

**Prepayment Risk Modelling on  
Mortgage-Backed Securities (MBS)  
(SUMMARY)**

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## **Overview:**

This project aims to model the prepayment risk associated with Mortgage-Backed Securities (MBS). By analysing historical loan data and various financial indicators, we seek to predict the likelihood of loan prepayment and understand the factors influencing this risk.

## **Data Preparation:**

- Dataset containing variables such as CS, MIP, Units, OCLTV, DTI, OrigUPB, LTV, OrigInterestRate, OrigLoanTerm, EverDelinquent, MonthsDelinquent, MonthsInRepayment, IsFirstTime, CreditRange, LTV\_range, and Repay\_range.
- Using Power Bi, I have deleted all duplicated rows, null and missing values.
- Changed data type according to type of data.
- Labelling has been done on columns like CreditScore, LTV, DTI, MonthsInRepayment.

## **KPIs:**

1. **Average Loan Term:**
  - It is 359.84.
2. **Average Interest Rate:**
  - It is 6.94% annually.
3. **Total Number of Loans:**
  - 213.44k unique mortgage backed securities.
4. **Delinquency Rate:**
  - 19.52% loans are overdue.
5. **Average Original Unpaid Balance:**
  - \$125.49k are unscheduled payments.

## **Visualizations:**

### **1. Prepayment Rate by DTI Range using bar chart:**

#### **Analysis:**

- ✓ A higher DTI ratio is associated with a higher risk involved in the ability to meet all scheduled payments.
- ✓ A higher DTI ratio also generally entails that people have fewer free resources to make unscheduled excess payments. Hence, its relation with prepayment rates is

expected to be negative.

## **2. Prepayment rate by LTV Range using stacked bar chart:**

### **Analysis:**

- ✓ A higher LTV is indicative of a higher default risk since mortgagees have the possibility to walk away from the loan if the value of the residential property is significantly lower than the outstanding loan.
- ✓ The relation between LTVs and prepayment rates is expected to be negative since a lower value of the residential property is associated with lower wealth of the user, especially given the fact that a residential property constitutes the largest fraction of wealth for an individual.

## **3. Prepayment Rate by First Home Buyer using pie chart:**

### **Analysis:**

- ✓ The effect of a first home on prepayment rates is twofold.
- ✓ On the one hand it is expected that prepayment rates are lower since young people often do not have a lot of spare funds to finance a prepayment.
- ✓ On the other hand, young people often relocate more than older people which could lead to higher prepayment rates.

## **4. Prepayment Rate by Property Type using bar chart:**

### **Analysis:**

- ✓ Prepayment rates are slightly higher when the property is a manufactured home (MH).

## **5. Prepayment Rate by Loan Purpose using donut chart:**

### **Analysis:**

- ✓ When the purpose of the loan is to purchase the property, prepayment rates are slightly higher compared to when the loan purpose is to cash out.

## **6. Prepayment Rate by Region using map:**

### **Analysis:**

- ✓ US mortgage market have high LTV value as compared to other countries.
- ✓ Prepayment rates differ per region.
- ✓ In region 4, the South West, default rates are higher and prepayment rates are lower compared to the rest of the US.
- ✓ Prepayment rates are the highest in the South East (region 3).

## **7. Delinquency Rate by Credit Score using pie chart:**

### **Analysis:**

- ✓ Users with poor credit score have highest delinquency rate value which means they are overdue with their payment.
- ✓ Users with excellent credit score have very less delinquency rate which is 9.02%.

## **8. Prepayment Rate by Credit Score using donut chart:**

### **Analysis:**

- ✓ Users with excellent credit score have prepaid their loans early.
- ✓ Users with low DTI ratio and excellent credit score have high prepayment rate.
- ✓ Users who have delinquent status as defaulted with fair credit score have not prepay their loans.
- ✓ Users with delinquent status as current with excellent credit score have repay their loans.
- ✓ As the number of years are passing prepayment rate keep on increasing and credit score most of the time lie between good to poor.
- ✓ Users with good and fair credit score have less loan term which means they will try to repay the loan as early as possible.
- ✓ The higher the prepayment rate, the more prepayments are expected and the less interest the investor is likely to receive in total. This is called prepayment risk.

## **Conclusion:**

- Mortgagees are unaware of optimal prepayment options as well as from diverging borrower specific attributes such as the Debt-to-Income ratio, Credit score, region in which the property is located. Therefore, optimal prepayment decision merely constitutes one indicator for prepayment.
- Estimate prepayment rates are according to a number of borrower specific, loan specific and macroeconomic variables.
- The main risk drivers for prepayments are the refinancing incentive, house prices, the Loan-to-Value ratio and loan size while these factors appear to be insignificant for partial prepayments.

## **Recommendations:**

Below are different risk management strategies that could reduce the probability and/or cost of prepayment.

- Through fees or charges to recover (some of) the cost of prepayment risk.
  - Charging an up-front fee for the prepayment option. Because having paid up-front for the option to prepay, borrowers might be more inclined to prepay and hence the structure of the charge can affect prepayment behaviour.
  - Making a charge at the time of prepayment.
- Through proactive adjustment of the funding requirement.

- A number of mortgages will prepay each year and reduce the amount of fixed rate funding required accordingly. For example, for a five year fixed rate mortgage, rather than arranging to have all of the funding for the full five years, progressively smaller amounts of funding could be arranged for each successive year. The amount of funding arranged for each year would depend on the lender's view of expected prepayment rates.
- Through identifying those customers and accounts with the highest prepayment risk in order to design products and customer retention initiatives that minimise prepayment risk.
  - Such as refinancing.