Credit Risk Analysis Project

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Introduction

This project involves analyzing the credit risk of a mortgage loan portfolio using the **Standardized Approach** and the **Internal Ratings-Based (IRB) Approach under Basel III/IV**. The goal is to calculate **Risk-Weighted Assets (RWA)** and **capital requirements** based on the data provided, and to compare the results from both approaches.

Data Cleaning and Preprocessing

Missing Data Handling

Dropped rows missing both Mortgage Due and Property Value, filled partial missing values assuming 0.45 LTV, imputed missing values for Job, Years On Job, Number of Major Derogatory Reports, Number of Delinquent Credit Lines, Age of Oldest Credit Line in Months, Number of Credit Lines, and Debt-to-Income Ratio using appropriate statistics.

Feature Engineering

Calculated Loan-to-Value (LTV) ratio for each loan as MORTDUE/VALUE to assess risk exposure.

Probability Modeling

Developed logistic regression model in Python to calculate Probability of Default (PD) for use in the IRB Approach.

Analysis

Standardized Approach

Used LTV to assign Risk Weights:

- 50% for lower LTV loans
- 75% for moderate LTV loans
- 100% for high LTV loans

Formula:

RWA = MORTDUE × Risk Weight

IRB Approach

Used Probability of Default (PD) and Loss Given Default (LGD) for more granular risk assessment.
Assumed LGD of 45% as per Basel guidelines.

Formula:

RWA = MORTDUE × PD × LGD

Main Results

Metric	Standarized	IRB
Risk-Weighted Assets	**$233,919,219**	**$34,465,161**
Capital Requirement	**$18,713,538**	**$2,757,213**
Tier 1 Capital	**$14,035,153**	**$2,067,910**

Histogram of LTV Ratios

The spike at 0.45 represents loans with imputed LTV. The distribution shows a concentration of LTVs between 0.60 and 0.80, indicating a significant portion of loans has moderate LTV.

Total RWA by Approach

The IRB approach results in a significantly lower RWA than the Standardized Approach, suggesting a lower overall credit risk assessment under the IRB model.

Capital Requirement Comparison

Similar to the RWA comparison, the IRB approach requires substantially less capital, reflecting the lower RWA.

Risk Weights Distribution

Most loans fall into the 50% risk weight category, indicating a large portion of loans has lower LTVs.

RWA (Standarized) vs. LTV

There's a clear positive correlation, with RWA generally increasing as LTV rises, as expected under the standardized framework.

RWA (IRB) vs. LTV

Compared to the Standardized Approach, the relationship is weaker, indicating that other factors in the PD model influence RWA.

RWA values are generally lower than in the Standardized Approach.

Tier 1 Capital, Standarized vs. IRB

Compared to the Standardized Approach, the relationship is weaker, indicating that other factors in the PD model influence RWA. RWA values are generally lower than in the Standardized Approach.

Key Insights

RWA Comparison: The IRB Approach resulted in lower total RWA for the portfolio compared to the Standardized Approach, primarily due to the more granular PD estimates used in the IRB model.

Capital Requirements: As expected, the IRB Approach required less capital than the Standardized Approach, reflecting the lower perceived risk in the loans based on their individual PD estimates.

Impact of LTV: Loans with higher LTV ratios (i.e., more than 80%) contributed significantly to the higher capital requirements under the Standardized Approach due to their higher risk weights.

Recommendations

Risk Management: Banks could potentially reduce their capital requirements by using **Internal Ratings-Based models (IRB)**, as long as they can accurately assess **PD** and **LGD** for each loan.

Regulatory Adjustments: Further adjustments or refinements in the **Basel III/IV** framework could make it easier for smaller institutions to adopt IRB models, ensuring that **capital requirements** more closely align with **actual risk exposures.**

conclusion

This analysis demonstrates a clear difference in credit risk assessment between the Standardized and IRB approaches. The IRB approach, utilizing a PD model, generally results in significantly lower RWA and capital requirements compared to the Standardized approach, which relies primarily on LTV for risk weighting. This highlights the potential for IRB models to provide a more refined and potentially less conservative view of credit risk. However, it also underscores the critical importance of accurate PD and LGD modeling and the need for robust validation and regulatory oversight of IRB models.

The visualizations effectively illustrate these differences, showing how the IRB approach's risk sensitivity leads to a different relationship between LTV and RWA compared to the standardized rules.

thank you