Research on Financial Crimes Detection based on Big Data Technology

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Abstract: Financial crimes including fraud, money laundering, insider trading, pose significant challenges to the stability and integrity of global financial systems. Detecting and preventing these crimes is a complex task that requires sophisticated tools and technologies. Currently, there still leaks effective methods to precisely detect crimes, which can cause tremendous economic loss in the trading system. In this work, we explore the role of big data technology in detecting financial crimes. Initially, we discuss the core challenges in financial crime detection and how big data technology can address these issues, which includes the importance of data integration, data quality and real-time analysis in identifying suspicious patterns and anomalies indicative of financial crimes. Subsequently, we simulate the proposed framework and evaluate the benefits of implementing big data technology in financial crime detection with existing detection methods. From our extensive simulation results, we can significantly observe that our proposed method can detect financial crimes from enormous trading data with reasonable response costs and effective detection accuracy through comparing with existing identification models.

Keywords: Financial Crimes, Big Data, Crime Detection, Accuracy, Response Cost.

1 Introduction

Financial crimes contain a wide range of illicit activities committed within the realm of finance and economic systems. These crimes encompass fraudulent actions, corruption, money laundering, embezzlement, insider trading, identity theft, cybercrime and various other unlawful practices that undermine the integrity and stability of financial institutions and markets [1].

Financial crimes detection is a task of identifying and uncovering illicit activities within the realm of finance and economic systems. Detecting financial crimes is essential for safeguarding financial institutions, protecting the interests of individuals and businesses, and maintaining the integrity of the global economy. Financial crimes

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encompass a wide range of illegal activities, including fraud, money laundering, corruption, insider trading, embezzlement, identity theft, cybercrime and more [2].

Detecting financial crimes is a complex and challenging task due to the evolving nature of these illicit activities and the sophisticated methods employed by perpetrators. The advancement of technology has both enabled criminals to devise new techniques and provided opportunities for innovative detection methods. One of the core elements in financial crimes detection is the establishment of robust regulatory frameworks and compliance measures [3]. Financial institutions are required to implement stringent controls, reporting systems and risk management procedures to detect and prevent illicit activities [4].

Moreover, data analytics and artificial intelligence play a crucial role in financial crimes detection. By leveraging vast amounts of data and employing advanced algorithms, financial institutions and regulatory bodies can identify patterns, anomalies, and outliers that may indicate fraudulent or illegal behavior. These technologies enable the detection of complex networks and facilitate the identification of hidden connections between seemingly unrelated transactions [5].

Additionally, the continuous monitoring of emerging threats and the implementation of proactive measures are essential in staying ahead of evolving financial crimes. As criminals adapt to technological advancements and exploit new vulnerabilities, detection methods must evolve and adapt accordingly to effectively identify and mitigate risks [6]. Through enhancing financial crimes detection capabilities, societies can better protect individuals, businesses, and economies from the detrimental impacts of illicit activities. Through ongoing collaboration, technological advancements, and robust regulatory frameworks, detecting financial crimes becomes a pivotal component in preserving the integrity and stability of global financial systems [7].

Big data technology is designed to process, analyze, and derive insights from vast volumes of structured and unstructured data. As the digital world continues to expand exponentially, organizations and industries are grappling with an enormous influx of data generated from various sources such as social media, sensors, mobile devices, and transactional systems [8]. Big data technology provides the means to harness the potential of this data and extract valuable information to drive decision-making, innovation, and competitive advantage. The essential component of big data technology is the concept of distributed computing, which involves breaking down large datasets into smaller subsets and processing them across multiple interconnected systems or clusters [9].

Furthermore, big data technology encompasses a range of complementary tools and frameworks that facilitate various stages of the data lifecycle. These include data ingestion and integration tools, distributed file systems, data storage technologies like Apache Hadoop cloud-based solutions and advanced analytics platforms including Apache Spark and machine learning algorithms [10]. These tools provide the foundation for data collection, cleansing, transformation, storage, and analysis. The impact of big data technology extends across multiple sectors and industries. In finance, it enables real-time fraud detection and risk analysis. In healthcare, it facilitates personalized medicine, disease surveillance and predictive analytics. In retail, it empowers targeted

marketing campaigns and customer behavior analysis [11]. In manufacturing, it enables predictive maintenance and supply chain optimization.

However, big data technology also presents challenges. Privacy concerns, data security, data quality, and ethical considerations are crucial factors that need to be addressed. The ability to extract meaningful insights from vast volumes of data relies on data governance, data management strategies, and expertise in data analysis and interpretation. As the volume and complexity of data continue to grow, big data technology will play an increasingly vital role in helping organizations derive actionable insights and make informed decisions [12].

The reminder of this work is arranged as an introduction contributions and primary parameter description about the proposed detection model in Section 2. Subsequently, we demonstrate the general framework and explain the execution procedures in the devised detection method in Section 3. Indeed, Section 4 contains the simulation results and compares with existing financial crimes detection methods to estimate the performance of proposed model. Finally, we conclude the proposed method and provide several possible improvements for the future research.

2 Preliminaries

2.1 Background

System management theory (SMT) is established on that in the modern social government management mode, all government management activities and behaviors exist in the form of a system, and various government departments interact with each other and rely on each other to jointly implement government management functions. Here, the government exists as a system, and the government departments are an organic part of the government system, and the government departments also independently constitute a system.

Barnard proposes that the essence of the organization is a system that consciously coordinates the activities or forces of more than two people, that is, human activities and effectiveness constitute an organizational system and human activities directly affect the existence and development of the organization. The organizational system of the government shall organize and coordinate all units and departments to manage economic activities and crack down on economic crimes.

2.2 Parameter Description

Following Table 1 shows the primary parameter symbols in the proposed model and explain the utilization function of these units.

Table 1. Primary parameter explanation.

Parameter symbols	Explanations
I	Input data

P	Self-supervised connection hyper-parameter
Φ	Time series control units

3 Model Framework

3.1 Execution Description

Following items describe the primary procedures in the proposed detection model and explain the specific functions of these modules.

- Data Collection: includes the identification of relevant data sources and gather financial data from various sources, such as transaction records, customer information, internal databases, external data providers, and regulatory reports. Utilizing data extraction techniques to retrieve structured and unstructured data from the identified sources. Integrating the collected data from different sources into a central repository for analysis.
- Data Preprocessing: Includes removing any duplicate, incomplete, or irrelevant data points to ensure data quality. Data transformation: Convert data into a consistent format, standardize variables, and resolve inconsistencies or errors. Protecting the sensitive customer information through anonymization techniques while retaining data integrity.
- Data Analysis: Includes the exploratory data analysis, which can conduct initial analysis to understand the characteristics, patterns, and trends within the data. Generating summary statistics and visualizations to gain insights into the data and identify anomalies. Employing machine learning algorithms to develop predictive models for identifying potential financial crimes based on historical patterns. Network analysis means to utilize network analysis techniques to identify complex relationships, such as money laundering networks or fraud rings.
- Rule-based Systems and Algorithms: aims to develop rule-based systems, which can create rules based on regulatory requirements, industry standards, or known fraud patterns to flag suspicious transactions or activities. Machine learning algorithms work as training machine learning models using labeled data to detect financial crime patterns and anomalies. Algorithms contains decision trees, random forests, neural networks can be employed to achieve detection process.
- Real-time Monitoring: aims to establish a system to continuously monitor financial transactions and activities in real-time. Stream processing can utilize stream processing techniques to analyze data in motion, enabling immediate detection and response to potential financial crimes.

3.2 Model Structure Description

Following Figure 1 shows the proposed model framework of proposed model and contains the inner components.

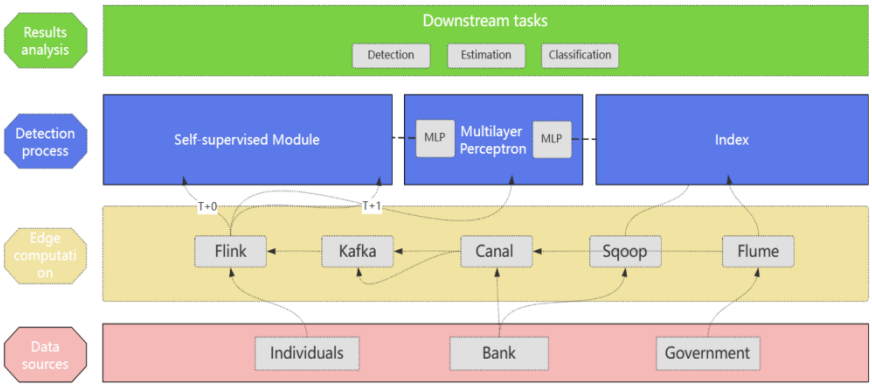

Fig. 1. Model framework illustration.

4 Experimental Analysis

Initially, we compare our model accuracy with system management theory (SMT) and utilize the random selection as the baseline to estimate the detection accuracy of proposed model. Following Figure 2 shows the comparison results with the increase of crimes.

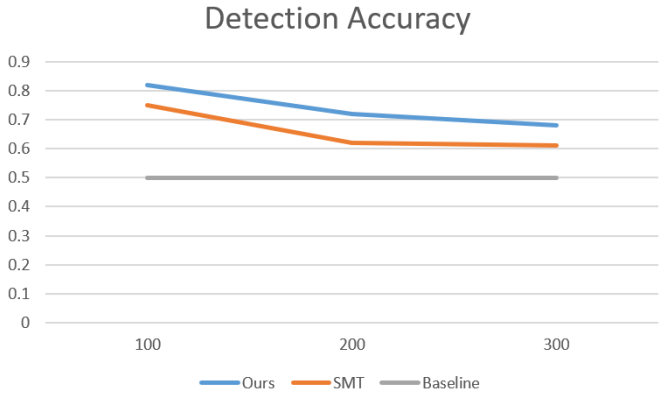

Fig. 2. Detection accuracy comparison results.

Additionally, the computation cost is another essential indicator to evaluate the proposed model in metric of effectiveness. Following Table 2 shows the computation costs through simulating the 400KB amount of crimes data.

Table 2. Computation costs comparison results.

Models	Computation costs
Ours	4.3s

SMT	5.1s
Baseline	1.2s

5 Conclusion

In conclusion, leveraging big data technology for financial crime detection empowers organizations to proactively identify and prevent fraudulent activities. By combining advanced analytics and collaborative approaches, organizations can enhance their ability to mitigate financial crime risks, protect their assets and ensure compliance with regulatory requirements. As for the future improvements, the utilization optimization process can significantly enhance the detection accuracy of proposed and may cause the numerous computation costs when dispose large-scale data set.

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