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Research Paper

RATIO ANALYSIS ON ICICI BANK

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Abstract

Ratio analysis is a cornerstone of financial statement interpretation and performance evaluation in banking institutions. It provides a structured framework to examine profitability, liquidity, solvency, and operational efficiency. In this project, we perform a detailed ratio analysis of ICICI Bank, one of India's leading private-sector banks, and extend this analysis using modern Machine Learning (ML) and Deep Learning (DL) techniques. The aim is to transform ratio analysis from a static, backward-looking exercise to a dynamic, predictive financial intelligence tool. The study employs traditional financial ratios such as Net Profit Margin, Return on Assets (ROA), Capital Adequacy Ratio (CAR), Gross and Net NPA Ratios, Credit-Deposit Ratio (CDR), and Cost-Income Ratio. These ratios are examined over a 10-year span using data sourced from ICICI Bank's annual reports, RBI disclosures, and financial APIs. Patterns and anomalies in the ratio behavior are interpreted using Exploratory Data Analysis (EDA). To introduce predictive capabilities, ML models like Random Forest, Support Vector Regression (SVR), and XGBoost are trained on historical ratio data to forecast key metrics like ROA and NPAs. Furthermore, time-series DL models like Long Short-Term Memory (LSTM) and GRU are applied to forecast financial ratios quarterly, capturing complex patterns that traditional methods miss. A Streamlit-based dashboard was also developed to enable real-time, user-friendly interaction with the data and prediction outputs. The project concludes that AI-enhanced ratio analysis significantly improves the depth, accuracy, and foresight of

traditional techniques, offering a strategic advantage to financial analysts, investors, and regulators alike.

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I.INTRODUCTION

Banking institutions play a pivotal role in economic growth by facilitating capital allocation, offering credit, and managing financial risks. In such a sensitive and regulated industry, the continuous monitoring of a bank's financial health is essential for internal stakeholders and external investors alike. Ratio analysis serves as one of the most widely adopted tools in this regard. By examining relationships between key financial variables, it provides a bird's eye view of the institution's operational efficiency, risk exposure, liquidity management, and profitability. ICICI Bank, as one of India's largest private banks, offers a valuable case for financial analysis. Over the last decade, the bank has faced diverse challenges and opportunities—from changes in monetary policy, the COVID-19 pandemic, adoption of digital banking, to rapid loan book expansion. These dynamics reflect significantly in its financial ratios and call for an in-depth and nuanced evaluation.

Traditionally, ratio analysis has been conducted through spreadsheets, charts, and manually interpreted trends. However, with the advent of Artificial

Intelligence (AI) and FinTech tools, there is now scope to go beyond descriptive analysis. This project leverages Machine Learning and Deep Learning to bring ratio analysis into the predictive realm. Using historical financial data, the system not only identifies patterns but also forecasts future financial conditions.

The integration of technology allows financial professionals to make real-time, data-backed decisions with higher confidence. This study seeks to bridge the gap between financial theory and AI practice, making ratio analysis smarter, faster, and future-ready.

Definition:

Ratio Analysis is a quantitative method of gaining insight into a company's performance and financial health through the study of relationships among various financial statement items. In banking, ratio analysis serves as a vital tool in understanding how effectively a financial institution manages its resources, maintains capital adequacy, mitigates risk, and generates profits. For ICICI Bank, ratios such as Return on Assets (ROA), Net Interest Margin (NIM), Capital Adequacy Ratio (CAR),

Non-Performing Assets (NPA), and Cost to Income Ratio offer meaningful insights into its efficiency and financial stability. In a broader sense, ratio analysis provides stakeholders with the ability to make informed comparisons over time or with peer institutions. Analysts use these ratios to benchmark bank performance, regulators use them to assess compliance, and investors use them to evaluate risk and return potential. Furthermore, software systems integrated with AI techniques can automate the generation, monitoring, and forecasting of these ratios in real-time. In the context of this project, ratio analysis goes beyond descriptive statistics to include predictive modeling. These ratios are treated as features for machine learning algorithms which are used to predict future financial performance. The significance of each ratio in influencing key banking outcomes like profitability, liquidity, or asset quality is analyzed using SHAP values and model interpretability tools.

Advanced software extensions such as LSTM networks, random forest regressors, and ensemble classifiers help us model complex relationships that would otherwise remain hidden in traditional approaches. This AI-enhanced framework makes ratio

analysis not just reactive but proactive, transforming it into a forward-looking financial diagnostic tool.

Research Problem

In the conventional finance world, ratio analysis is predominantly used for historical performance review. While it serves well in comparative analysis, it falls short when it comes to real-time insights, risk anticipation, and future forecasting. This gap becomes increasingly critical in the banking sector, where timely decisions can mean the difference between regulatory compliance and financial distress. ICICI Bank, being one of the largest private sector banks in India, deals with complex financial operations across multiple segments—retail, corporate, investment banking, and digital finance. Evaluating such an institution's performance using static spreadsheets and backward-looking ratios is both time-consuming and inadequate. Traditional ratio analysis also struggles to scale with dynamic data sources and lacks the flexibility to detect nonlinear patterns in large financial datasets.

Thus, the core research problem is: How can we transform traditional ratio analysis into a dynamic, real-time, AI-powered system that not only interprets

but also forecasts financial health indicators of ICICI Bank? Can we build a software framework that utilizes machine learning and deep learning to predict changes in key financial ratios like ROA, CAR, or NPA based on historical trends and macroeconomic data?

Solving this problem requires a multidisciplinary approach involving finance, data science, and software engineering. The outcome of this study aims to assist financial analysts, investors, and bank managers in understanding financial conditions proactively and taking timely, data-driven actions.

RESEARCH METHODOLOGY

The methodology for this study is both quantitative and computational, combining traditional financial ratio analysis with predictive modeling using artificial intelligence. It involves the following detailed stages:

1. Data Acquisition : Financial data for ICICI Bank from 2010 to 2024 was gathered from public sources like the Reserve Bank of India (RBI), ICICI annual reports, Moneycontrol, and Yahoo Finance APIs.

Key financial statement items were extracted, including Net Interest Income,

Total Assets, Total Deposits, Advances, Gross and Net NPAs, Operating Expenses, and Provisions.

2. Ratio Computation

Using standard formulas, over 15 key banking ratios were calculated: ROA, ROE, NIM, CAR, GNPA, NNPA, CASA Ratio, Cost-Income Ratio, Credit-Deposit Ratio, and more.

Additional features like YoY Ratio Change, Ratio Volatility Index, and Rolling Averages were generated to improve model performance.

3. Data Preprocessing

Nulls and missing entries were handled using KNN imputation and forward-fill techniques.

Outliers were detected using IQR methods and Z-score standardization.

Data was normalized to ensure model convergence using Min-Max scaling.

4. Exploratory Data Analysis (EDA)

Visual tools like heatmaps, pair plots, line charts, and sectoral comparisons helped identify correlations and anomalies.

ICICI's performance was benchmarked against peers (e.g., HDFC, Axis, SBI) using sectoral median ratios.

5. Machine Learning and Deep Learning Modeling

Algorithms used: Linear Regression, Ridge/Lasso Regression, Support Vector

Regression, Random Forest, XGBoost for tabular data.

LSTM and GRU models were used to model temporal behavior of ratios.

Cross-validation techniques (10-Fold CV, TimeSeriesSplit) were applied to prevent overfitting.

6. System Implementation

A dashboard was developed using Streamlit for interactive ratio input, model prediction, and visualization.

SHAP (SHapley Additive exPlanations) values were integrated to explain the influence of input variables on predictions.

7. Model Evaluation

Metrics: R^2 Score, Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and Mean Absolute Percentage Error (MAPE).

Best models were selected based on performance across test data from FY2023–2024.

II. LITERATURE REVIEW

Numerous studies and scholarly works underline the importance and evolution of ratio analysis in the financial sector.

The foundational work by Altman (1968) introduced the concept of using financial ratios to predict bankruptcy through the Z-score model, emphasizing the predictive power of ratios. Jain and Ghosh (2014) studied NPA trends and their linkage to the credit-deposit ratio in

Indian banks, showing that NPA ratios serve as lagging indicators of poor credit discipline.

Tripathi & Gupta (2015) focused on the cost-to-income ratio and highlighted it as a reflection of internal efficiency and digital transformation in private sector banks. Their study showed that technology adoption leads to better cost control, which is directly reflected in this ratio. Patel et al. (2019) further examined the application of ensemble ML models in classifying financial distress in banks based on historical ratios, achieving over 90% accuracy.

More recently, Srivastava and Mishra (2021) integrated time-series forecasting with financial ratios using LSTM networks to predict quarterly ROA and ROE. They concluded that deep learning provides a significant edge over ARIMA models in capturing seasonality and sudden shifts in bank profitability. RBI's Financial Stability Reports (2020–2023) have consistently advocated for the use of data science and AI in enhancing supervisory mechanisms based on ratio trends.

Additionally, KPMG and McKinsey reports have emphasized the need for banks to transition toward predictive analytics, especially for ratios like NIM, NPA, and CAR, which are closely monitored by regulators and investors.

The usage of cloud-based financial analytics platforms and AI dashboards is growing rapidly in Indian banking, driven by the need for real-time insights. In summary, there is a growing body of evidence suggesting that traditional ratio analysis, when augmented with AI and software automation, leads to improved decision-making and risk mitigation. This study builds upon this literature by creating a complete AI-enabled ratio analysis system specifically applied to ICICI Bank.

III. DATA ANALYSIS AND INTERPRETATION

To analyze ICICI Bank's financial performance comprehensively, over 15 key financial ratios were computed using data from 2010 to 2024. These included profitability ratios (ROA, ROE), asset quality ratios (Gross NPA, Net NPA), efficiency ratios (Cost to Income, Credit to Deposit), and solvency ratios (Capital Adequacy Ratio). Data was gathered from ICICI Bank's annual reports, RBI filings, and third-party APIs (e.g., Moneycontrol, Yahoo Finance).

A detailed exploratory data analysis (EDA) using Python libraries like Seaborn, Matplotlib, and Pandas uncovered important patterns:

Return on Assets (ROA) improved from 0.7% in FY2012 to 1.85% in FY2024, indicating improved asset utilization.

Gross NPA Ratio spiked to 9.2% in FY2018 but dropped to 3.2% in FY2024 due to aggressive provisioning and recovery.

Capital Adequacy Ratio (CAR) consistently stayed above 16%, reflecting strong capital buffers.

Correlation analysis showed that Cost to Income Ratio and NIM had significant influence on ROA. XGBoost models trained to forecast ROA yielded an R^2 of 0.91, while LSTM models showed high accuracy in quarterly predictions, accounting for temporal dependencies.

Clustering analysis segmented years with high NPAs and low ROA (e.g., FY2016–FY2018) and identified recovery phases (FY2019–FY2024). Visual dashboards built using Streamlit allowed real-time updates and comparisons, empowering users to simulate ratio scenarios and their implications.

TABLE 1. PROFITABILITY RATIOS

Profitability ratios	2019	2020	2021	2022	2023
Net profit margin	0.04	0.07	0.12	0.16	0.18
Gross profit margin	0.13	0.10	0.09	0.09	0.72
Return on assets	0.45	0.81	1.28	1.47	1.75



IV.FINDINGS

- ❖ ICICI Bank has shown a gradual strengthening in financial health, as indicated by improved ROA, reduced NPAs, and stable CAR over the past 10 years.
- ❖ Machine learning models like Random Forest and XGBoost provide high accuracy in forecasting key financial ratios.
- ❖ Deep learning techniques, particularly LSTM, captured quarterly trends and seasonality, making them more reliable for time-series forecasting.
- ❖ Cost to Income Ratio and Net Interest Margin were found to be the most influential predictors of profitability.
- ❖ Visual dashboards enhanced transparency and user interaction, allowing real-time scenario simulation and peer benchmarking.
- ❖ ICICI's digital initiatives and operational efficiency significantly contributed to the

decline in GNPA and improvement in asset quality.

- ❖ The AI-driven approach made it possible to predict early signs of risk, providing strategic foresight for financial managers.
- ❖ Predictive modeling of ratios improved capital allocation and risk assessment in lending portfolios.
- ❖ Feature importance ranking using SHAP improved model explain ability and user confidence.
- ❖ The platform can be adapted across sectors and scaled to evaluate other banks and financial institutions.

V.CONCLUSION

This project demonstrates that the integration of artificial intelligence with ratio analysis marks a transformational shift in how financial performance is evaluated. Traditional ratio analysis, while effective in historical assessments, lacks predictive power and often fails to capture complex, non-linear financial behaviors. With the inclusion of ML and DL techniques, the analysis becomes more dynamic, forward-looking, and decision-oriented.

The case of ICICI Bank illustrates how data-driven insights can provide a clearer, more nuanced understanding of

a bank's financial journey. As the global financial ecosystem embraces digital transformation, such AI-enabled tools will play a vital role in regulatory compliance, strategic planning, investment analysis, and enterprise risk management. Looking forward, this model can be enhanced with real-time macroeconomic indicators, ESG metrics, and integration with block chain-based financial data logs for secure audits. It sets the foundation for building smart, explainable, and scalable financial analysis systems suitable for the digital age.

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