp. 63–88, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[4] Rohit B R et al., "Stock Market Prediction using Machine Learning," *SSRG International Journal of Communication and Media Science*, vol. 7, no. 2, pp. 6-9, 2020. [CrossRef] [Publisher Link]

[5] Shiv Ranjan, Ruchika Gupta, and Anish Gupta, "Artificial Intelligence in Financial Acumen: Challenges and Opportunities," *Cosmos Journal of Engineering*, vol. 10, no. 1, pp. 23–27, 2020. [Google Scholar] [Publisher Link]

[6] Ajitesh Kumar, Linear vs Non-Linear Data: How to Know, 2022. [Online]. Available: https://vitalflux.com, Jul. 31, 2022. https://vitalflux.com/how-know-data-linear-non-linear/

[7] Gianfranco Marotta, and Cam-Duc Au, "Budgeting in the Age of Artificial Intelligence – New Opportunities and Challenges," *SSRN*, pp. 1-18, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[8] Ayesha Saleem et al., "Challenges and Strategies for Sales Prediction in Apparel Industry," *SSRG International Journal of Computer Science and Engineering,* vol. 6, no. 8, pp. 7-11, 2019. [CrossRef] [Publisher Link]

[9] Ibuomo R. Tebepah, "Digital Signal Processing for Predicting Stock Prices Using IBM Cloud Watson Studio," *SSRG International Journal of Computer Science and Engineering* , vol. 7, no. 1, pp. 7-11, 2020. [CrossRef] [Publisher Link]

[10] Xiaohua Zeng et al., "Prediction of Stock Price Movement Using an Improved NSGA-II-RF Algorithm with a Three-Stage Feature Engineering Process," *PLoS One*, vol. 18, no. 6, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[11] Chinmay Paranjape, NLP With Classical Machine Learning, 2022. [Online]. Available: https://medium.com, Dec. 07, 2022. https://medium.com/@Chinmay_Paranjape/nlp-with-classical-machine-learning-e7aef52b2288

[12] Thomas Fischer and Christopher Krauss, "Deep Learning with Long Short-Term Memory Networks for Financial Market Predictions," *European Journal of Operational Research*, vol. 270, no. 2, pp. 654–669, 2018. [CrossRef] [Google Scholar] [Publisher Link]

[13] Spyros Makridakis, Evangelos Spiliotis, and Vassilios Assimakopoulos, "Statistical and Machine Learning Forecasting Methods: Concerns and Ways Forward," *PLoS One*, vol. 13, no. 3, 2018. [CrossRef] [Google Scholar] [Publisher Link]

[14] Jigar K Patel, "The Importance of Equipment Maintenance Forecasting," *SSRG International Journal of Mechanical Engineering*, vol. 8, no. 5, pp. 7-11, 2021. [CrossRef] [Publisher Link]

[15] Xiaodong Li et al., "Hierarchical Deep Reinforcement Learning for VWAP Strategy Optimization," *arXiv*, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[16] Hutter, Frank, Kotthoff, Lars, and Vanschoren, Joaquin, Automated *Machine Learning: Methods, Systems, Challenges*, The Springer Series on Challenges in Machine Learning, 2019. [Google Scholar] [Publisher Link]

[17] Yaping Chen, "Framework of the Smart Finance and Accounting Management Model under the Artificial Intelligence Perspective," *Mobile Information Systems*, vol. 2021, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[18] Sarah Perez, Amex and Microsoft turn to AI to make expense reports less horrible, 2023. [Online]. Available: https://techcrunch.com/2023/02/09/amex-and-microsoft-turn-to-ai-to-make-expense-reports-less-horrible/

[19] Ryan Owen, Artificial Intelligence at American Express – Two Current Use Cases, 2021. [Online]. Available: https://emerj.com/ai-sector-overviews/artificial-intelligence-at-american-express/

[20] HSBC, HSBC Introduces First Multi-Asset Index Powered by AI and Big Data, 2021. [Online]. Available: https://www.about.us.hsbc.com/newsroom/press-releases/hsbc-introduces-first-multi-asset-index-powered-by-ai-and-big-data.

[21] Dom Galeon, An AI Completed 360,000 Hours of Finance Work in Just Seconds, 2023. [Online]. Available: https://futurism.com/an-ai-completed-360000-hours-of-finance-work-in-just-seconds.