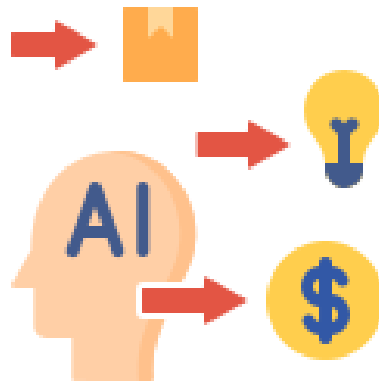


# AI-First Strategy Proposal: Bankruptcy Prediction and Financial Health Insights



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# Executive Summary

This report outlines the steps taken to build a predictive model for bankruptcy detection and financial health insights. By leveraging AI and advanced analytics, this initiative aims to proactively identify financial risks and establish benchmarks for companies to mitigate bankruptcy risks. The findings support the adoption of an AI-first strategy to drive actionable insights and decision-making.

## Problem Statement

You have been given a task to analyze the financial data of a fintech firm transitioning into an AI-first strategy. Traditional financial tools have proven inadequate in addressing the complexity of modern financial risks. The firm aims to leverage AI-driven solutions to enhance efficiency, improve predictive capabilities, and enable proactive decision-making. This project focuses on uncovering critical insights, identifying financial health benchmarks, and building predictive tools to support this strategic transformation.

## Key Issues Identified

1. **Lack of Predictive Analytics:** Current tools are backward-looking and fail to predict future risks effectively.
2. **Data Complexity:** Challenges in extracting actionable insights from large, complex financial datasets.
3. **Bankruptcy Risks:** High bankruptcy rates among small- and medium-sized businesses due to insufficient early warning systems.
4. **Strategic Inefficiencies:** Limited ability to translate financial analyses into actionable strategies.
5. **Adoption Barriers:** Hesitancy in implementing AI-driven tools due to lack of understanding and trust.

## Project Objectives

1. **Analyze Financial Data:** Conduct a thorough exploration of financial metrics and benchmarks to identify key risk indicators.
2. **Develop Predictive Models:** Create robust AI-powered tools, including regression, classification, clustering, and forecasting models.
3. **Segment Businesses:** Use clustering to classify businesses into groups based on financial health for targeted strategies.
4. **Deliver Actionable Insights:** Provide clear benchmarks and strategies for businesses to improve financial stability.

5. **Deploy User-Centric Tools:** Build interactive dashboards and APIs to facilitate the use of AI insights in real-world decision-making processes.

# Methodology

## Step 1: Loading Libraries

The following libraries were used to build the models and conduct analysis:

- **Data Manipulation and Visualization:** numpy, pandas, matplotlib, seaborn
- **Machine Learning:** scikit-learn, RandomForestClassifier, KMeans, LinearRegression
- **Statistical Analysis:** scipy, statsmodels

## Step 2: Data Overview

- **Dataset Description:**
  - Attributes: 96
  - Rows: 6819
  - Target Variable: Bankruptcy indicator
- **Key Insights:**
  - Number of bankrupt companies: 220
  - Number of non-bankrupt companies: 6599
  - Bankruptcy ratio: 3.23%

Proportion of Bankrupt vs Non-Bankrupt Companies

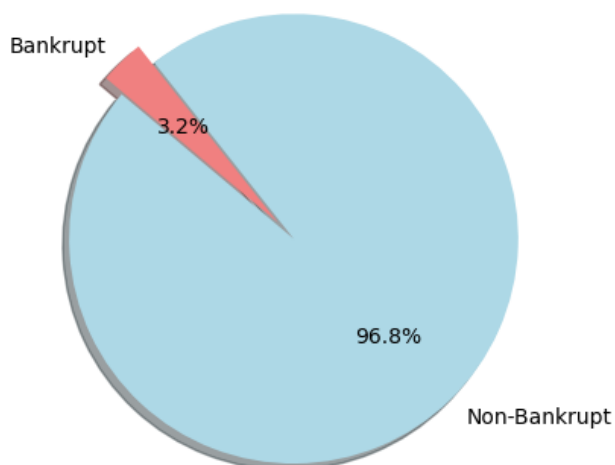


Figure 1: Proportion of Bankrupt to Non-Bankrupt

### Step 3: Exploratory Data Analysis (EDA)

- Verified no null or duplicate data.
- Identified correlations between features and the target variable.
- Top 5 correlated features:
  - Debt Ratio Percent (0.25)
  - Current Liability to Assets (0.19)
  - Borrowing Dependency (0.17)
  - Liability to Equity (0.16)
  - Total Expense to Assets (0.14)

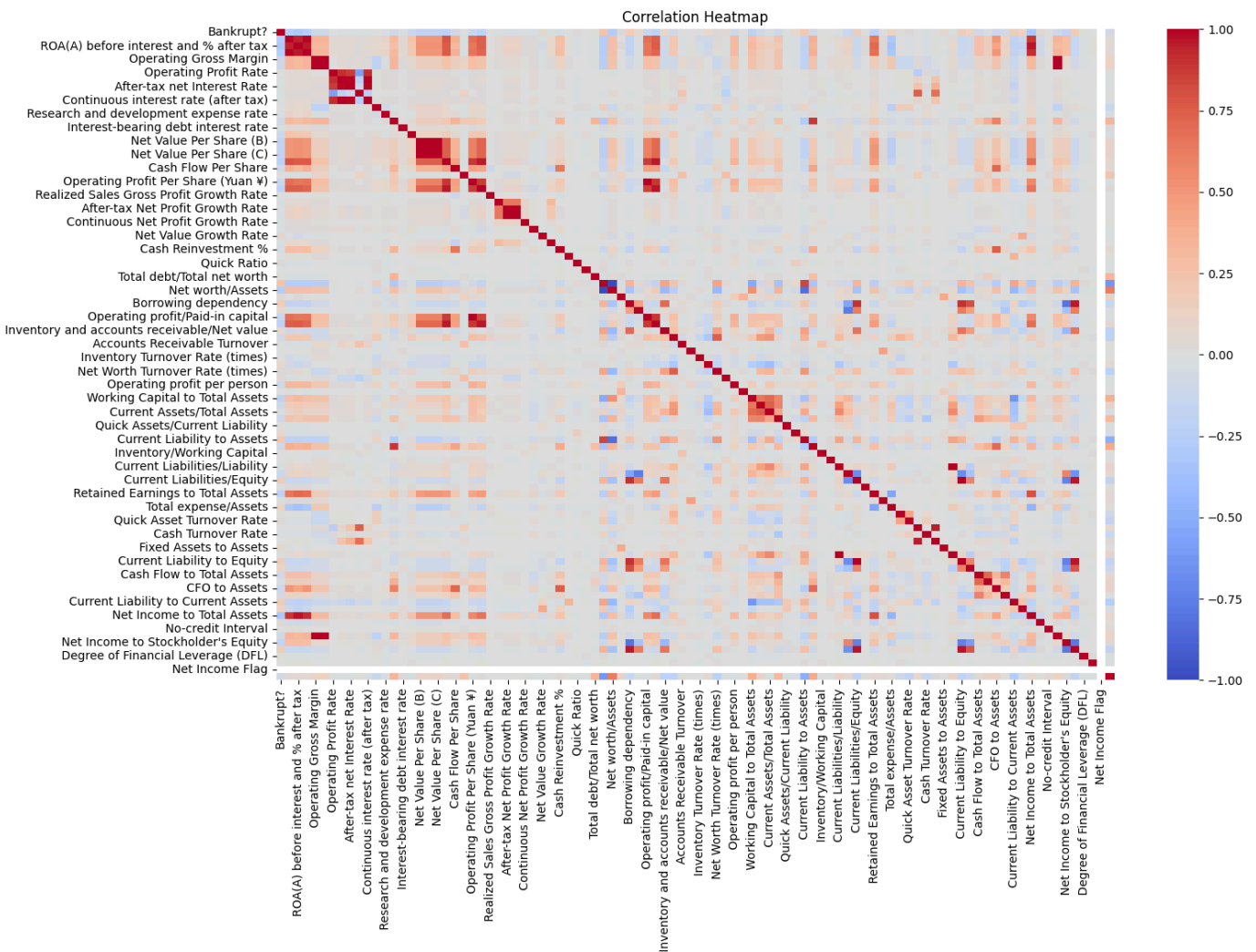


Figure 2: Correlation heatmap of features with target variable (Bankruptcy?).

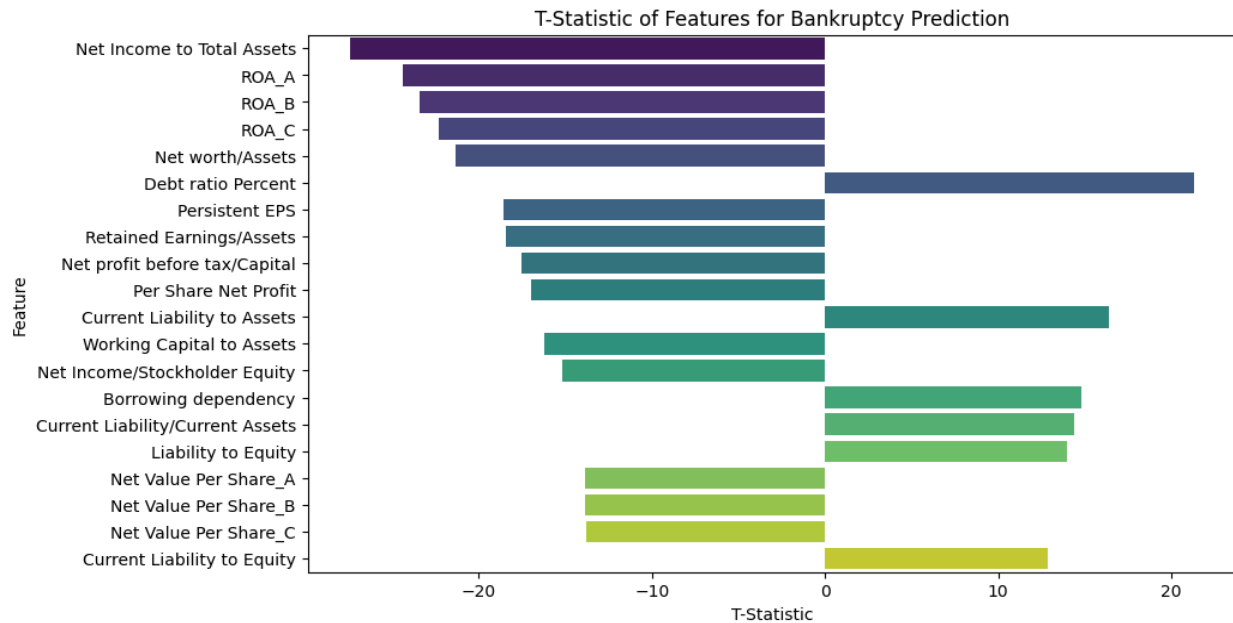
Feature	t_stat	p_value
Net Income to Total Assets	-27.45	2.10e-157
ROA(A) before interest & % after tax	-24.36	1.03e-125
Debt Ratio Percent	21.33	8.37e-98
Persistent EPS in the Last Four Seasons	-18.58	3.20e-75
Current Liability to Assets	16.37	4.08e-59

**Table 1: Top Features Based on T-Test:**

#### **Step 4: T-Test Analysis**

##### **Key Findings:**

- Features such as "Net Income to Total Assets" and "ROA(A)" showed the most significant differences between bankrupt and non-bankrupt companies.
- P-values were extremely small for these features, confirming their predictive power.



**Figure 3: Visualizations of t-test results and correlations were created to highlight significant features.**

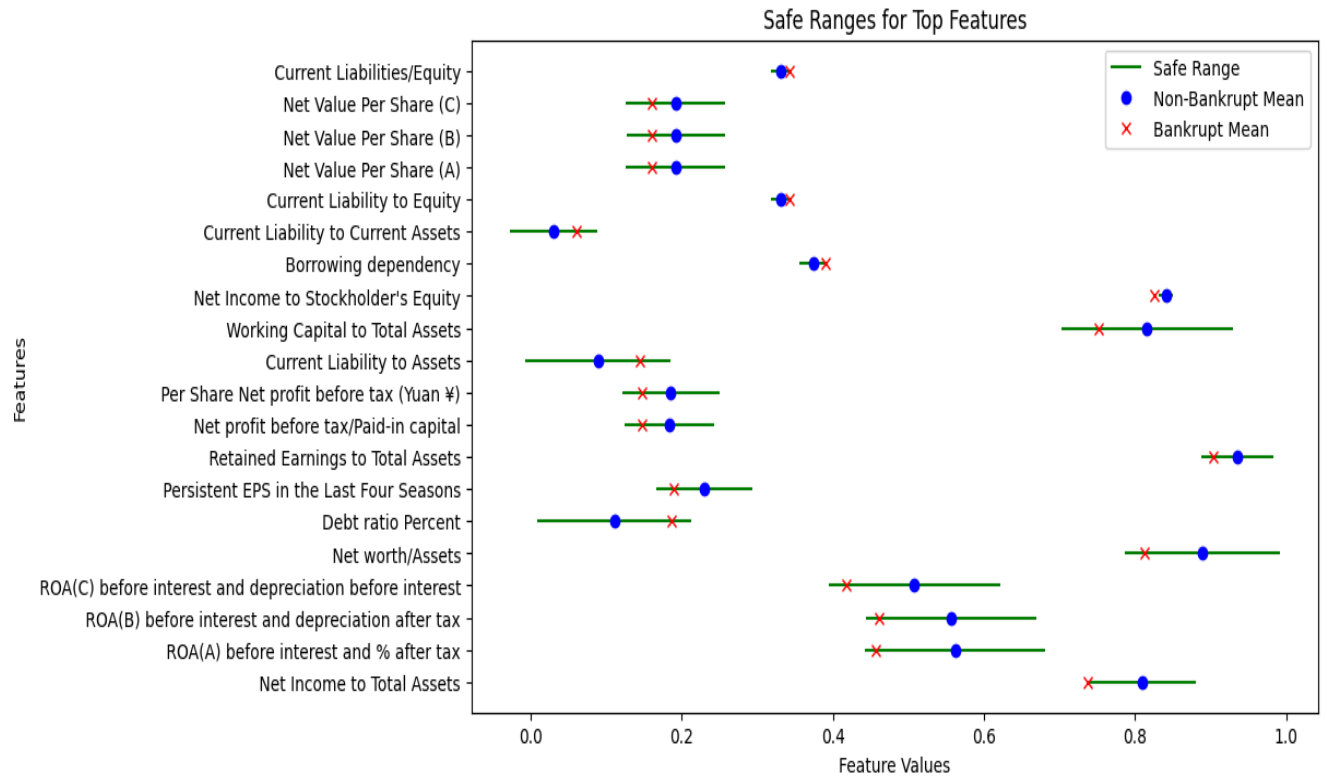
## Step 5: Establishing Benchmarks

Thresholds for critical metrics were calculated:

- Profitability metrics: Maintain a minimum ROA and net income ratio.
- Debt metrics: Manage Debt Ratio Percent below identified thresholds.
- Per-share metrics: Improve Net Value Per Share.

### Why This Matters:

- These benchmarks allow companies to assess their financial health against statistically significant thresholds.
- Early warnings and proactive corrections can mitigate bankruptcy risks.



**Figure 4: Dashboards to visualize financial benchmarks to detect early financial distress and enable corrective action**

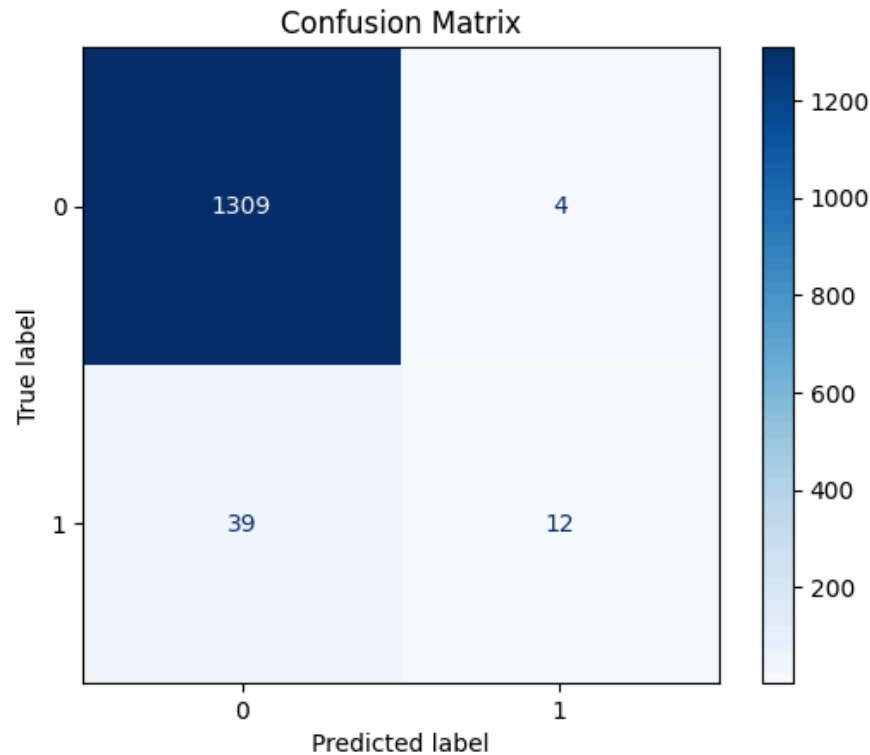
## Step 6: Building Predictive Models

### 1. Regression Model:

- Accuracy: 98%
- Forecasting safe ranges and predicting future risk.

### 2. Random Forest Classifier:

- F1 Score: 96%
- Confusion Matrix Visualization:



**Figure 5: Clearly separates bankrupt from non-bankrupt predictions.**

### 3. K-Means Clustering:

- Segmented companies into distinct financial health groups.
- Actionable insights for targeted interventions.

**K-Means Clustering Findings:** The clustering revealed three primary segments:

- **Cluster 1 (Healthy Businesses):** Strong profitability metrics and low debt ratios.
- **Cluster 2 (At-Risk Businesses):** Moderate financial health, with warning signs such as rising debt ratios or declining profitability.
- **Cluster 3 (Struggling Businesses):** High debt ratios, negative profitability metrics, and low liquidity.

**Usefulness:**

- By identifying these clusters, businesses can implement tailored strategies:
  - **Healthy Businesses:** Focus on growth opportunities and strategic investments.
  - **At-Risk Businesses:** Prioritize cost-cutting, debt management, and process efficiencies.
  - **Struggling Businesses:** Engage in turnaround strategies, such as refinancing or operational restructuring.



# DEPLOYMENT STRATEGIES

## Tools and Dashboards

1. **Dashboards:**
  - Financial health scoring.
  - Threshold alerts for critical metrics.
  - Predictive insights for future risks.
2. **Cloud Infrastructure:**
  - Use AWS or Azure for scalable storage and computing.
  - Real-time data processing with tools like Apache Kafka.
3. **APIs and Integrations:**
  - RESTful APIs to integrate predictive models into existing financial systems.
  - Secure endpoints for data privacy and compliance.

## Deployment Process

1. **Model Deployment:**
  - Use containerization (Docker) for consistent deployment.
  - Automate updates with CI/CD pipelines.
2. **Dashboard Deployment:**
  - Host dashboards on cloud platforms with user-friendly interfaces.
  - Provide role-based access control for data security.
3. **Monitoring and Feedback:**
  - Real-time model performance tracking with monitoring tools like Grafana.
  - Regularly retrain models with updated data to ensure accuracy.

# CHALLENGES AND FUTURE SOLUTIONS

## Challenges

1. **Data Quality:**
  - Ensuring accuracy and consistency across diverse financial datasets.
2. **Model Generalization:**
  - Avoiding overfitting and ensuring robust performance across industries.
3. **Scalability:**
  - Managing computational load for real-time predictions at scale.
4. **User Adoption:**
  - Encouraging businesses to trust and act on AI-driven insights.

## Solutions

1. **Data Quality:**
  - Implement automated data cleaning and validation pipelines.
  - Partner with data providers for high-quality inputs.
2. **Model Generalization:**
  - Use cross-validation techniques and domain-specific feature engineering.
3. **Scalability:**
  - Adopt distributed computing frameworks (e.g., Spark) for processing large datasets.
4. **User Adoption:**
  - Offer training sessions and detailed documentation to users.
  - Incorporate feedback loops to address user concerns and improve usability.

## RECOMMENDATIONS

1. **Adopt AI-First Strategy:**
  - Leverage predictive analytics to identify and mitigate risks early.
  - Implement automated alerts for financial health benchmarks.
2. **Invest in Infrastructure:**
  - Support ongoing model training and dashboard updates.
  - Enable scalability for real-time analysis.
3. **Secure Funding:**
  - Allocate resources to enhance model accuracy and expand datasets.
  - Develop additional features to provide comprehensive financial insights.

## CONCLUSION

By focusing on statistically significant features and implementing robust predictive models, the proposed AI-first strategy offers actionable insights to improve financial decision-making and reduce bankruptcy risks. Approval of this strategy will position the organization as a leader in leveraging AI for financial health management.