Augmenting Human Minds: Artificial Intelligence and Big Data in Financial Risk Assessment

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Abstract: **The study sought to explore on the role of AI and Big Data on risk assessment in financial institutions. The study adopted a systematic review of literature and secondary data sources to present a qualitative analysis of the key elements of AI and big data and their application in financial risk assessment and management. Peer reviewed journal articles were used to provide essential and relevant information on AI and big data on risk assessment. The study established that machine learning tools were used in predictive analytics and based on big data extracted from databases, the risks managers were able to use regression, classification, clustering, and anomaly detection to carry out fraud detection, portfolio optimization, volatility forecasting and sensitivity analysis. Machine learning was the basic form of AI used in risk assessment in financial institutions in conjunction with big data. Market risks are assessed through portfolio optimization, sensitivity analysis, and volatility forecasting while credit risks are assessed through credit scoring and defaulting prediction. Insurance risks are measured by claims modelling, reserve losses, mortality forecasting, and fraud detection. The study recommended that financial sector should invest in research and development for a specialized AI machines and software to meet the rising needs of cyberspace in the banking systems and mobile banking transactions.**

Keywords: **Artificial Intelligence, Big Data, Machine Learning, Risk Management, Risk Assessment, Financial Risk Assessment**

I. INTRODUCTION

Artificial Intelligence (AI) has taken the center stage of most operations in the financial world. The advancement of technology has contributed to the use of AI changing the structures of financial operations that include the use of machine learning, natural language processing, and business automation (Cerchiello & Giudici, 2016). The computing power has played a crucial role in integrating AI in the era of big data. AI is the process of using smart machines that can perform tasks that require human intelligence. This process involves computer systems that are capable of recognizing speech, have machine vision, and can process natural language. Most financial services have been designed to utilize AI to ensure there is increased accuracy, precision, and short task turnaround (Cerchiello & Giudici, 2016) s. AI systems in finance work through the use of big data which are fed into the computers to be processed into meaningful output. The work that could take large workforce to process can be done in seconds, accurately, and with little human effort. One of the key components of AI is the machine learning which uses specialized hardware and software. The machine learning algorithms use languages like Python, R, Java among others.

AI systems work through ingesting large amounts of data which is analyzed to establish any possible correlations and trends (Cerchiello & Giudici, 2016). These trends can be used to make future predictions for certain states like stock prices. AI also has programming that is used to focus on three cognitive skills that include learning, reasoning, and self-correction. The learning process is done through acquiring data and creating rules to assist in turning the data into actionable information.

Data is a critical input in financial risk management and any operation within the industry. Big data is defined as the structured and unstructured datasets that an organization can collect in its daily operations and use it in making decisions. Big data is classified by its volume which is the amount of incoming data and the rate at which its accumulated (Stasinakis & Sermpinis, 2020). Machine learning and AI are the key tools used in processing Big Data by analyzing it and extracting possible insights. Big data is very useful in financial risk management as it's the key input. It helps in identifying and forecasting on the potential risks that can harm the financial operations like the patterns of potential business threats (Stasinakis & Sermpinis, 2020). AI and Big Data work hand in hand in financial risk management as managers have large volumes of data that cannot be worked in time by human efforts with high accuracy. AI provides tools to make sense out of the big data in financial risk management.

Financial industry has improved their compliance and risk management processes and systems through effective use of big data and artificial intelligence to augment their current risk assessment processes by utilizing machine learning models.

Statement of the Problem

Financial institutions gather large amounts of data on daily basis, and it keeps on increasing significantly for the human expertise to process. The detail of reporting in modern financial institutions has increased due to the digitalization of services and operations in the institutions. Large-amounts of data are collected due to high-frequency and unstructured consumer data (Malhotra, 2018). Due to this aspect, financial institutions require powerful analytical tools to assist in risk assessment. The tools should be efficient enough to handle the big data as human capabilities are limited to process it. Since the data is in many formats, making sensible extraction for decision making and meaningful risk assessment needs intelligent analysis using machine learning and AI. Machine learning works directly within the statistical power to present

analytical trends of risks involved in financial operations while computing power play a major role to ensure high accuracy of the analysis (Malhotra, 2018). Most financial institutions have adapted the use of big data and AI to ensure the potential risks are identified. Some of the potential risks are fraud and money laundering and surveillance breaches. Machine learning is a powerful tool used in predictive analytics. Identifying the patterns or possible correlations in the data helps in risk assessment in financial institutions. The predictions are attained from the created models that incorporated certain identified models and using the data, it is possible to identify the out-of-sample predictions or areas of risk concerns (Liu, 2019). Machine learning is useful in big data revolution due to the ability of heavy computing power and AI. Such tasks cannot be computed manually and requires AI to make sense of the big data through the machine learning-algorithms. The role played by Big Data and AI in risks assessment is quite huge in the financial institutions.

Artificial intelligence has been widely deployed in financial services to take care of the daily operations. AI has effectively been used to take care of cost efficiencies as well as improving the tailored consumer engagement. Companies have incorporated AI but due to limitation of data quality and quantity, the effectiveness of AI is still underutilized in transforming the operations (Liu, 2019). While AI is useful in risk assessment, some companies still perceive it as a potential risk and a barrier for its adoption in financial institutions.

II. REVIEW OF RELATED LITERATURE

AI, according to international regulators and European Union, has been a critical tool in risk assessment not only within the finance sector but also across a wide scope within many industries. The era of Big Data has contributed to integration of effective tools used in predictive analytics that allow financial institutions to streamline their decision making. Leveraging data to give insightful trends on the operations improves income streams and direct operations effectively (Liu, 2019). Big data is vital tool in risk assessment and management, and it plays a big role in financial risk management. Existence of Big data has paved way for AI which seeks to provide efficient data analytics tools like machine learning to ensure that better insights are derived from large amounts of data. Predictive algorithms are used in analyzing big data to detect trends and patterns to indicate the potential security threats in financial operations (Miller, 2019). Organizational risks can be assessed through AI by leveraging the various sources of big data. Organization minimizes threats through application of big data and AI that assists in structuring financial revenue streams. Predictive indicators are used in machine learning models to derive various relationships of some of the identified risk factors. The insights provided by the models helps managers to make decisions on the directions to take in managing the risks.

Big data and AI are quite applicable in fraud and money laundering prevention through predictive analytics. Any activities that are suspicious can be identified through predictive analytics that help in collecting accurate data and making predictions through AI tools. Risks involving costs of operations as well can be identified through establishing such models and trends as a key risk management tool (Miller, 2019). Customer loyalty can also be identified through dig data as the company prevents any customer defections. Companies dealing with credit management mitigates its risks through analyzing data from historical spending and past repayment patterns. This is made possible by AI models. Social media behavior, purchases and other financial transactions can be some of indicators utilized in the models to predict a consumer's creditworthiness (Malhotra, 2018). In manufacturing industries, big data is helpful in assessing supplier quality levels and dependability. Cost defects in production can also be identified using sensor technology data analytics. In improving risk management with big data, AI tools are imperative to sound and accurate decision-making that allows managers to seek growth, avoid risks, diversify products and attain their objectives. Companies use historical data and real-time data analytics to provide significant systems in extracting valuable information (Malhotra, 2018). Robust predictive analytics are used to assess possible risks in many sectors and are not limited to financial institutions. Financial markets also use big data risk management

Big Data and Machine Learning Assess Risks

Big data, as a new technology, has yet to be defined with particular authority. Some are characterized as massive data, while others are defined as full data. They are extensively gathered, mined, and processed to produce all-round picture data using operators' communication attribute data and user behavior data, as well as machine learning and big data related technologies (Ozili, 2021). Big data can be categorized into hyperplanes that can be divided into several sub-divisions. Because the hyperplane has the highest tolerances for the localized disturbance of the training set, the prediction accuracy is the most robust and have the greatest prediction accuracy for unseen cases. A commonly recognized definition in the IT sector is that big data refers to data sets which cannot be processed and used using standard database software tools in a reasonable amount of time (Ozili, 2021). Some of the most utilized tools to process big data are machine learning and AI which uses statistical analysis of the large data amounts.

In data processing, the larger amounts of data learned, the higher the prediction accuracy. The algorithm training process, and the connection between the input layers, hidden layers and the bias vector are not iteratively adjusted. The optimal solution is obtained through solving the minimum norm least squares problem (Ozili, 2021). There are other approaches that can be used to reduce the degree of risk since it is difficult to eliminate the risk. Machine learning allows conducting both supervised and unsupervised learning analysis on big data using various algorithms. It also summarizes the rules and uses the analysis results in

predicting the future data points (Ozili, 2021). The use of the models in predictive analysis helps in transforming the process of human intelligence and offers an inductive experience into the computing process.

Data Collection

One of the key steps of utilizing big data is the data collection process. The information management process actively coordinates risk management through big data collection, ports connection, lag and isolation elimination and establishing data center that is suitable for processing. The reason behind this process is to establish an optimal classification line that classifies the training sets (Žigienė et al., 2019). In financial risk management, risk is assessed decomposing various cashflows or operational points. The model process may involve a series of user information collected during individual transactions. This data is modelled and using selected variables of interest, the managers are able to identify the possible trends that can point to risks like fraud and money laundering. Because the huge data contains the qualities of perhaps being fake, as well as the fuzzy features of the machine learning algorithm, the prediction results are frequently unclear (Žigienė et al., 2019). The greater the amount of data learned, the greater the forecast accuracy. By gathering historical loss data, financial risk management analysis technology employs probability analysis and trend analysis to forecast the potential of future losses. Risk assessors should offer full and accurate historical assessment data, covering not just past risks but also possible accidents (Žigienė et al., 2019). All data should be reported and entered into the risk case database.

Machine Algorithm

Machine learning can be accomplished through various phases that include supervised, unsupervised, semi-supervised, intensive, deep, migration integrated and dimensionality learning. The sample data used in machine learning must attain both quantity and quality requirements where the data should have good representation of the overall data pool (Žigienė et al., 2019). To attain better prediction results, repetitive testing is recommended to rule out erroneous prediction effects. Various learning approaches use different algorithms which also have different prediction results, data sets and objectives. Collected data and the model becomes objects of analysis and the results may lead to further machine learning process. Trend and probability of occurrence are some of the analytical approaches used to determine the chances of reoccurrence of a risk in the future as well as the loss of patterns (Liu, 2019). The use of advanced statistical techniques is widely applied in risk assessment using big data and AI. Algorithms have a better performance on data training sets than on other sets.

Iterative Learning

Machine learning is not a one-time event, but rather a cyclical process that self-renews and validates and corrects existing empirical models and logic. The performance difference between the training and test sets is minimal. Business verification, which uses indicators widely used in business to graphically show the model's impacts (Liu, 2019). As a result, the forecast findings are more uncertain. Many machine learning algorithms' predictions are highly probable. The trend analysis primarily computes the influence of each independent trend and each independent trend on the frequency and magnitude of future loss, and then combines the trend impacts to provide an overall trend analysis. However, too much missing data will make modeling difficult; on the other side, even if a good model exists, it will be ineffective if it cannot extract consumer data (Liu, 2019). The evaluation findings are dispersed and unable to establish a cohesive norm due to the high degree of human subjectivity. Quantitative assessment and rating methods based on a complete study of data are not uniform among sectors, associated aspects, and features. Machine learning is not a one-time event; it may iterate and modify current empirical models and logics on a continual basis.

Artificial Intelligence in Risk Assessment

Cognitive computing has played a big role in augmenting business decisions while its existence has portrayed power performance alongside human thought process. The domain of risk management is aligned to cognitive computing capabilities as risk events are identified through predictive analytics that incorporate use of big data (Stasinakis & Sermpinis, 2020). Companies have large databases of data that cannot fit in spreadsheets and require AI tools like machine learning to process them. An instance in fraud detection cannot be achieved for a million of data files from consumer transaction entries with the use of a smart computer program to identify the flaws and key trends that are risky to the business (Stasinakis & Sermpinis, 2020). Cognitive analytics are part and parcel of AI that has seen risk analysts utilize data to assess risks in any operations. The role assumed by AI currently is undeniable and sooner it will be widely adopted across many sectors.

III. METHODOLOGY

The research methodology involved the process of conducting research through data collection, analysis, and interpretation. The project explores the role of AI and big data in risk assessment in the financial sector. The paper used secondary data from printed and peer reviewed journals to explore the use of AI on risk assessment. A systematic review of literature was used in the analysis of information collected from various articles to present the sentiments supporting the use of AI and big data in risk assessment. Various models as used in the risk assessment were presented in the study findings as used in the financial industry and other sectors.

IV. DISCUSSION OF FINDINGS

Machine learning techniques were applicable in financial risk management through computational methods and approaches

that aimed to improve the overall institutional performance. The machine learning approaches are reliant in optimizing loss or gain functions. The findings further reported that AI utilized various machine learning approaches that included supervised, unsupervised, deep and reinforcement learning (Malhotra, 2018). In its application, machine learning is purely dependent on large amounts of data sourced from various entry points of the transactional systems like the consumer data or historical events. Predictive models are derived to measure various attributes of identifiable risk in the business operations. Financial institutions run large databases from its millions of customers and their daily transactions. This data can only be analyzed and made useful through adopting various machine learning techniques that are effective to identify any flaws or risks to the business (Malhotra, 2018). Some of the risks identified are market risk, credit risk, insurance risk and operational risks. These types of financial risks are assessed through volatility measurement and forecasting. Market risks are assessed through portfolio optimization, sensitivity analysis, and volatility forecasting while credit risks are assessed through credit scoring and defaulting prediction (Mashrur et al., 2020). Insurance risks are measured by claims modelling, reserve losses, mortality forecasting, and fraud detection. Table 1 below shows how machine learning techniques are used to assess various financial risks.

Table 1: Machine Learning for Techniques

Learning Method	Learning Task	Risk Application
		Fraud detection
	Classification	Portfolio optimization
		Credit scoring & Bankruptcy prediction
Supervised Learning		Volatility forecasting
		Sensitivity analysis
	Regression	Claims modelling
		Loss reserving
		Mortality modelling
		Insurance pricing
	Clustering	Sensitivity analysis
		Credit scoring & bankruptcy prediction
	Anomaly detection	Fraud detection
		Insurance underwriting
	Dimensionally reduction	Mortality modelling
Reinforcement Learning		Portfolio optimization
Semi-supervised learning		Sensitivity analysis

From the Table, machine learning tasks involve classification, regression, clustering, anomaly detection, and dimensionally

reduction which are all based on the data extracted from the institutional databases.

Further findings reveal that modeling and analysis technology are widely applicable in assessing financial risks as they are based on big data. Financial institutions rely on their databases to collect data which provides insights on various risk trends. An instance for insurance companies, a risk control method is applied which focusses to identify potential risks and avoid losses. Insurance companies apply machine learning and big-data modeling technology to mine useful data from their databases and build models (Mashrur et al., 2020). The data is verified, re-adjusted, and trained to display intrinsic patterns for optimal throughput. Financing decisions works as a combination of retaining and transferring risk to various degrees. Risk is also evaluated through management decisions which is also communicated by data analysis using the extracted data. Key variables of interest are modeled, and their outcome is predicted which helps in pre-determining the future events (Mashrur et al., 2020). Machine learning, which is an AI technology, is therefore, widely applied in diagnosis of big data to display key trends, predictive analysis and also risk assessment in the financial institutions.

Risk assessment in the financial institutions is largely dependent on the data acquired by the banks. The computing systems adopted by such institutions can be classified to purely utilize AI and big data. The software used in such institutions have high capabilities in handling big data demands. Some of the software used in carrying out learning tasks include R, Python, and Java. There are also some systems with ready designed to directly analyze data and provide graphical outputs and tables that helps managers make informed decisions (Cerchiello & Giudici, 2016). For instance, SAS is one of those platforms that provide extensive analytical power to the banking systems. SAS is designed on a real-world problem like combating fraud in financial services.

Machine learning in banking industry is the leading tool used in fraud detection like wire transfers, credit cards, gift cards, bank account debit, and mobile banking. The data that is received by banks from the customers, investors, partners, and contractors that is used for different purposes (Cerchiello & Giudici, 2016). The data is analyzed based on the parameters of interest aimed at assessing risk factors that may be affecting the business. Also, same predictive models and algorithms are used to predicting market future stock prices based on the historical performance of individual stocks. AI and big data have been established to play a huge role in risk assessment not only in financial industry but also in other sectors.

V. CONCLUSION AND RECOMMENDATIONS

AI and big data are some of the latest technologies that are taking shape in the technology realm providing intelligent solutions that mimic human minds. In the light of risk assessment and management, AI and big data play a big role

in identifying risks involved in daily operations. At the era of technology and big data, risk managers have been forced to adopt efficient approaches of predictive analytics and machine learning tools. The big data has challenged most institutions that rely on human intelligence and inferior data analytical tools due to low levels of accuracy and time consuming. Even the normal spreadsheets find it hard and limited to make sense out of big data due to its capability and the nature of the data. Financial institutions have advanced and extended the need to use machine learning that mimic human intelligence in making predictions and identifying potential areas of risks. Informed decision making is also part of the predictive analytics modeling which is based on the outcomes of the big data analysis. Supervised learning, reinforcement machine learning and semi-supervised learning are some of the adopted approaches that are useful in classification, regression, clustering, anomaly detection, and dimensional reduction. These learning tasks allow fraud detection, portfolio optimization, volatility forecasting, and sensitivity analysis among other variable detections in the financial sector. Since the AI and big data are relatively new concepts, their advancement is still on course as more machine designs and software developments with advanced cognitive abilities to mimic human minds, financial institutions need to invest heavily in new technologies that make the work of risk assessment and other operations more efficient and timelier. While there is limited specific-based software to offer AI like in the robotics industry, financial sector will need to invest in research and development for a specialized AI machines and software to meet the rising needs of cyberspace in the banking systems and mobile banking transactions.

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