Rakamin Academy

id/x partners

Credit Risk Intelligence

Analytical Insights and Predictive Solutions

Project-Based Virtual Internship:
Data Scientist at ID/X Partners x Rakamin Academy

Presented by:
Az-Zukhrufu Fi Silmi Suwondo

Rakamin Academy

id/x partners

Company Profile

About Company

id/x partners is an **Indonesian consulting firm** specializing in **Data Analytics**, **Decisioning**, and **RegTech solutions** since 2006. With 18+ years of experience, we have helped 75+ institutions, including top banks, multifinance companies, fintechs, and insurers, leverage advanced analytics and AI-based solutions to solve challenges in **digital lending**, **risk management**, **financial crime prevention**, and **regulatory compliance**.

This proven track record is recognized through **multiple industry awards**, including CIO Advisor's Top 10 APAC Data Analytics Consulting (2019) and four consecutive SAS Partner Appreciation Awards (2022-2025).

Project Overviews

Rakamin Academy

Problem

Lending platforms face **significant credit risk** from **borrower defaults**, leading to **substantial financial losses** without effective risk assessment.

Goal

Develop a **predictive credit risk model** achieving **0.70+ AUC-ROC** score to classify borrowers into risk tiers, enabling data-driven lending decisions and portfolio risk optimization.

Objectives

Exploratory Data Analysis
Identify key factors correlated with default risk through comprehensive data exploration.

Model Development
Build and optimize a predictive model to estimate default probability using feature engineering and algorithm comparison.

Risk Tiering System
Convert probability scores into actionable risk tiers with recommendations for each tier.

Business Impact Assessment
Quantify potential loss reduction and provide insights for portfolio management.

Dataset Overviews

Rakamin Academy

Dataset Size

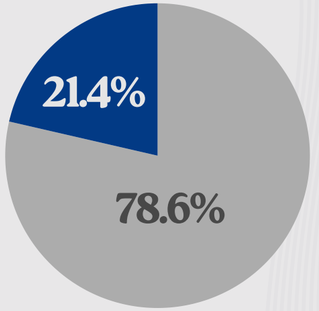
466K	75	780
records	features	MB

2007 · 2008 · 2009 · 2010 · 2011 · 2012 · 2013 · 2014

Target Distribution

Good Loans
(Fully Paid)

Bad Loans
(Charged Off, Default, Late >31 days)



**Includes policy-exception loans classified by final outcome*
**Excludes current loans and in-progress statuses*

Feature Categories

Identification & Admin	5 features
Loan & Borrower Info	17 features
Credit & Payment History	40 features
Dates & Timeline	5 features
Status & Target	4 features
Joint Application	3 features

Credit Risk Analytics Workflow

Rakamin Academy

Data Preparation

Processed 400K+ loan records with 20+ engineered features. Applied leakage prevention, domain-based imputation, and stratified train/val/test split (60/20/20). Identified outliers with business logic capping.

Exploratory Data Analysis

Performed univariate and bivariate analysis across key dimensions. Examined distribution patterns and correlation matrices between risk grades, income segments, and loan characteristics.

Model Development

Benchmarked 16 algorithms with LightGBM as champion (class_weight='balanced'). Optimized hyperparameters using Optuna and selected 20 optimal features balancing performance and simplicity.

Model Calibration

Applied Isotonic/Sigmoid calibration to improve probability reliability. Validated with 5-fold CV showing improved Brier Score, producing more accurate confidence estimates for decision-making.

Risk Segmentation

Segmented borrowers into 5 risk tiers with custom thresholds. Validated expected vs actual default rates and defined business rules from auto-approve to reject with production monitoring plan.

Industry-standard workflow **adapted from CRISP-DM framework**, tailored for credit risk modeling: **comprehensive data preparation** with leakage prevention, **exploratory analysis** revealing key risk indicators, **systematic model development** achieving 0.70+ AUC, **probability calibration** for decision reliability, and **5-tier risk segmentation** with production monitoring, delivering **end-to-end credit risk intelligence**.

Portfolio Composition

Rakamin Academy

Total Loans

466K

Total Value

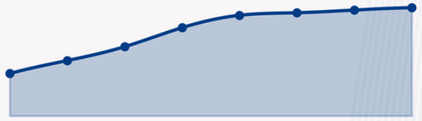
$6.7B

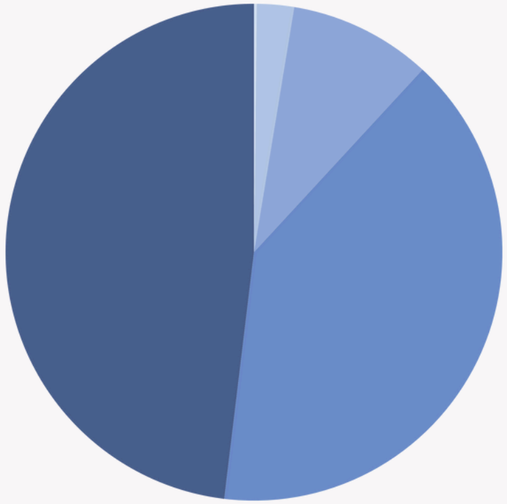
Average Loan

$14K

Healthy Portfolio

87.7%





- Current (**48.1%**)
- Fully Paid (**40.0%**)
- Charged Off (**9.3%**)
- Late/Delinquent (**2.4%**)
- Default (**0.2%**)

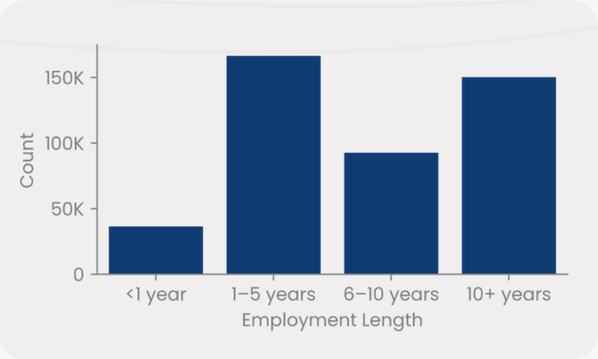
Actionable Item

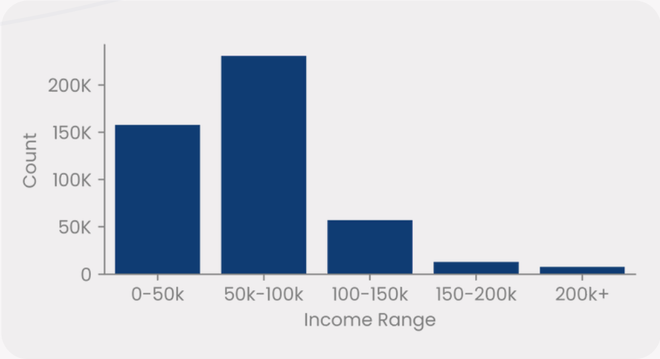
Continue monitoring late/delinquent accounts to prevent potential defaults and maintain portfolio health above 85%.

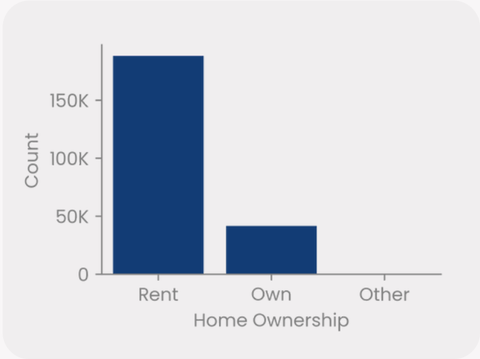
The portfolio demonstrates **strong performance** with 87.7% health rate and controlled risk levels. Current loans represent 48.1% of the portfolio, while fully paid loans account for 40%, indicating steady repayment activity. The minimal default rate of 0.2% reflects **effective credit assessment** and **monitoring practices**.

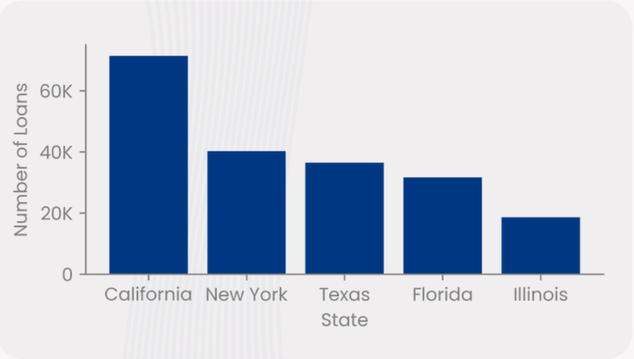
Rakamin Academy

Customer Profiling









Experienced Workforce Dominance

37.4% have 1-5 years employment, followed by 33.7% with 10+ years. Only 8.2% are in their first year, indicating overall employment stability.

Middle-Income Concentration

51.9% earn $50k-100k, representing the core segment. Only 4.4% earn above $150k, showing a middle-class customer base.

Predominantly Renters

81.9% are renters (188,473), while just 18.1% own homes. This signals lower asset ownership and potentially higher credit risk.

Geographic Concentration

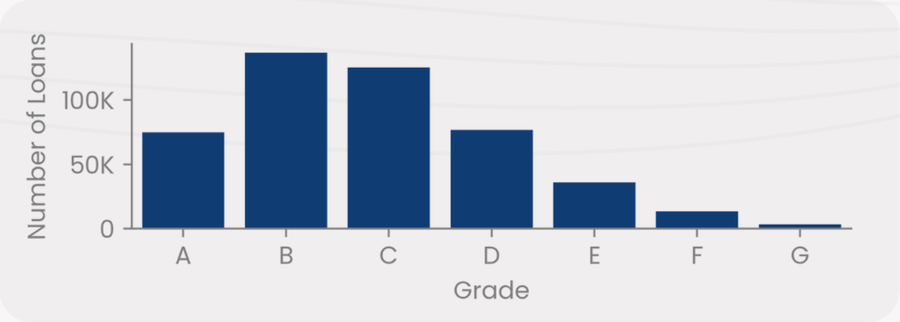
Top 5 states (California, New York, Texas, Florida, and Illinois) represent the majority, with California leading at 71,450 customers.

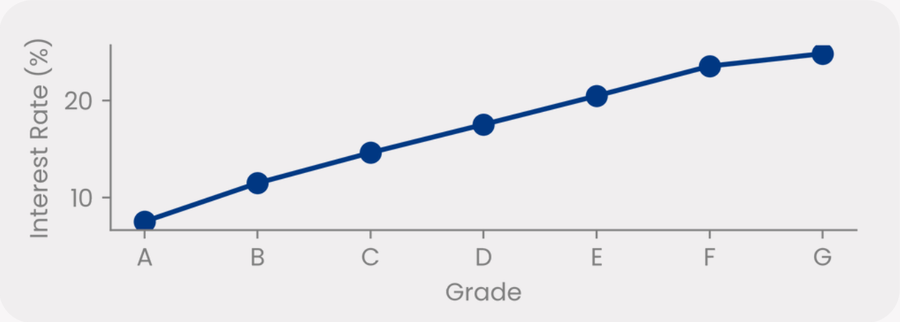
Total Customers	Total Portfolio
466,285	$6.7B

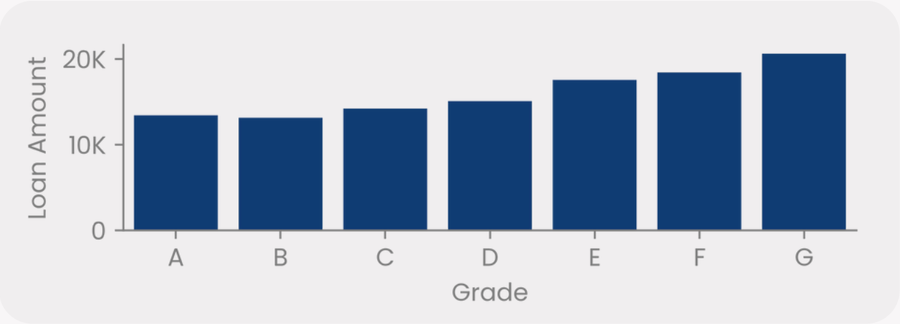
Annual Income	Loan Amount	Employment Length
$63K	$12K	10+ years
Range: $2k-$7,500k	Range: $0.5k-$35k	Range: <1 year to 10+ years

Rakamin Academy

Portfolio Skewed Toward Mid-Grade Risk







Heavy Mid-Grade Concentration

Grades B-C represent 56% of portfolio (262K borrowers), while Grade A (lowest risk) only accounts for 16%. This creates significant exposure to medium-risk segments.

Interest Rate Inefficiency

While rates correlate with risk (7.5% for A to 24.8% for G), the spread between grades isn't proportional—particularly compressed in high-risk grades E-G.

Inverse Risk-Amount Relationship

Lower grades paradoxically borrow larger amounts—Grade G averages $20.6K vs Grade A's $13.4K, amplifying potential losses.

Actionable Item

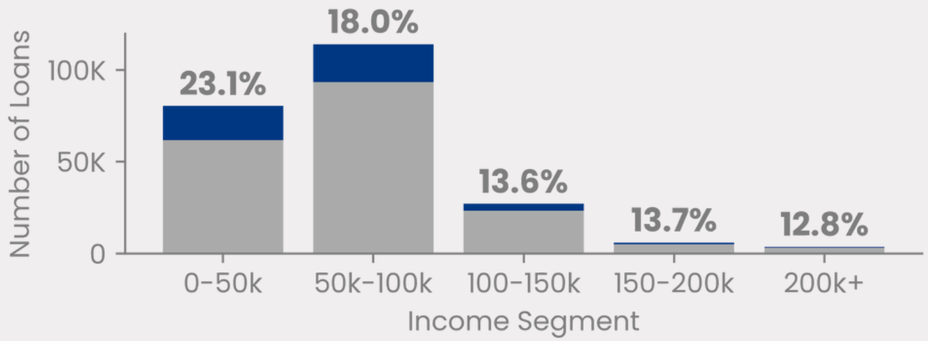
Rebalance the portfolio by launching targeted campaigns to increase Grade A-B acquisition

Rakamin Academy

Risk Indicators Analysis: The Poverty-Grade Paradox

Low Income Drives Half of All Defaults

The 0-50k income segment shows **2x higher default rate** (23.15%) compared to 200k+ segment (12.81%), yet comprises 43% of the portfolio (80,429 loans). This single segment drives **48% of all defaults** (18,617 cases).

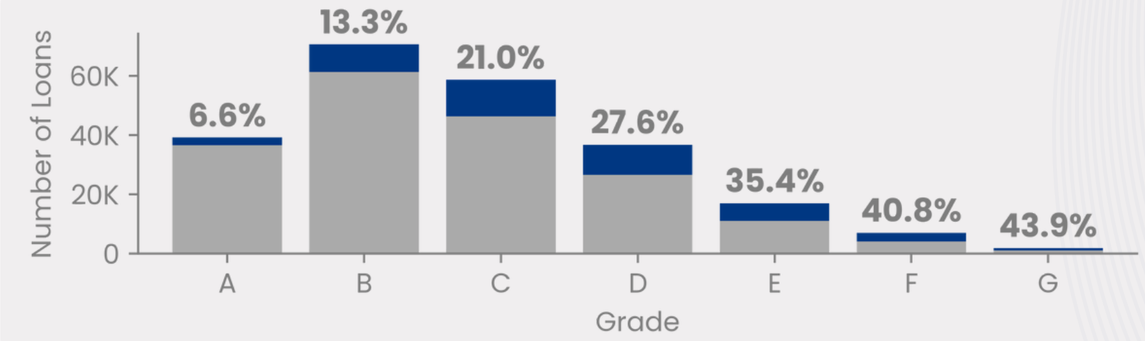


Actionable Item

Tighten approval criteria for 0-50k segment

Grade D-G: 20% Volume, 50% Defaults

Default rate escalates from 6.6% (Grade A) to 43.9% (Grade G), a **7x gap**. Grades D-G represent only 20% of loans but account for **50% of all defaults** (19,785 cases). Grade D marks the critical inflection point where default rate **jumps to 28%**.



Actionable Item

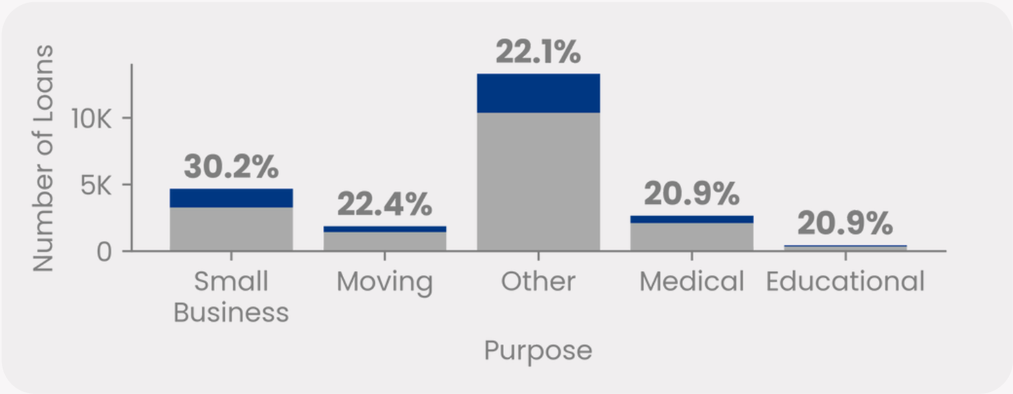
Restrict or discontinue lending to Grades F-G

Rakamin Academy

Risk Indicators Analysis: Purpose & Place Risk Nexus

Small Business Loans: Highest Default Risk

Small business loans have 30% default rate, significantly **higher** than other purposes (21-22%). Despite being only 19% of this portfolio subset, they contribute 28% of defaults (1,407 cases). Educational and medical loans show the lowest risk (~21%).

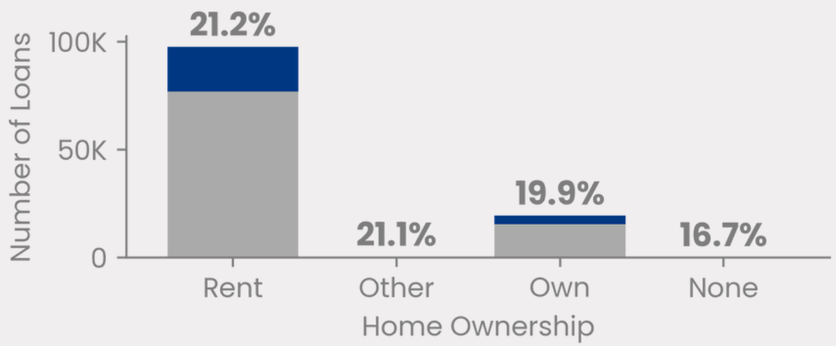


Actionable Item

Require cash flow proof for small business loans

Renters Show Highest Default Volume

Default rates are consistent across housing types (20-21%), but **renters dominate 53% of portfolio** and contribute **53% of total defaults** (20,670 cases). Homeowners show slightly lower default rate (19.9%) with better stability indicators.



Actionable Item

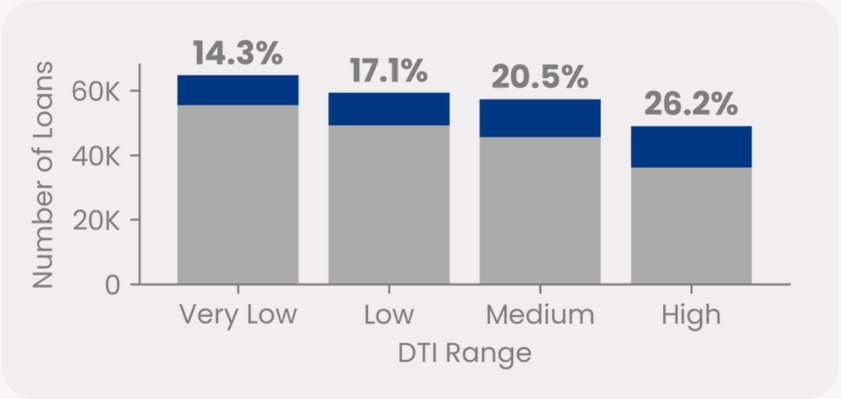
Require higher down payments (15-20%) for renters

Rakamin Academy

Risk Indicators Analysis: The Triple Threat Framework

High DTI: 26% Default Rate

Default rate climbs from 14% (Very Low DTI) to 26% (High DTI), an **83% increase**. High DTI borrowers are 25% of portfolio but **drive 29% of defaults** (12,869 cases).

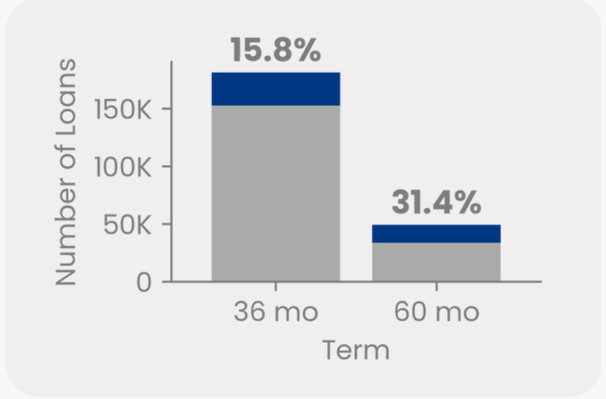


Actionable Item

Cap DTI at 35-40% maximum

60mo: 2x Default Risk

60-month loans default at 31% vs 16% for 36-month, a **2x gap**. They're 25% of volume but **35% of defaults**.

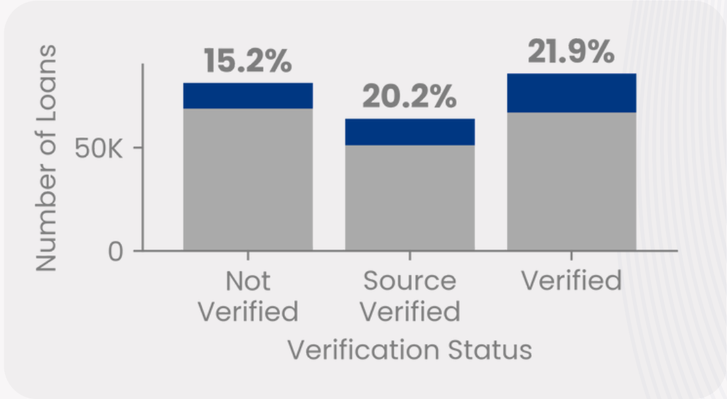


Actionable Item

Limit 60mo terms to Grade A-B

Verified Loans Default More

Verified loans show **22% default rate** vs 15% for unverified, a counterintuitive 44% increase. Verified loans are 44% of portfolio but contribute 43% of defaults.

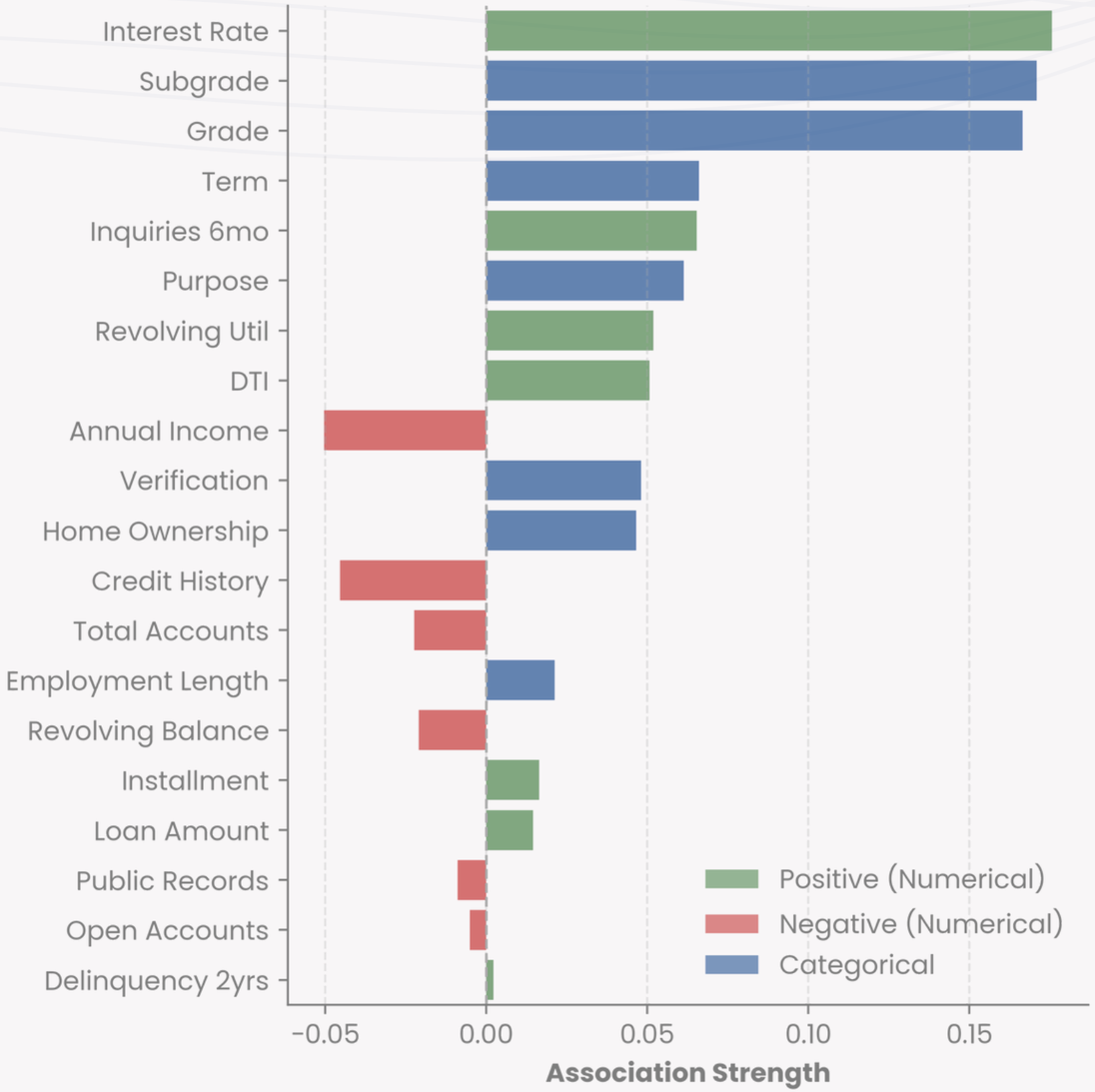


Actionable Item

Don't rely on verification alone

Rakamin Academy

Feature Correlation Analysis



Weak Linear Relationships Across All Features

Interest rate (0.176), sub_grade (0.171), and grade (0.167) are the top correlated features with default risk. However, these values below 0.20 are classified as weak correlations, indicating limited linear predictive power when examined individually.

Negligible Individual Predictors

The remaining features show correlations below 0.10—term (0.066), recent inquiries (0.065), loan purpose (0.061), DTI (0.051), and annual income (-0.050). These fall into the "very weak" category, demonstrating minimal standalone impact on default prediction.

Key Insight

Correlations below 0.3 indicate very limited linear relationships. Credit default appears to be driven by complex interactions between multiple factors rather than any single dominant predictor. This suggests multivariate analysis and advanced modeling techniques will be necessary.

Data Preprocessing Pipeline

Rakamin Academy

Numerical Features

Iterative Imputer, Winsorize, Yeo-Johnson Transform

Ordinal Features

Custom Ordinal Encoder (grade, sub_grade, etc)

Categorical Features

Label Encoding (2 cols), OneHot Encoding (7 cols)

Outlier Handling

Winsorization at 1st and 99th percentiles to clip extreme values while preserving distribution

Missing Data

IterativeImputer for numerical (MICE algorithm) + SimpleImputer for categorical (most frequent)

Distribution Normalization

Yeo-Johnson transformation handles skewed distributions and works with zero/negative values

Custom Ordinal Encoding

Hierarchical mapping for grade (A-G), sub_grade (A1-G5), employment length (0-10+ years)

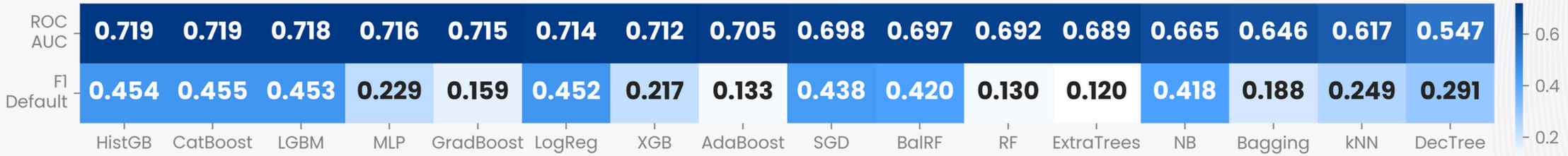
Feature Selection

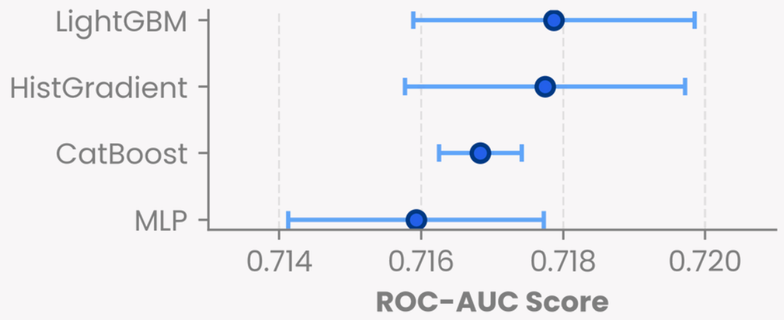
- L1 Regularization (Lasso) for linear models
- Feature Importance (Mean) for tree ensemble
- XGBoost Importance (Median) for boosting
- Variance Threshold (0.01) for distance-based

Model Selection

Initial Model Screening on Validation Set

Initial evaluation of **16 machine learning algorithms** showed ROC-AUC performance ranging from **0.547 to 0.719**, with **HistGB**, **CatBoost**, **LGBM**, and **MLP** as top performers. The four best models were then selected for **more comprehensive cross-validation** to validate performance stability. This approach optimizes computational efficiency while maintaining evaluation quality.



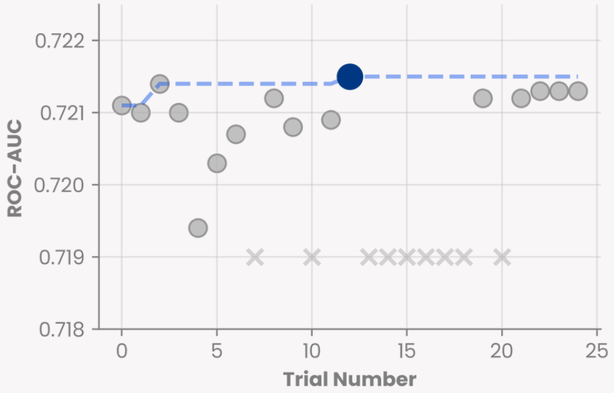


Cross-Validation Results (5-Fold with 95% CI)

LightGBM was selected as the final model with a CV ROC-AUC of **0.7179** (highest) and a **stable confidence interval** (0.7159 - 0.7199). This model provides an **optimal balance** between **prediction performance** and **cross-fold consistency**, with **good recall** for positive case detection.

Model Optimization

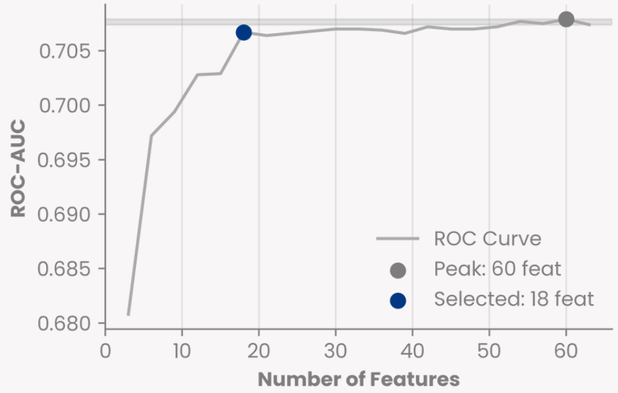
Hyperparameter Tuning



ROC-AUC: 0.7215

The optimization process completed **16 trials** and **pruned 9 others** over 5.2 hours using the **TPE algorithm**, achieving a best ROC-AUC score of **0.7215**.

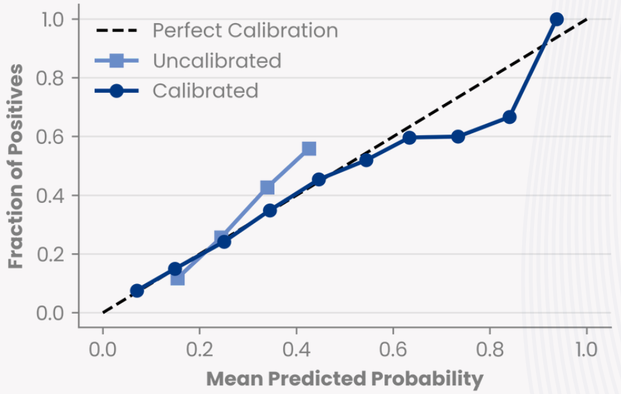
Feature Optimization



-70% Reduction

Feature reduction from 60 **to 18 features** (70% reduction) **maintained 99.83% performance**, with a final ROC-AUC of 0.7067 and training time of 6.2 seconds.

Model Calibration



Isotonic Regression

The model uses **Isotonic Regression** with 5-Fold Cross Validation, improving **Brier Score** and **Log Loss** for reliable probability predictions in production.

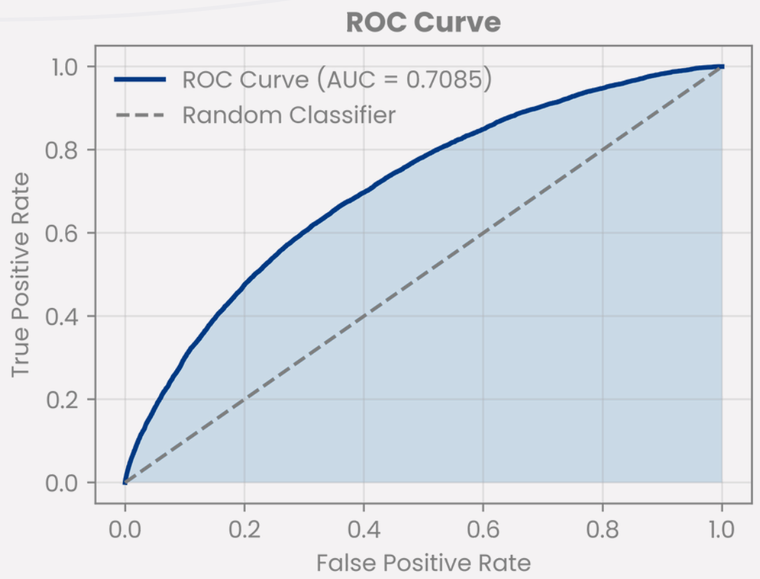
Evaluation

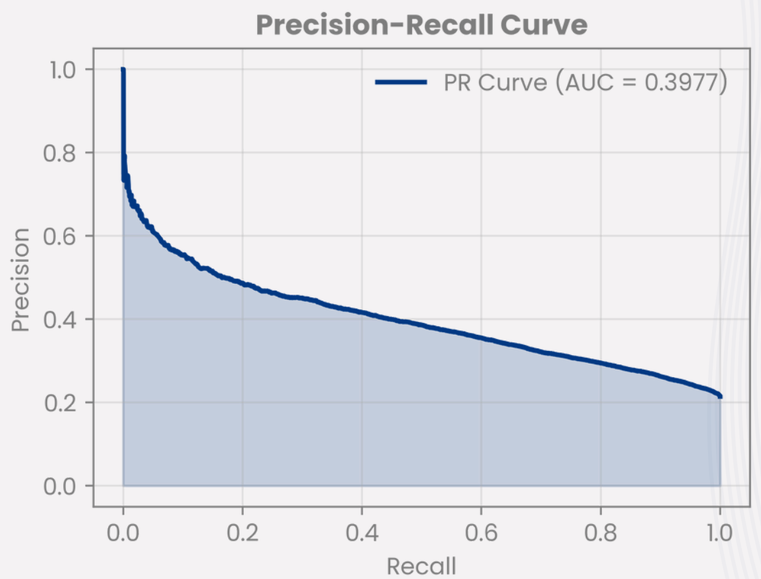
ROC-AUC
0.708
Acceptable

Brier Score
0.152
Excellent

Log Loss
0.472
Fair

Accuracy
78.98%
Good





The model demonstrates **solid discriminative ability** with ROC-AUC of 0.708 and **well-calibrated probabilities** (Brier Score: 0.152). Overall accuracy reaches 78.98%. The lower PR-AUC (0.3977) reflects class imbalance, addressed through balanced class weights. **Tier segmentation** is applied for practical implementation.

Model Interpretability Overview

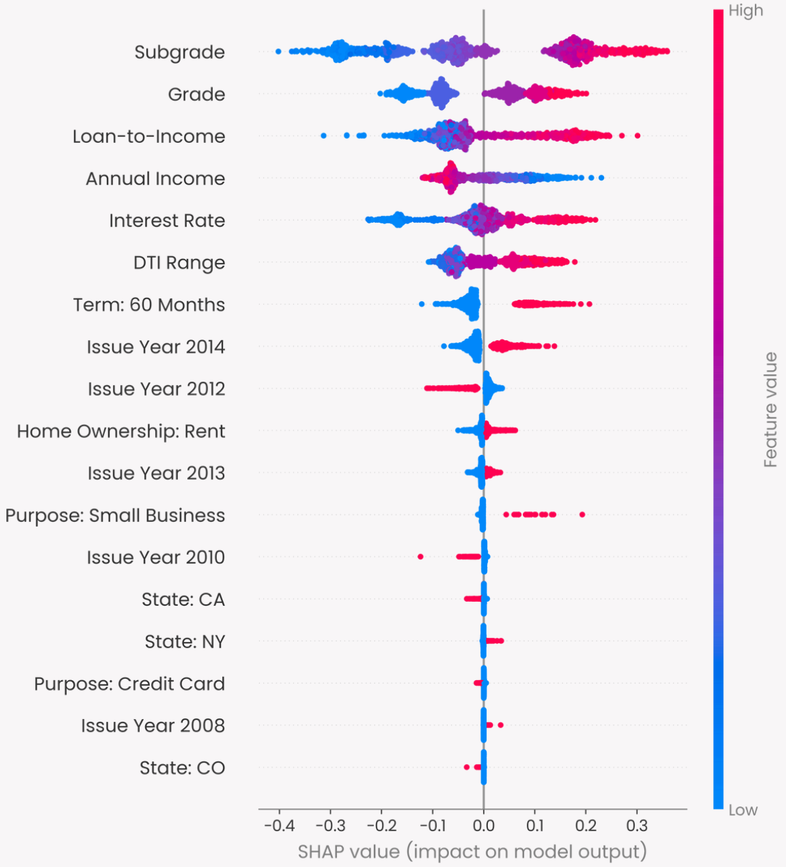
Rakamin Academy

Why SHAP Analysis?

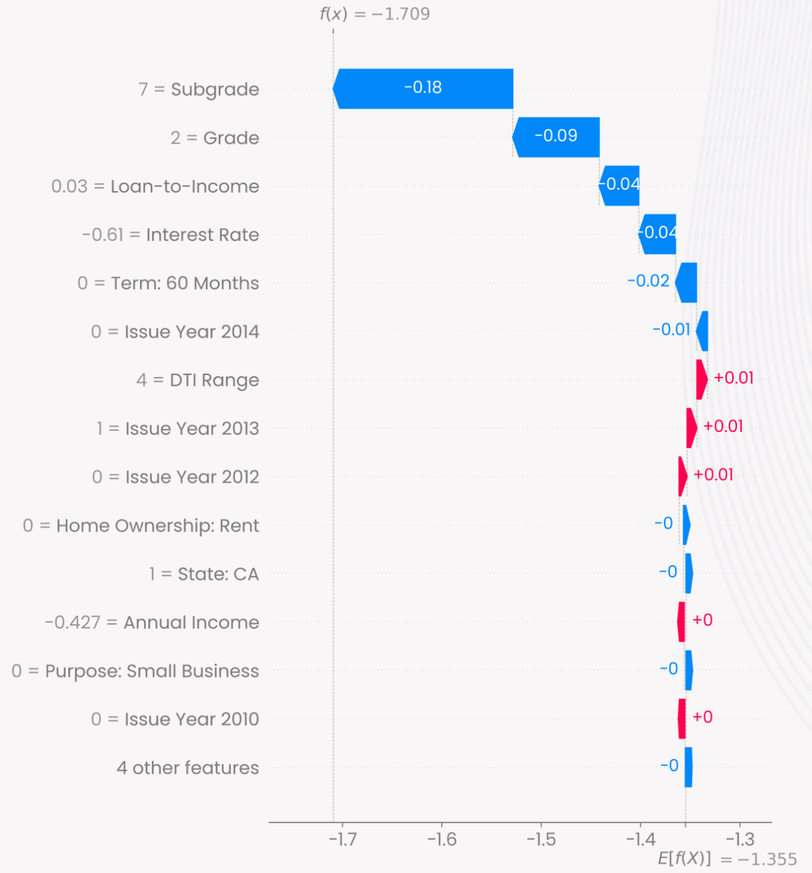
- Regulatory compliance (OJK transparency requirements)
- Transparent explanations for credit officers & applicants
- Validate model learns correct risk patterns

DTI Range and **2012-2014 vintage loans** show highest risk contribution, while **premium grades** (A-B) are strongest protective factors against default.

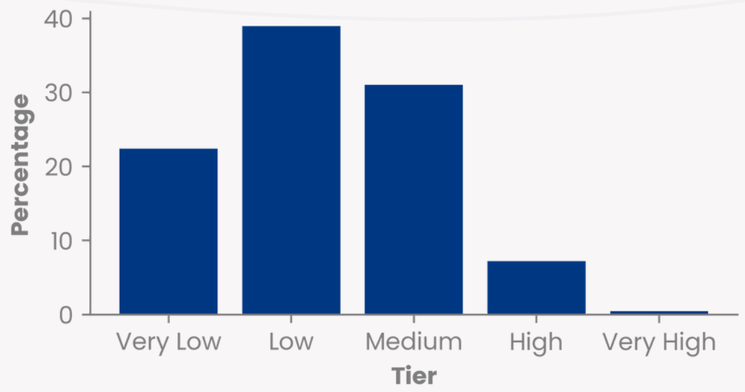
Global Feature Importance

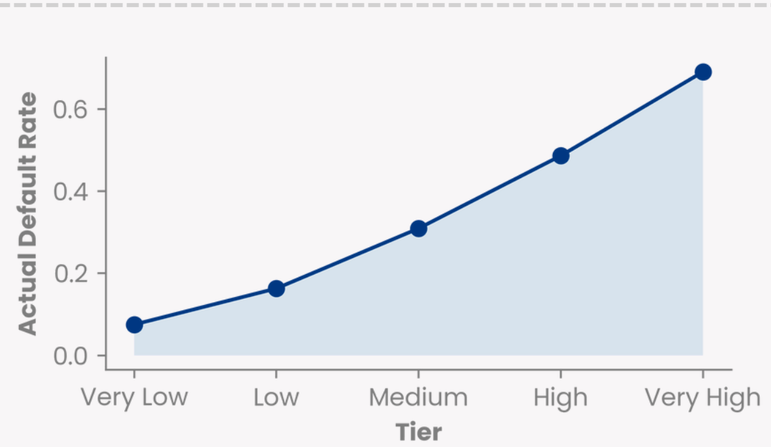


Individual Case Example



Risk Tier Segmentation





Risk Tier Actions

Very Low
Auto-approve

Low
Standard Approval

Medium
Manual Review

High
Strict Review

Very High
Reject

	Threshold	Volume	Default Rate	Predicted Prob
Very Low	11%	10,644	7.5%	7.4%
Low	23%	18,514	16.3%	16.3%
Medium	43%	14,751	30.9%	30.9%
High	62%	3,423	48.6%	49.6%
Very High	100%	207	69.1%	66.5%

Five-tier segmentation achieves strong calibration with <2% deviation, enabling automation of 20% approvals and focused manual review on 10% high-risk cases.

Financial Impact

$16.0M

Portfolio Loss Reduction
(31.5% decrease)

19.6%

Default Rate
(8.8pp reduction)

2.22%

Risk-Adjusted Return
(+95 basis points)

Executive Summary

Rakamin Academy

The developed credit risk predictive model achieved solid performance with **ROC-AUC score of 0.708** and **Brier Score of 0.152**. Implementation of the **five-tier risk segmentation system** enables automated decisions for **20% of low-risk applications** and focused manual review on **10% of high-risk cases**.

Portfolio analysis revealed critical findings: the **0-50k income segment contributes 48% of total defaults** despite being only 43% of the portfolio, while **Grades D-G** representing just 20% of volume **account for 50% of all defaults**. Small business loans show the **highest default rate (30%)**, and **60-month term loans carry 2x the risk** compared to 36-month terms.

The model delivers significant financial impact with potential **portfolio loss reduction of $16.0M (31.5% decrease), default rate reduction to 19.6%** (down 8.8%), and **risk-adjusted return improvement to 2.22%** (up 0.95%). Strategic recommendations include tightening approval criteria for low-income segments, restricting lending to Grades F-G, and implementing a tier-based decision framework for portfolio risk optimization.

Rakamin Academy

id/x partners

Thank You

This presentation is the result of a Project-Based Virtual Internship as Data Scientist at ID/X Partners x Rakamin Academy

---

E-mail
afsilmis@gmail.com

Connect
linkedin.com/in/az-zukhrufu-fi-silmi-suwondo/

Portfolio
github.com/afsilmis/