

## A Novel Sentiment Analysis-Based Hybrid Machine Learning Approach for Forecasting Financial Indices Under Economic Instability

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Forecasting financial market behaviour during periods of economic instability presents a significant challenge for traditional predictive models, such as ARIMA and standard machine learning classifiers, which often rely on assumptions of linearity and historical stationarity. Market volatility driven by exogenous shocks, such as the COVID-19 pandemic, frequently renders these conventional methods ineffective. This research introduces a novel multi-modal hybrid machine learning approach that integrates technical market data with unstructured sentiment signals to enhance forecasting precision and risk identification during crisis periods. The proposed architecture utilises a Gated Recurrent Unit (GRU) to capture temporal dependencies in financial time series, complemented by a dense Artificial Neural Network (ANN) that processes static context vectors derived from macroeconomic indicators and global news sentiment (via GDELT). A cross-attention mechanism is used to dynamically weigh the influence of diverse data inputs. The model was empirically evaluated using S&P 500 data, specifically covering the COVID-19 crisis period from 2019 to 2021. Experimental results indicate that the proposed hybrid model achieved a directional accuracy of 60.76% compared to the Random Forest baseline, which recorded 59.34%. The model effectively mitigated bull market bias by substantially improving the recall for market downturns from 0.00 to 0.30, demonstrating an enhanced capability to identify negative market movements. Moreover, the attention mechanism dynamically prioritized sentiment-related features during the March 2020 market crash, thereby empirically supporting the hypothesis that sentiment information functions as a critical leading indicator under periods of market instability.

**Keywords:** *Attention Mechanism; Deep Learning; Economic Instability; Financial Forecasting; Sentiment Analysis*