

## FINANCIAL STATEMENT ANALYSIS OF PNB

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### ABSTRACT

This study proposes an innovative and in-depth financial statement analysis of **Punjab National Bank (PNB)**, a prominent public sector bank in India, by synergistically integrating traditional financial ratio analysis with advanced Machine Learning (ML) and Deep Learning (DL) techniques. Recognizing the complex and dynamic nature of the Indian banking sector, characterized by evolving credit cycles, stringent regulatory frameworks, and intense competition, conventional financial analysis often provides a retrospective view. This research aims to move beyond static analysis by leveraging the power of AI to unearth deeper insights and generate predictive intelligence. The methodology will involve meticulously collecting and processing PNB's audited financial statements over a significant 5-10 year period (e.g., FY2015-FY2024). A comprehensive set of bank-specific financial ratios will be computed across key dimensions including **liquidity** (e.g., Credit-Deposit Ratio, Liquid Assets to Total Assets), **profitability** (e.g., Net Interest Margin, Return on Assets, Cost-to-Income Ratio), **solvency/capital adequacy** (e.g., Capital Adequacy Ratio), and **asset quality** (e.g., Gross Non-Performing Assets Ratio, Provision Coverage Ratio). Subsequently, ML algorithms such as **Random Forest** and **XGBoost** will be employed. These models are adept at identifying intricate, non-linear relationships and will be used to pinpoint the most influential ratios impacting PNB's core profitability and asset quality, thereby revealing hidden drivers and potential risk

factors. Furthermore, to provide crucial forward-looking perspectives, **Long Short-Term Memory (LSTM) networks**, a specialized form of Deep Learning, will be applied. LSTMs are particularly well-suited for time-series forecasting, enabling the models to capture inherent temporal dependencies, seasonal patterns (e.g., quarterly fluctuations in deposit growth or credit off-take), and market volatilities unique to the banking sector. The performance of these AI-driven forecasting models will be rigorously evaluated against traditional linear time-series models (e.g., ARIMA) using standard metrics like Mean Squared Error (MSE) and prediction accuracy. The expected outcome is to demonstrate how AI significantly enhances predictive accuracy and offers dynamic, data-driven insights, thereby empowering stakeholders with superior tools for strategic decision-making, proactive risk management, and more informed capital allocation within the complex banking landscape.

### I. INTRODUCTION

Punjab National Bank (PNB), a venerable institution among India's public sector banks, operates in an environment characterized by rapid digital transformation, evolving regulatory landscapes, and persistent macroeconomic influences. Traditional financial statement analysis, while fundamental, often presents a snapshot of past performance, limited in its ability to unravel complex interdependencies or forecast future trends with high precision. The banking sector, in particular, is highly sensitive to external

shocks, credit cycles, interest rate fluctuations, and asset quality concerns, making dynamic and predictive financial insights indispensable.

This study is motivated by the need to augment conventional financial analysis with the power of Artificial Intelligence (AI), specifically Machine Learning and Deep Learning. PNB, like other public sector banks, has faced challenges related to Non-Performing Assets (NPAs) and profitability fluctuations, necessitating a deeper, more predictive analytical approach. By applying sophisticated AI algorithms to PNB's financial data, we aim to transcend mere historical review. Our goal is to uncover the nuanced drivers behind PNB's profitability and asset quality, anticipate future financial scenarios with greater accuracy, and ultimately provide actionable intelligence for strategic decision-making, risk management, and resource allocation. This research will demonstrate how AI can transform raw financial data into a powerful tool for navigating the complexities of the modern banking ecosystem.

### Research Objective:

- Comprehensive Data Acquisition and Structuring: To meticulously collect and organize 5-10 years (e.g., FY2015-FY2024) of Punjab National Bank's audited annual financial statements, including Balance Sheets, Income Statements, and Cash Flow Statements, into a robust and clean dataset suitable for both traditional and AI-driven analysis.
- Bank-Specific Ratio Computation: To accurately calculate a diverse set of bank-specific financial ratios across various dimensions:
  - Liquidity: E.g., Credit-Deposit Ratio, Liquid Assets to Total Assets.
  - Profitability: E.g., Net Interest Margin (NIM), Return on Assets (ROA), Return on Equity (ROE), Cost-to-Income Ratio.
  - Solvency/Capital Adequacy: E.g., Capital Adequacy Ratio (CAR/CRAR), Tier 1 Capital Ratio.
  - Asset Quality: E.g., Gross Non-Performing Assets (GNPA) Ratio, Net Non-Performing Assets (NNPA) Ratio, Provision Coverage Ratio (PCR).
- Historical Trend and Peer Comparative Analysis: To visually represent the annual trends of these computed ratios for PNB, identifying significant shifts, cycles, and anomalies. This objective also includes benchmarking PNB's performance against the averages of other major Indian public and private sector banks to assess its competitive position.
- Identification of Key Performance Drivers (ML): To apply supervised Machine Learning algorithms, specifically Random Forest and XGBoost, to the calculated financial ratios. The primary aim is to identify and quantify which specific ratios or financial metrics most strongly influence PNB's key performance indicators, such as its Net Profit Margin and Gross NPA Ratio, uncovering previously obscured relationships.
- Forecasting Future Financial Ratios (DL): To leverage Long Short-Term Memory (LSTM) networks, a specialized Deep Learning architecture, for time-series forecasting of critical financial ratios (e.g., NIM, GNPA Ratio, ROA). This objective aims to capture complex temporal dependencies, intrinsic seasonality (e.g., quarterly loan book growth, deposit mobilization patterns), and the impact of macroeconomic factors and regulatory changes on PNB's future financial trajectory.
- Rigorous Model Evaluation and Benchmarking: To systematically evaluate the predictive accuracy and robustness of the developed AI models (Random Forest, XGBoost for feature

importance; LSTM for forecasting) using appropriate statistical metrics such as Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and Mean Absolute Error (MAE). This includes a comparative analysis against forecasts generated by traditional linear time-series models (e.g., ARIMA) to quantitatively demonstrate the superiority of the AI approach.

- **Derivation of Actionable Insights:** To translate the complex analytical findings into clear, concise, and actionable insights for PNB's management, regulators, investors, and other stakeholders, enabling more informed decision-making concerning credit policies, capital planning, risk mitigation strategies, and operational efficiency improvements.

### Research Methodology:

The methodology for this in-depth financial statement analysis of Punjab National Bank, enhanced by Machine Learning and Deep Learning, is structured into several interconnected and rigorous phases. It commences with **Data Collection and Pre-processing**, a foundational step ensuring the quality and completeness of the financial information. The primary data source will be PNB's **audited annual financial statements** from FY2015-FY2024, meticulously sourced from their official investor relations website, stock exchange filings (BSE/NSE), and regulatory disclosures by the Reserve Bank of India (RBI). Recognizing the benefits of higher frequency data, **quarterly data** for key financial metrics such as Net Interest Income, Gross NPAs, Advances, and Deposits will also be diligently sought and incorporated where publicly available. This granular data significantly enriches time-series analysis, enabling the capture of crucial seasonality and shorter-term market dynamics. The extracted financial figures, encompassing a wide range of parameters from interest income to risk-weighted

assets, will be transformed from PDF reports into a clean, structured tabular format. A crucial aspect of this phase is **Data Cleaning and Validation**, involving rigorous consistency checks, handling missing values through appropriate imputation techniques (e.g., interpolation for minor gaps), and cross-verification with external sources like credit rating reports (CRISIL, ICRA) or industry aggregate data (Indian Banks' Association - IBA) to ensure data integrity and accuracy.

### II.REVIEW OF LITERATURE

Financial statement analysis remains the bedrock of assessing corporate financial health, as posited by Pandey (2019), providing essential metrics for decision-making and robust corporate governance. In the banking sector, this analysis becomes even more critical due to the systemic importance of financial institutions. Specialized banking ratios, encompassing liquidity, profitability, capital adequacy, and asset quality, are meticulously scrutinised to gauge a bank's stability and performance (Corporate Finance Institute, n.d.). For the Indian banking landscape, studies frequently emphasize the profound impact of macroeconomic variables, regulatory interventions by the Reserve Bank of India (RBI), and inherent credit cycles on bank profitability and Non-Performing Assets (NPAs). The period under review for PNB, especially post-2015, saw significant asset quality challenges across Indian public sector banks stemming from issues like the Asset Quality Review (AQR) initiated by RBI and subsequent clean-up efforts, which profoundly impacted profitability and capital adequacy. Recent reports from the Press Information Bureau (PIB, 2024) indicate a substantial decline in the aggregate Gross NPA ratio for Public Sector Banks (PSBs) to 3.12% by September 2024 from a peak of 14.58% in March 2018, showcasing a significant turnaround. Similarly, the Capital to Risk-Weighted Assets Ratio (CRAR) for PSBs has seen a

notable improvement. These trends underscore the volatile yet resilient nature of India's public sector banking.

The burgeoning field of Artificial Intelligence (AI) has demonstrably transformed numerous facets of finance. Kou et al. (2021) offer a comprehensive review of Machine Learning (ML) applications in financial forecasting, highlighting its capacity to process voluminous, complex datasets and identify subtle, multi-dimensional patterns. Within credit risk assessment, ML models have consistently outperformed traditional statistical methods. Lessmann et al. (2015), in their benchmarking study of classification algorithms for credit scoring, empirically demonstrated the enhanced accuracy and predictive power of ML-based approaches. For time-series prediction, Deep Learning (DL) architectures, particularly Long Short-Term Memory (LSTM) networks, have emerged as exceptionally potent tools. Fischer & Krauss (2018) provided compelling evidence of LSTMs' superior performance in forecasting highly volatile financial markets, attributing this to their ability to effectively capture long-term dependencies and temporal nuances in sequential data. Furthermore, ensemble methods such as Random Forest and XGBoost are widely recognized for their robustness in prediction and their inherent capability to provide insightful feature importance analysis, which helps in identifying the most influential variables within complex datasets (ResearchGate, 2025 - "Early Prediction of Bank Performance Using Machine Learning Algorithm"; MDPI, 2025 - "Application of XGBoost Algorithm"). These models offer a powerful avenue for dissecting the drivers of financial performance.

However, despite these advancements, there remains a discernible gap in the academic literature concerning the detailed, integrated application of ML/DL specifically to a comprehensive ratio-based financial

analysis of a major Indian public sector bank like PNB. While studies exist on using AI for credit risk assessment or NPA prediction in Indian banks (e.g., Elets BFSI, 2023 - "AI to early indicate NPAs"; Bangladesh Journals Online, 2025 - "PREDICTIVE MODELING FOR NON-PERFORMING ASSETS"), a holistic framework that leverages AI for end-to-end financial ratio analysis, including driver identification and multi-metric forecasting, is less explored. Moreover, the critical insight from Heaton et al. (2017), advocating for the synergistic combination of human expertise with ML models rather than a complete replacement of traditional methods, reinforces the value of this study's approach. By bridging this gap, this research aims to offer novel insights and a practical methodology for PNB and the broader Indian banking sector to enhance financial performance assessment and strategic foresight using cutting-edge AI.

### III.FINDINGS

- **Historical Financial Volatility:** The analysis will likely reveal periods of significant volatility in PNB's profitability and asset quality ratios, particularly influenced by the broader Indian banking sector's challenges (e.g., high NPA cycles) and subsequent recovery efforts.
- **Mixed Competitive Performance:** PNB's financial ratios will show varying performance relative to industry benchmarks; while some ratios might be at par or slightly better, others, particularly asset quality and efficiency, may indicate areas needing continued improvement compared to leading private sector banks.
- **NIM and CIR as Profitability Drivers:** Random Forest and XGBoost models are expected to consistently identify Net Interest Margin (NIM) and Cost-to-Income Ratio (CIR) as the most significant drivers influencing PNB's overall Net Profit Margin, highlighting

- the critical importance of core lending profitability and operational efficiency.
- Credit Growth and Provisioning Impact Asset Quality: Feature importance analysis will likely show that Credit Growth, Provision Coverage Ratio (PCR), and possibly sectoral loan concentrations are major determinants of PNB's Gross NPA Ratio, emphasizing the need for prudent lending and robust provisioning.
  - Superior Forecasting with LSTMs: LSTM models will quantitatively demonstrate lower Mean Squared Error (MSE) and higher prediction accuracy for key ratios (e.g., NIM, GNPA Ratio, ROA) compared to traditional linear models, underscoring their ability to capture complex non-linear trends and time-series dependencies.
  - Effective Seasonality Capture: The LSTM forecasts will successfully reflect seasonal patterns (if quarterly data is used) in banking metrics, such as quarterly fluctuations in deposit inflows or credit demand, providing more realistic and context-aware predictions.
  - Actionable Insights for Risk Management: The study's findings will provide PNB's management with data-driven insights to proactively manage credit risk, optimize capital allocation, and refine operational strategies based on AI-powered predictions of future financial performance and asset quality.

#### 1V.CONCLUSION

This study lays out a robust and innovative framework for performing enhanced financial statement analysis of Punjab National Bank by seamlessly integrating traditional financial ratio methodologies with advanced Machine Learning and Deep Learning techniques. By moving beyond a purely retrospective view, the proposed approach offers a dynamic and predictive understanding of PNB's financial health and performance trajectory. The application of

Random Forest and XGBoost models is designed to pinpoint the critical drivers of profitability and asset quality, uncovering insights that are often elusive to conventional analyses. Furthermore, the deployment of LSTM networks for forecasting crucial financial ratios is expected to provide more accurate and reliable future projections, explicitly accounting for the complex temporal dependencies and inherent volatilities of the banking sector. The anticipated results, encompassing detailed trend visualizations, clear feature importance insights, and precise AI-driven forecasts, will collectively empower PNB's management, regulators, and investors with superior, data-driven tools for strategic planning, proactive risk mitigation, and optimizing resource allocation, thereby contributing to the bank's long-term stability and growth.

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