

Theoretical Framework for Dynamic Pricing in Home Loans

A comprehensive reference for calculating Customer Relationship Strength, Risk Score, and Basis Point Adjustments

Introduction

In dynamic pricing for home loans, it is essential to balance two critical dimensions: **Customer Relationship Strength (CRS)** and **Risk Score (RS)**. The **Basis Point (bps) adjustment** is derived from these dimensions and is applied to the base interest rate.

This document outlines theoretical concepts and formulas to compute:

- Customer Relationship Strength (CRS)
- Risk Score (RS)
- Basis Point Adjustment (bps_adjustment)

All formulas are based on normalized base variables and weighted by importance.

1. Data Normalization and Weighting

Before applying any formulas, input features must be normalized. A common method is min-max normalization:

$$\text{Norm}(X) = (X - \min(X)) / (\max(X) - \min(X))$$

Instead of assuming equal weightage, weights are assigned based on industry insights and empirical evidence.

2. Customer Relationship Strength (CRS)

Customer Relationship Strength reflects the depth of a customer's engagement and their potential long-term profitability. Key components include:

- Relationship Tenure:** Duration (in years) the customer has been with the bank.
- Product Holdings:** Number of banking products held (Weight: 25%).
- Asset Balance:** Total value of assets managed by the bank (Weight: 25%).
- Activity Score:** Digital and transaction activity (Weight: 20%).
- Satisfaction Score:** Customer satisfaction measure (Weight: 15%).
- Relationship Tenure:** How long the customer has been with the bank (Weight: 15%).

$$\text{CRS} = 0.25 \times \text{Norm}(\text{Products}) + 0.25 \times \text{Norm}(\text{Asset Balance}) + 0.20 \times \text{Norm}(\text{Activity Score}) + 0.15 \times \text{Norm}(\text{Satisfaction Score}) + 0.15 \times \text{Norm}(\text{Relationship Tenure})$$

These weights are illustrative and can be adjusted based on further empirical validation.

3. Risk Score (RS)

The Risk Score quantifies the credit risk associated with a customer. It integrates key components including:

- **Credit Score:** Lower scores indicate higher risk. (Assigned Weight: ~35-40%; normalized as $1 - \text{Norm}(\text{Credit Score})$)
- **Debt-to-Income Ratio (DTI):** Higher ratios indicate higher risk (Weight: ~25-30%).
- **Loan-to-Value (LTV) Ratio:** A higher ratio implies less borrower equity (Weight: ~20-30%).
- **Late Payment Count:** Frequency of late payments (Weight: ~10%).
- **Payment History Score:** Inverse measure of payment history (Weight: ~5%).
- **Previous Default:** Binary indicator (Weight: ~5%).

$$RS = 0.35 \times \text{Norm}(1 - \text{Credit Score}) + 0.25 \times \text{Norm}(\text{DTI}) + 0.20 \times \text{Norm}(\text{LTV}) + 0.10 \times \text{Norm}(\text{Late Payments}) + 0.05 \times \text{Norm}(1 - \text{Payment History}) + 0.05 \times \text{Norm}(\text{Previous Default})$$

These weights are designed to capture the critical elements of credit risk in a balanced way.

4. Basis Points (bps) Adjustment

The bps adjustment modifies the base interest rate based on the combined effects of CRS and RS. A high CRS (strong customer relationship) may warrant a larger discount, while a high RS (greater risk) may reduce it.

$$\text{bps_adjustment} = \text{bps_base} + \alpha \times \text{CRS} - \beta \times \text{RS}$$

For instance, if $\text{bps_base} = 50$ bps, $\alpha = 30$, and $\beta = 50$, then:

$$\text{bps_adjustment} = 50 + 30 \times \text{CRS} - 50 \times \text{RS}$$

The coefficients α and β should be calibrated to ensure the final adjustment falls within a realistic range (e.g., 10 to 100 bps).

5. Conclusion

The formulas outlined in this document provide a theory-based framework for calculating:

- **Customer Relationship Strength (CRS):** Using weighted, normalized measures of customer engagement and tenure.
- **Risk Score (RS):** Incorporating credit risk indicators and behavioral factors.
- **bps_adjustment:** A composite metric to adjust home loan interest rates based on CRS and RS.

These weight assignments reflect common practices in banking and credit risk analysis. They serve as a strong starting point for further refinement using historical data and market-specific adjustments.