Mortgage-Backed-Securitied-Prepayment-Risk-Analysis-and-Prediction

In this Project we have done stepwise processes to analyze the given data.Below are the performed steps on Mortgage backed security dataset and insights taken after analysis.

1. Data Preprocessing-

- Firstly Checked every column of dataset for null values and duplicate values.
- In columns like first time home buyer, PPM ,Number of Borrowers X values are present which are not available values. I have Replaced that values with the respective mode value of column.
- First payment date and maturity date columns shows date in number format. Converted number to date using formula [DATE(INT(C2/100),MOD(C2,100),1)].
- Calculated credit range column using formula [IFS(A2<=650, "Poor", A2<=700, "Fair", A2<=750, "Good", A2<=900, "Excellent")].
- Calculated Is first time home buyer column from First time home buyer using formula [IF("First time home buyer "="N",0,1)]
- Calculated LTV_Range from LTV column using formula[IFS(P2<=40,"Low",P2<=70,"Medium",P2<=105,"High")].
- Calculated Repay_Range using formula [IF(AF2<=48, "0-4yrs", IF(AF2<=96, "4-8yrs", IF(AF2<=144, "8-12yrs", IF(AF2<=192, "12-16yrs", "16-20yrs"))))]

2.Dashboard Creation-

- Created Different visualization charts to visualize factors that affect on prepayment risk and analysze the various patterns.For that I have created Line charts,bar chart,Pie chart,Donut chart,Map,Tree chart,histogram etc.
- Each graph shows different visualization against delinquency and prepayment rate.
- Also I have created various filters to analyze data by applying filters.Like Property state,property type,loan status,delinquency status,time filter,LTV range,DTI range,etc.
- **Created Measures-**

Prepayment rate-

➢ Created measure Prepayment_Rate using formula

```
Prepayment_Rate =
VAR TotalRows = COUNTROWS('finalpr dataset')
VAR PrepaidCount =
   SUMX('finalpr dataset',
      IF(
        AND(
      'finalpr dataset'[OrigUPB] / 'finalpr dataset'[OrigLoanTerm]
       * 'finalpr    dataset'[MonthsInRepayment < 'finalpr dataset'
        [OrigUPB] * 0.2,'finalpr dataset'[OrigUPB] * 0.1 <
       'finalpr dataset'[OrigUPB] / 'finalpr dataset'[OrigLoanTerm] *
       'finalpr dataset'[MonthsInRepayment]
       ),1, 0 ) )
 VAR PrepaymentRate = DIVIDE(PrepaidCount, TotalRows)
 RETURN
 SWITCH(
  TRUE(),
  ISBLANK(PrepaymentRate), BLANK(),PrepaymentRate
  )
```

➢ Created measure Loan_Status using formula-

- LoanStatus =
  IF(
  'finalpr dataset'[MonthsInRepayment] > 0 && 'finalpr dataset'[Prepayment_Rate] > 0,
  "Active",
  IF(

```
        'finalpr dataset'[MonthsInRepayment] = 0 && 'finalpr
        dataset'[Prepayment_Rate] > 0, "Paid Off",
        IF(
                'finalpr dataset'[MonthsInRepayment] > 0 && 'finalpr
                dataset'[Prepayment_Rate] = 0, "Charged Off",
                "Unknown"
        )
    )
    )
```

- Created measure Delinquency Rate.
  - Delinquency Rate = DIVIDE (CALCULATE (COUNTROWS('finalpr dataset'),'finalpr dataset'[EverDelinquent] = 1), COUNTROWS('finalpr dataset'),0)

- Created Measure DTI Range-
  - DTI_Range = IF(AND('finalpr dataset'[DTI] <= 20, 'finalpr dataset'[DTI] >= 0), "0-20", IF(AND('finalpr dataset'[DTI] <= 40, 'finalpr dataset'[DTI] >= 21), "21-40", IF(AND('finalpr dataset'[DTI] <= 60, 'finalpr dataset'[DTI] >= 41), "41-60", IF(AND('finalpr dataset'[DTI] <= 75, 'finalpr dataset'[DTI] >= 61), "61-75", "Above 75"))))

- Created measure Total Mortgage Securities using below formula
  - Total Mortgage Securities =

```
CALCULATE(
 DISTINCTCOUNT('finalpr dataset'[LoanSeqNum]),
ALLEXCEPT('finalpr dataset', 'finalpr dataset'[PropertyState])
)
```

- Total Number of Loans=count(“LoanSeqNum”)
- Average Original UPB=average(“OrigiUPB”)
- Average Original Interest Rate =average(“OrigInterestRate ”)
- Average Loan Term .=average(“OrigLoanTerm”)

3.Insights-

- Average OrigInterestRate is 6.93.
- Average OrigLoanTerm is 359.84
- When we apply geographical filter i.e PropertyState filter ,For Each state all values like kpi values and all charts visuals changes and shows different prepayment rate.
- Prepayment Rate is higher for credit range good and lower for credit range poor.
- For DTI range 0-20 prepayment rate is lower and for DTI range 21-40 prepayment rate is high .
- In line chart of prepayment rate over time ,Trend line shows that prepayment rate is increasing over the time.Forecasting shows that prepayment rate toggle between(60.42%) and (52.35%)
- In delinquency trends ,forecasting shows that delinquency rate is constant(0.23) over the time.
- Prepayment rate is highest for year 2031.
- I have added forecasting which shows prepayment rate which toggle between 62.42% and 52.35% over the time.
- Line chart shows delinquency rate is highest for year 2026.
- Lowest Delinquency Rate is for year 2027(0.15)
- When we apply Delinquency status 0 ,prepayment rate is (52.68%)and Delinquency rate is (0.25) .
- For Delinquency status 1 ,prepayment rate is (44.89%), Delinquency rate is (1.00) ,interest rate is (6.97)and 100% loans are ever delinquent.
- For poor credit range prepayment rate is low i.e (46.12%), Delinquency rate is (0.41) ,interest rate is(7.02) ,average month delinquent is 6 and 40.56% loans are ever delinquent.
- For Excellent credit range prepayment rate (51.41%), Delinquency rate is (0.09) ,interest rate is(6.87) ,average month delinquent is 0 and 9.11% loans are ever delinquent.

- For good credit range prepayment rate is high i.e.(52.78%), Delinquency rate is (0.15) ,interest rate is(6.91) ,average month delinquent is 1 and 14.87% loans are ever delinquent.
- For fair credit range prepayment rate is (50.32%), Delinquency rate is (0.26) ,interest rate is(6.96) ,average month delinquent is 3 and 26.13% loans are ever delinquent.
- Pie chart shows the top 5 states having high prepayment rate.
- Funnel chart shows that for credit range Good prepayment rate is hig(52.78%)h and for poor range prepayment rate is low(48.12%).
- When we apply Loan status filter and select active option then scatter plot shows constant prepayment rate i.e 1.0 for all LTV values.,DTI Ranges and credit ranges .
- Total number of mortgage securities by state is 496.
- Prepayment rate by geographic region is 49.79%
- When we apply property type filter and select co- Condominium then it shows high prepayment rate for state WV and low for state PR.For CP-Cooperative only state NY shows value for prepayment rate.
- For Deliquency status 1 state WI shows prepayment(0.51) and PR state shows(0.20). For status 0 state SD shows high prepayment rate(0.62) and low for state PR(0.33) .
- When we apply maturity date between 2031 to 2043 then it shows 100% prepayment rate for most of the states.And between 2039 to 2043 only two states shows 100 percent prepayment rate(IN,KS)
- Whenever we click on any state in any chart total mortgage securities value changes for each state.

4.Recommendations-

- Focus on top 5 states where prepayment rate is high and apply strategies to avoid prepayment risk.
- We have to Offer incentives or rewards for on-time payments
- Provide educational resources and support services to help customers understand the importance of timely payments, financial planning, and credit management
- Continuously monitor trends in prepayment rates, delinquency rates, and credit performance over time.
- Adjust interest rates, fees, and terms accordingly to mitigate risk and attract creditworthy customers.

5.Conclusion-

From above visualization and insights we can say that the factors affecting prepayment risk are credit score,Property state,delinquency status,loan status,Original interest rate,DTI range ,LTV range.