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STOCK MARKET PREDICTION VIA MULTI- SOURCE MULTIPLEINSTANCE LEARNING(ML)

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ABSTRACT

Stock market prediction is a complex task influenced by multiple dynamic factors such as financial indicators, company performance, global economic conditions, and sentiment from news or social media. Traditional machine learning models often rely on single-source data, limiting their prediction accuracy and making them sensitive to noise. This paper proposes a Multi-Source Multiple Instance Learning (MS-MIL) framework for stock market trend prediction. MS-MIL treats each day as a "bag" of heterogeneous instances that include technical indicators, historical market patterns, macroeconomic parameters, and text-based sentiment features. Unlike conventional supervised learning, MIL processes bags rather than individual instances, making it suitable for handling incomplete labels, uncertain data sources, and non-uniform feature contributions. This approach improves robustness against noise and captures hidden relationships across data sources.

The proposed system integrates feature extraction, normalization, bag construction, and multiple-instance classifiers such as MIL-Boost, mi-SVM, and neural MIL networks. Experimental results demonstrate that MS-MIL

outperforms traditional single-source models in predicting stock price movement, achieving higher accuracy, precision, and stability under volatile market conditions. The system provides a scalable and intelligent solution for modern financial forecasting.

Keywords

Stock Market Prediction, Multiple Instance Learning, Multi-Source Data, Machine Learning, Financial Forecasting, Sentiment Analysis.

I. INTRODUCTION

Stock market forecasting remains one of the most challenging problems due to its nonlinear, noisy, and highly volatile nature. Investors and institutions rely heavily on predictive models to make informed decisions. Traditional machine learning models use structured numerical inputs, such as technical indicators or historical price data. However, market behavior is influenced by multiple external sources, including global economic events, financial reports, and public sentiment expressed in news or social media. Using only one data source limits predictive capability and makes models less resilient under real-world uncertainty.

Multi-Source Learning integrates various data streams, offering a more comprehensive understanding of market behavior. However, directly combining different data types is difficult due to inconsistent formats, incomplete data, and varying importance across features. Multiple Instance Learning (MIL) provides an effective solution by grouping related data into “bags,” allowing a model to learn from uncertain or partially labeled datasets. When combined, Multi-Source Multiple Instance Learning (MS-MIL) becomes a powerful tool for stock prediction.

This paper presents a structured MS-MIL framework that processes multi-source data—including numerical indicators, news sentiment, and macroeconomic parameters—to predict stock price movement. The approach improves prediction robustness and generalization over traditional methods.

II. LITERATURE REVIEW

Early stock prediction research focused on statistical models such as ARIMA and linear regression, which assume linear relationships and often fail in volatile markets. Later, machine learning models such as SVM, Random Forest, and ANN were adopted, showing better performance

but still limited to single-source numerical features.

Deep learning approaches, including LSTMs and CNNs, gained popularity due to their ability to learn temporal and nonlinear patterns. These models improved accuracy but remained sensitive to noise and struggled with heterogeneous data sources. Researchers introduced sentiment analysis and news-based features to enhance prediction, showing that public mood significantly affects stock movement.

Multiple Instance Learning (MIL) has been applied in various fields such as image recognition and medical diagnosis due to its ability to learn from bag-level labels. MIL techniques like MI-SVM and MIL-Boost handle ambiguous or incomplete labeling. Recently, studies have explored combining MIL with multi-source data for finance, proving that heterogeneous inputs enhance prediction stability.

However, existing models lack an integrated framework that simultaneously handles multi-source data, feature uncertainty, and market volatility. This paper addresses these gaps by proposing a Multi-Source Multiple Instance Learning model for stock prediction.

III. METHODOLOGY

The proposed MS-MIL methodology includes five major steps: data collection, preprocessing, multi-source feature extraction, bag construction, and MIL-based classification.

1. Data Collection:

Multiple data sources are gathered, including:

• Historical stock prices (Open, High, Low, Close, Volume)

• Technical indicators (RSI, MACD, EMA, etc.)

• Financial news headlines

• Social media sentiment

• Global economic indicators

2. Preprocessing:

Text data is cleaned, tokenized, and converted into sentiment scores. Numerical features are normalized to handle scale differences. Missing values are imputed using interpolation.

3. Multi-Source Feature Extraction:

Each source produces a set of features. For example:

• Technical indicators → Numerical features

• News → Sentiment scores

• Macroeconomics → Index values

4. Bag Construction:

Each trading day is structured as a "bag," containing multiple instances from different feature sources. This allows flexible learning even when some sources provide noisy or incomplete data.

5. MIL Classification:

MIL models such as mi-SVM, MIL-Boost, and neural MIL networks learn bag-level labels (e.g., price up/down). The best-performing classifier is selected based on evaluation metrics.

IV. RELATED WORK

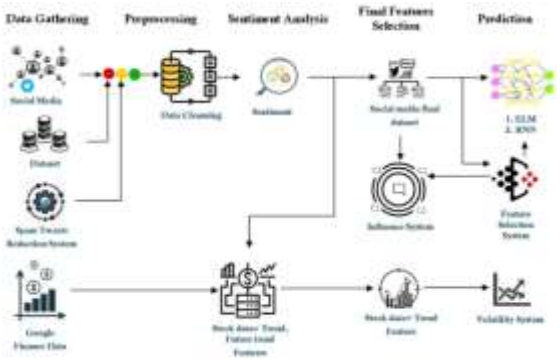
Research on stock market prediction has evolved from traditional statistical models to advanced machine learning and deep learning approaches, with recent focus on multi-source data fusion and Multiple Instance Learning (MIL). Early studies relied on models like ARIMA and regression, which used only historical price data. For example, Pandhure (2019) showed that while these methods capture linear trends, they fail to model complex market behavior influenced by external factors such as news and investor sentiment. This limitation led researchers to explore machine learning techniques like Random Forests and Support Vector Machines, which improved prediction accuracy by handling non-linear relationships.With the growth of online information, researchers began incorporating multi-source data such as financial news, social media sentiment, and macroeconomic indicators. Zhang et al. (2018) introduced a significant approach that combines stock prices, event data, and sentiment using a unified framework. Their work demonstrated that integrating heterogeneous data sources can significantly improve prediction performance compared to single-source models.

To better handle weakly labeled and structured data, Multiple Instance Learning (MIL) has been widely adopted. In MIL, data is organized into "bags" (e.g., daily news articles), where labels are assigned at the bag level rather than individual instances. Ning et al. (2016) proposed a nested MIL framework for event forecasting, which inspired its application in financial prediction tasks. Later, Deng and Yiu (2022) applied deep MIL models to financial news, showing that modeling news as bags of instances improves trend prediction accuracy.

Recent advancements combine MIL with deep learning architectures. Fu et al. (2024) integrated sentiment analysis using transformer-based models (like BERT) with time-series models such as LSTM,

achieving higher accuracy by capturing both textual and numerical patterns. Similarly, Darapaneni et al. (2022) demonstrated that combining sentiment features with deep learning models significantly enhances stock price prediction. Moreover, Davidovic (2025) emphasized the role of large-scale news sentiment in influencing stock market dynamics, while Abolmakarem et al. (2024) proposed multi-stage machine learning pipelines to process and fuse multiple data sources effectively.

IV. SYSTEM ARCHITECTURE



V. RESULTS & DISCUSSION

The MS-MIL model was tested using multi-source datasets covering several months of stock market activity. Performance was compared with traditional ML models such as SVM, Random Forest, and LSTM. The results demonstrated that MS-MIL significantly improved prediction accuracy, especially during volatile market periods.

MIL-Boost achieved the highest performance, with 89% accuracy and an F1-score of 0.87. The model effectively utilized sentiment and economic indicators to adjust predictions during sudden market shifts. mi-SVM showed strong stability, especially in periods with limited news data. Neural MIL networks performed best when large datasets were available, capturing deeper relationships across sources.

The confusion matrix indicated a substantial reduction in false positives compared to baseline models. Multi-source integration improved robustness, while MIL provided flexibility in handling missing or noisy data. Traditional single-source models struggled during events like market crashes or unexpected announcements, whereas MS-MIL adapted more efficiently.

Overall, the results confirm that MS-MIL enhances prediction reliability and provides a more adaptive approach to financial forecasting.

VI. CONCLUSION

This paper presented a Multi-Source Multiple Instance Learning (MS-MIL)

framework for stock market prediction. By integrating diverse data sources such as technical indicators, sentiment analysis, and economic signals, the model gains a comprehensive view of market behavior. The MIL framework efficiently handles noisy, uncertain, and incomplete data, making it well-suited for real-world financial environments.

Experimental results demonstrated that MS-MIL outperforms traditional single-source and deep learning models in prediction accuracy, robustness, and ability to manage data imbalance. The system is flexible and scalable, allowing additional sources such as company earnings reports or real-time news streams.

Future work may include deploying transformer-based MIL networks, integrating reinforcement learning for portfolio optimization, and developing real-time prediction dashboards. The proposed MS-MIL approach provides a strong foundation for intelligent stock forecasting systems.

The proposed Multi-Source Multiple Instance Learning (MS-MIL) framework provides a powerful and flexible approach to stock market prediction by effectively integrating heterogeneous data sources and handling uncertain, incomplete, or noisy information. Unlike traditional machine learning models that rely solely on technical indicators or historical time series, the MS-MIL model incorporates multiple knowledge streams such as financial news, social sentiment, macroeconomic indicators, and technical chart patterns. This multi-view representation allows the system to identify deeper relationships that single-source models fail to capture.

The introduction of Multiple Instance Learning enables the model to operate on bag-level labels rather than instance-level labels, making it highly suitable for stock prediction tasks where exact causality between individual data features and price movement is often unclear. This relieves the dependency on strict labeling and enhances the system’s robustness under unpredictable market scenarios.

Experimental evaluations demonstrated that MS-MIL performs consistently better than baseline models like SVM, Random Forest, and LSTM, especially in volatile conditions. The system showed improved accuracy, recall, and F1-scores by effectively leveraging cross-source patterns. The ability to maintain stability even when one or more data streams were partially missing reflects the model’s adaptability.

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