

Fall Internship Learnings

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Risk Management
US MVG

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Internship Objectives

Residential Mortgage Market

- Securitization Process
- Loan Types
- Home Price Appreciation
- Macroeconomic Factors
- Refinancing Effects
- Delinquency and Default

MBS Valuation & Trading Strategies

- Cash Flow Analysis
- OAS Analysis
- Monte Carlo Simulations
- Dollar Roll Trade

Machine Learning Modeling

- Prepayment Modeling
- Default Rate Modeling
- Loss Severity Modeling
- Applying Generative AI

Residential Mortgage Market



Residential Mortgage Market

Home Price Appreciation Findings

Investor Activity

- Investors buying fixer-uppers, renovating, and renting
- Families struggle to compete financially

Aging Population Holding On

- Seniors staying in larger homes
- 56% of 3+ bedroom homes occupied by 1-2 people, mostly 62+

Closing Costs and Fees

- Median loan costs increased 21.8% (2021-2022)
- Average closing costs nearly \$6,000 in 2022

Pandemic Effects

- More time spent at home (Perceived higher value of home ownership)
- Low interest rates

Supply and Demand

- Lagging single-family home construction
- Rapid household formation

Mortgage Rate Lock-In Effect

- 47.9% of homeowners have rates $\leq 3.5\%$
- Each 1% rate increase reduces sale probability by 18%



How to value Mortgage Backed Securities?

Cash Flow Analysis

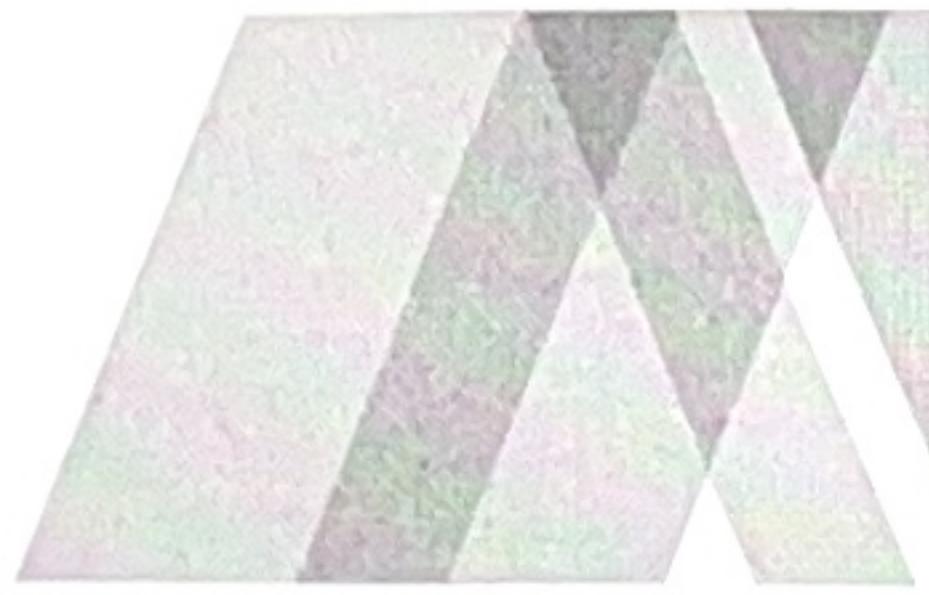
- Projection and discounting future cash flows
- Consider factors like prepayment rates, default rates, and interest rates
- YTM, WALA, Duration used for comparison

Projecting MBS Prices

- MBS prices are heavily influenced by interest rate movements
- Accurate price projections require models that account for factors such as refinancing incentives, seasonality, and borrower behavior.

Why is it important to project precisely?

- Allows for more accurate risk assessment of MBS
- Calculate risk-weighted assets for their MBS holdings, leading to optimized capital allocation under Basel regulations
- Accurately rate and price structured Mortgage Products



What are the main risks we observe with Mortgage Products?



Prepayment Risk

- Borrower making advanced payments
- Affects Yield of MBS



Interest Rate Risk

- Represents Coupon Rate of MBS
- Signals Refinancing



Credit Risk

- Default
- Loss Severity



Objectives

1. Develop Predictive Loss Severity Models
2. Combine Predicted Components of Loss Severity
3. Validate and Optimize for Specific Mortgage Products

Loss Severity Modeling

$$Loss = (DB - NSP) + DAI - E - R$$

$$LossSeverity = \frac{Loss}{DB} * 100$$

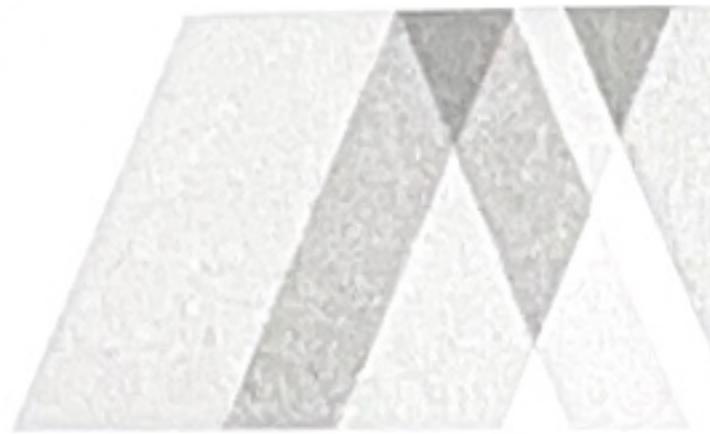
Defaulted
Balance

Net Sale
Proceeds

Expenses

Delinquent
Accrued
Interest

Recoveries

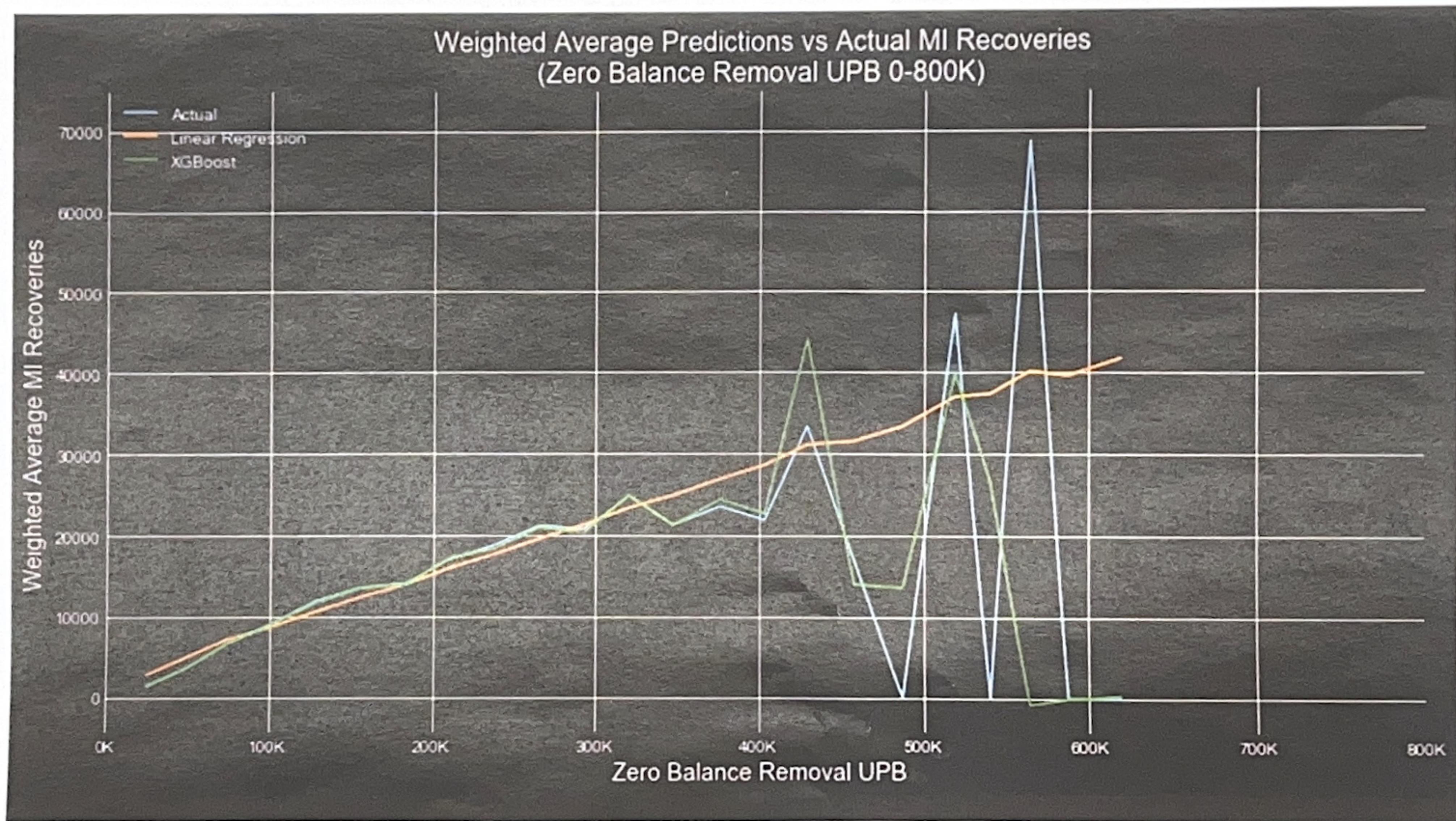


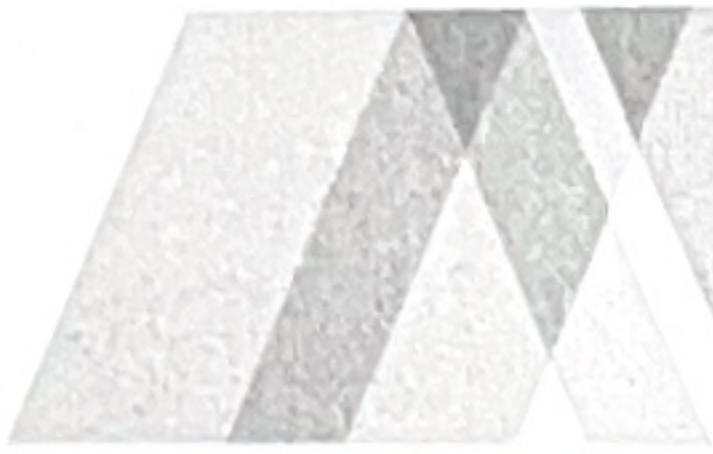
Linear Regression Model

$$\text{Recovery} = 11,120 + 6,248(\text{MI_PCT}) + 5,632(\text{DB})$$

XGBoost Model

MI_PCT: 0.809752
DB: 0.190247178

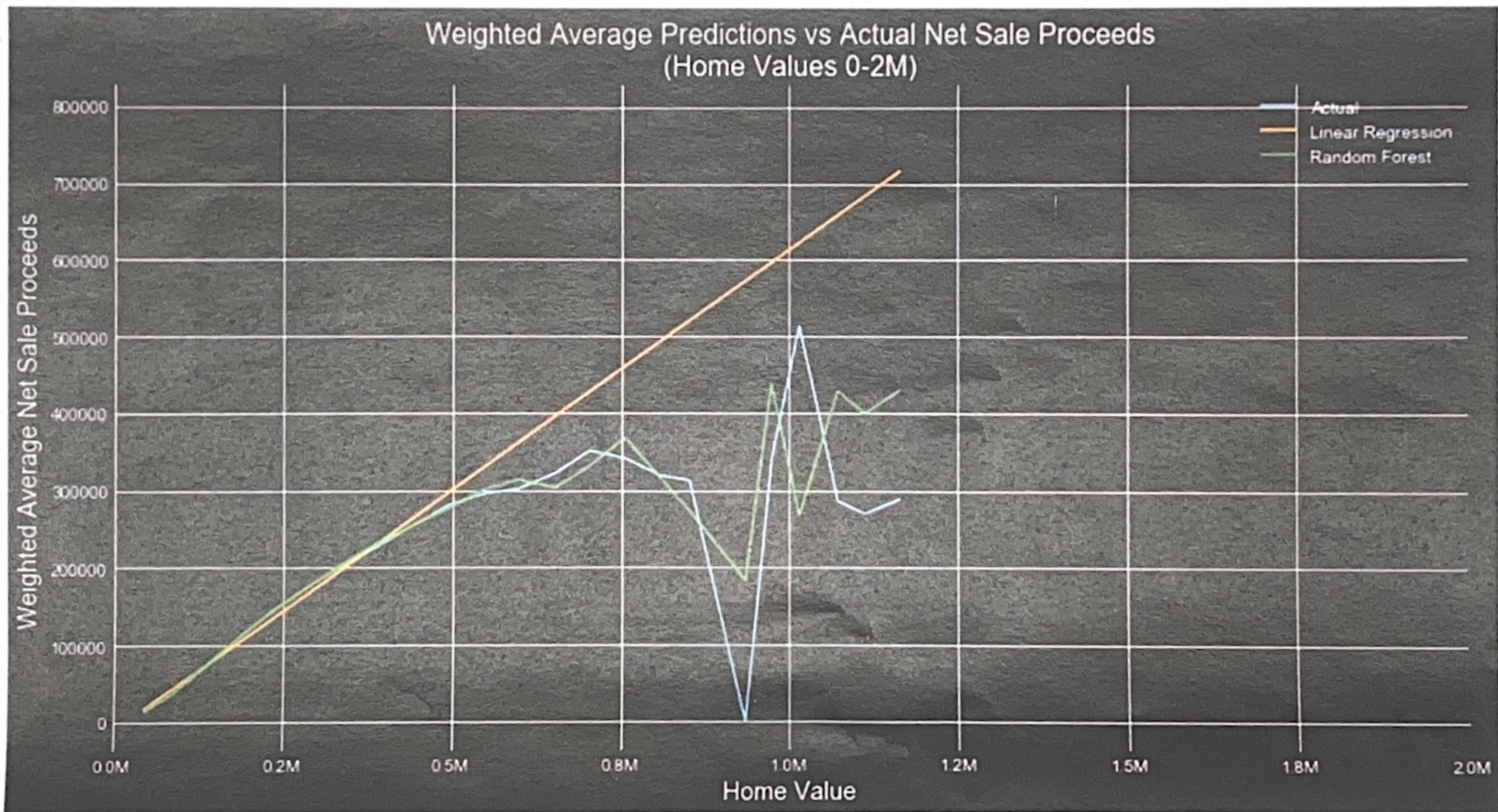




Linear Regression Model

$$\text{Net Sale Proceeds} = 0.67565(HV) - 12617$$

Random Forest Model



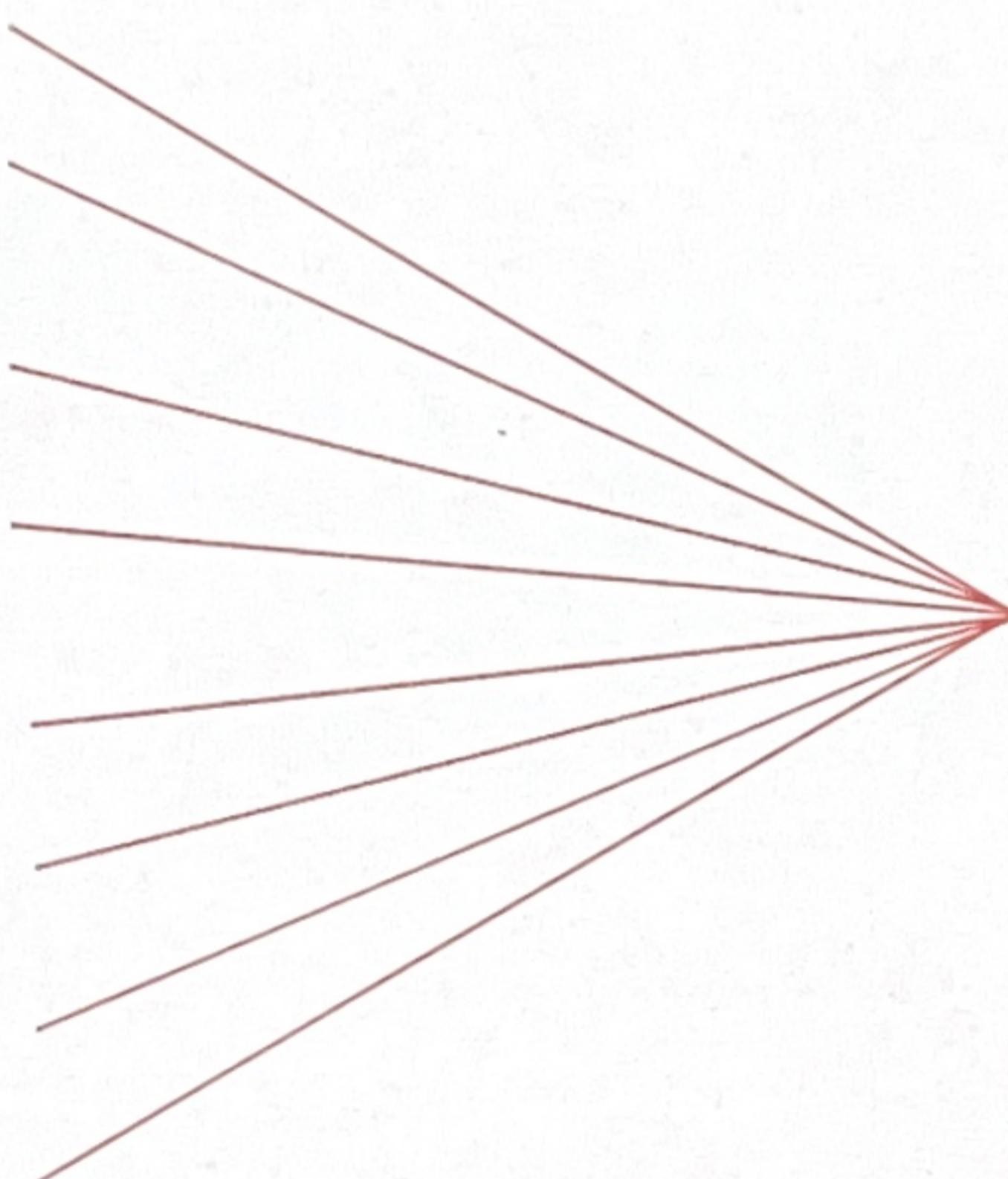
Expense Modeling for REO Loans

Model Inputs

- Loan to Value Ratio*
- Home Value*
- Interest Rate*
- Property Type Numeric*
- State Severity Score*
- Loan Age*
- Is Judicial*
- Time in REO*

Model Output

- Expense to Value Ratio*

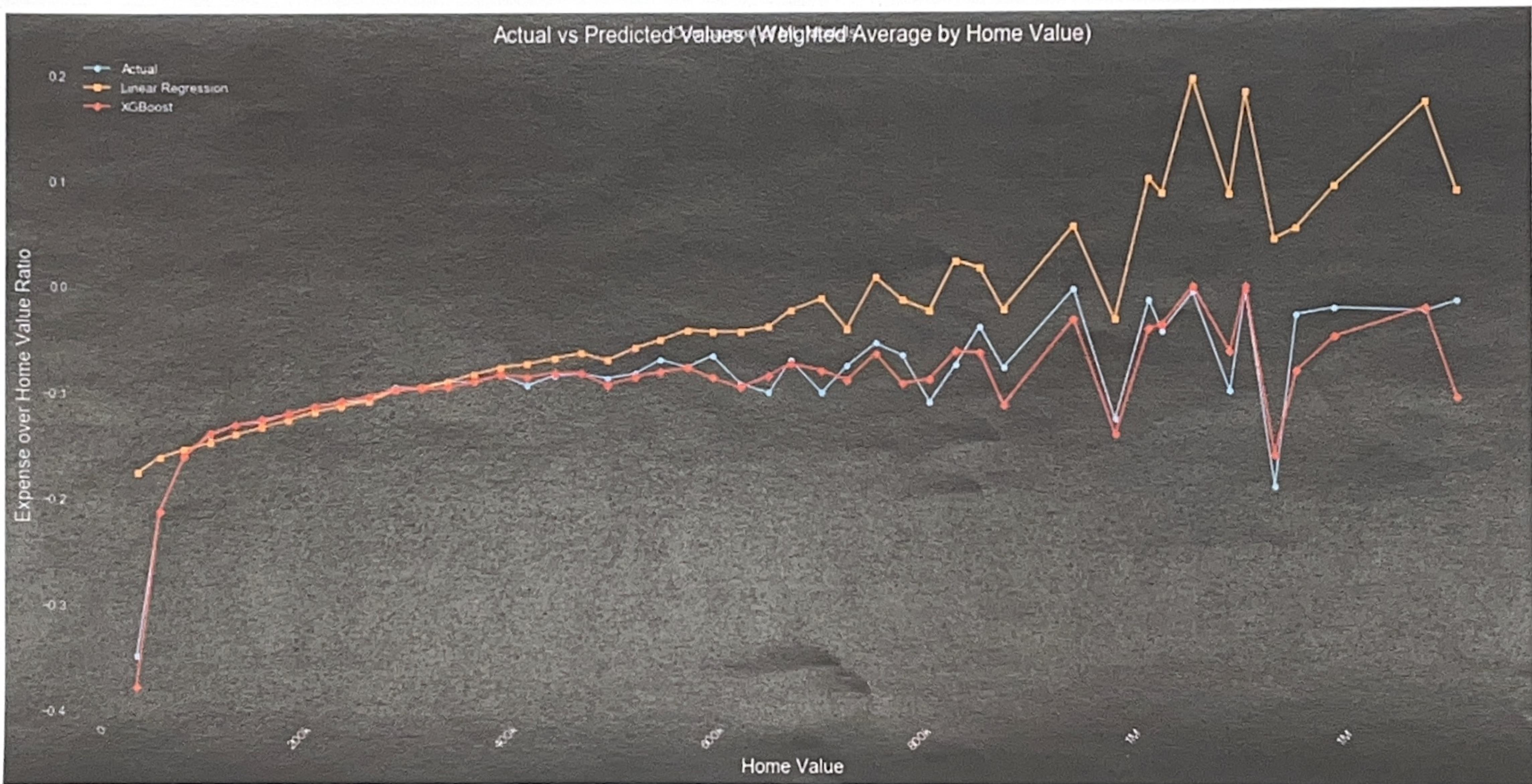


Assumptions

Expense Projections can be made based on Historical Data

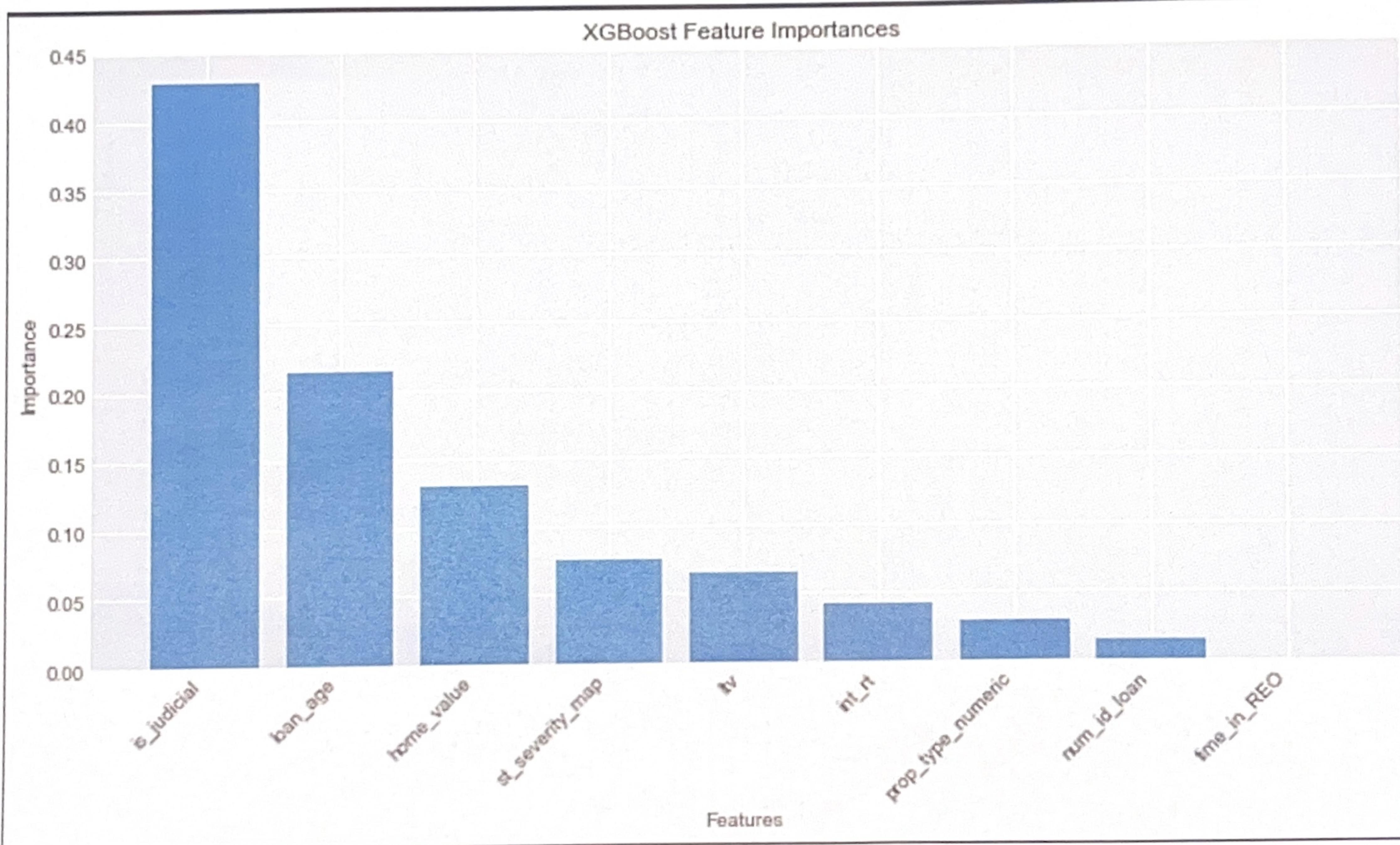
Expense Modeling REO Loans

Expense Prediction Results



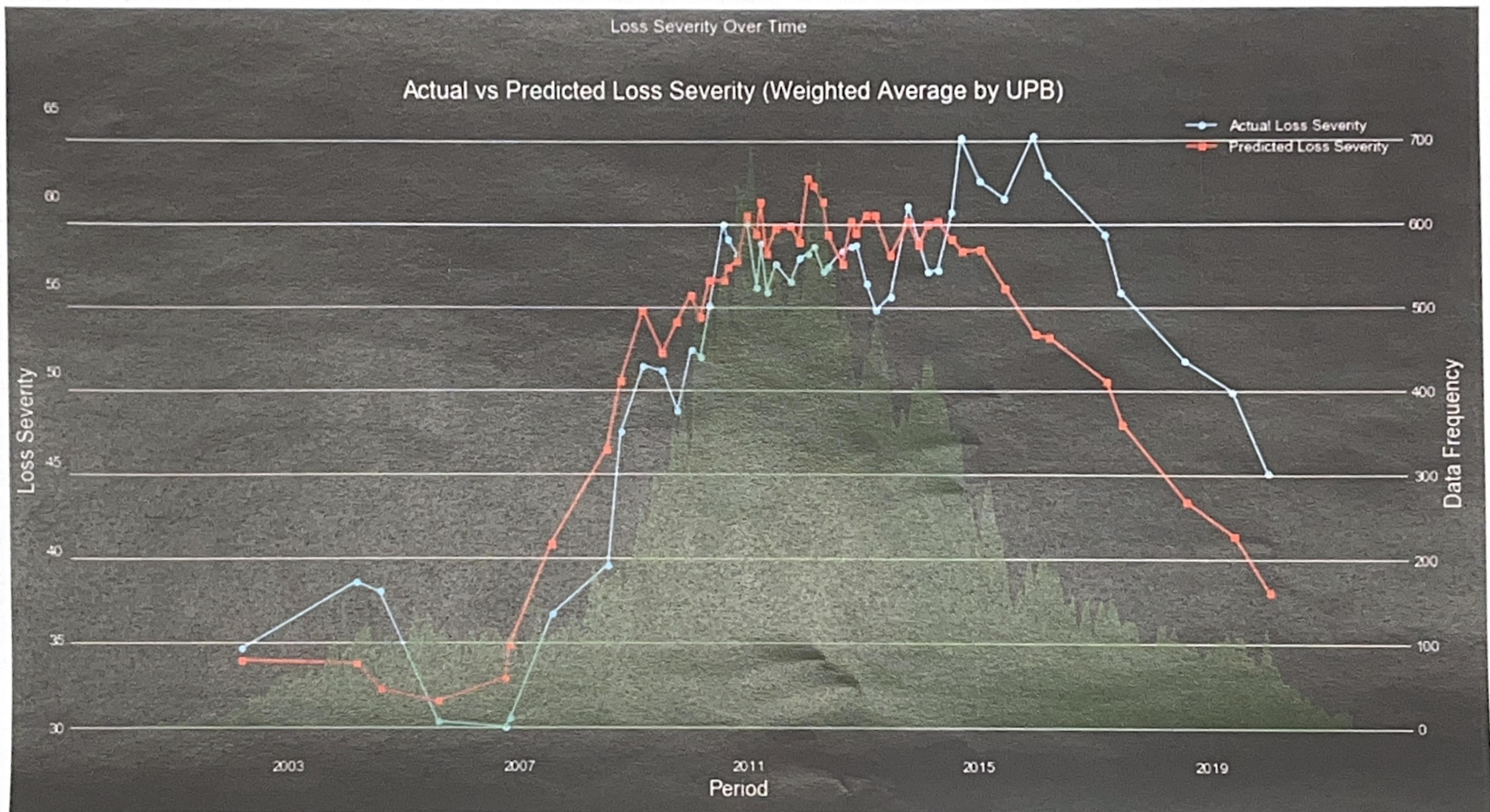
Expense Modeling for REO Loans

Feature Importance



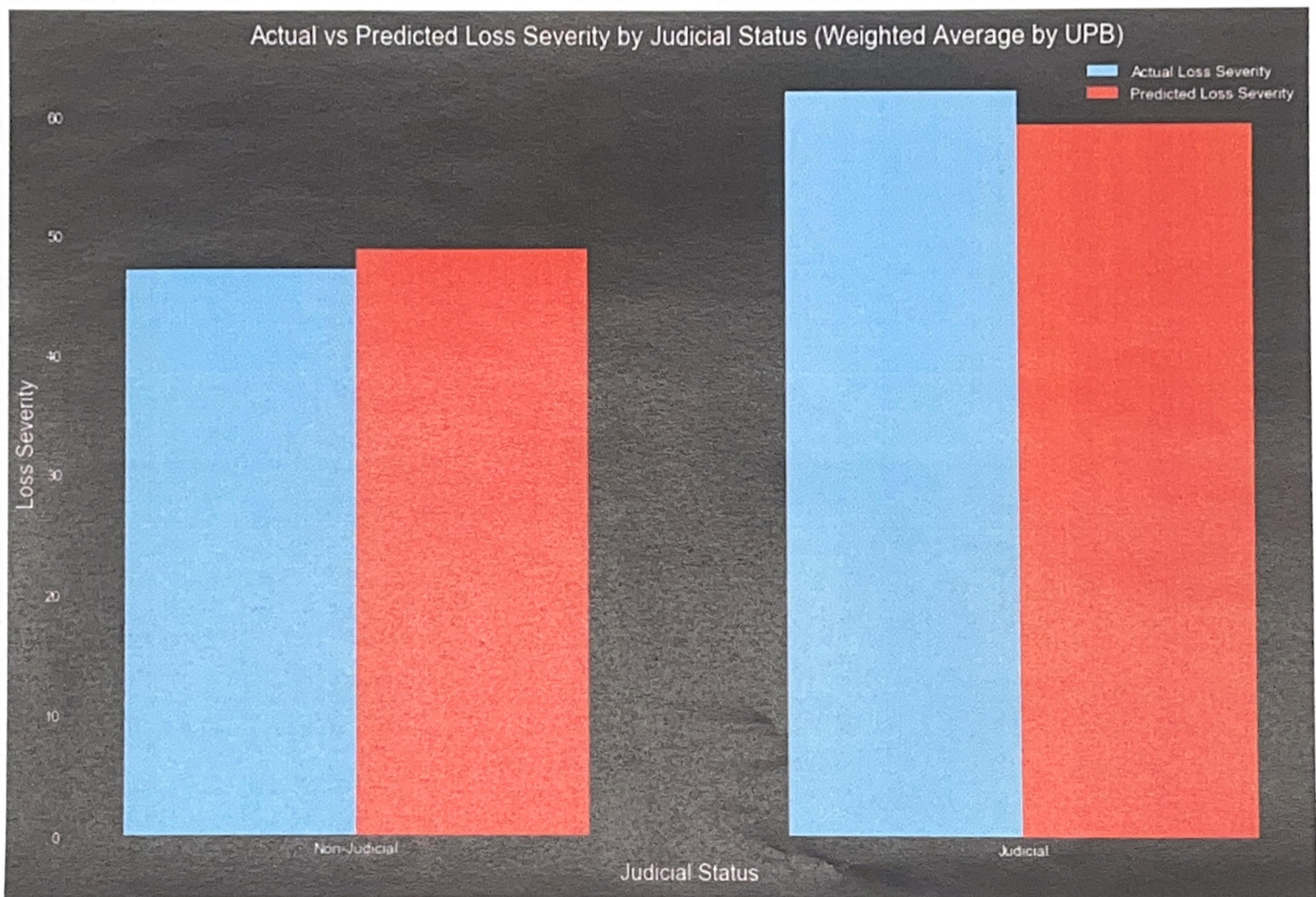
Modeling Loss Severity

Loss Severity Along Factor Date



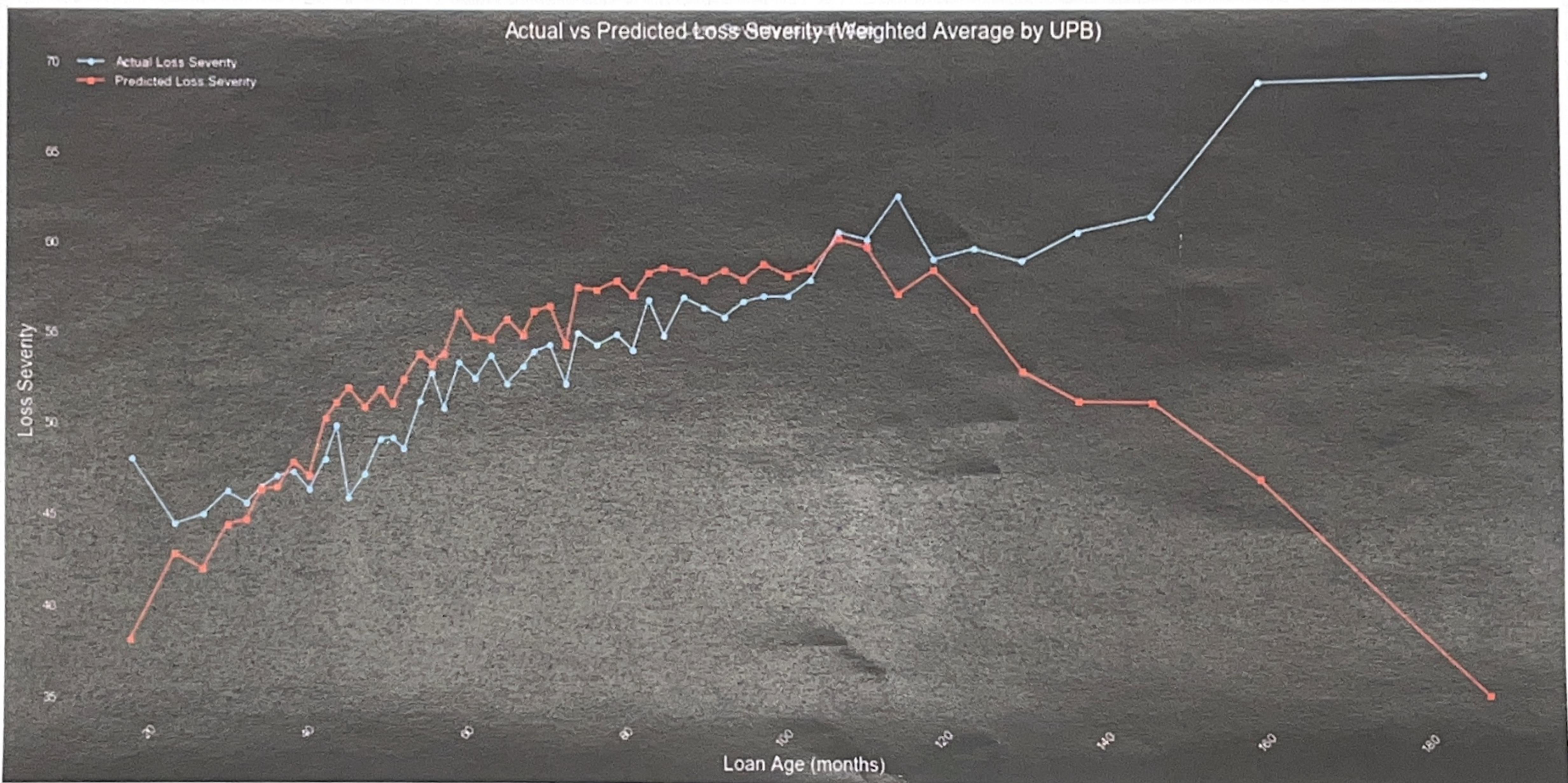
Modeling Loss Severity

Loss Severity Judicial Plot



Modeling Loss Severity

Loss Severity Along Loan Age

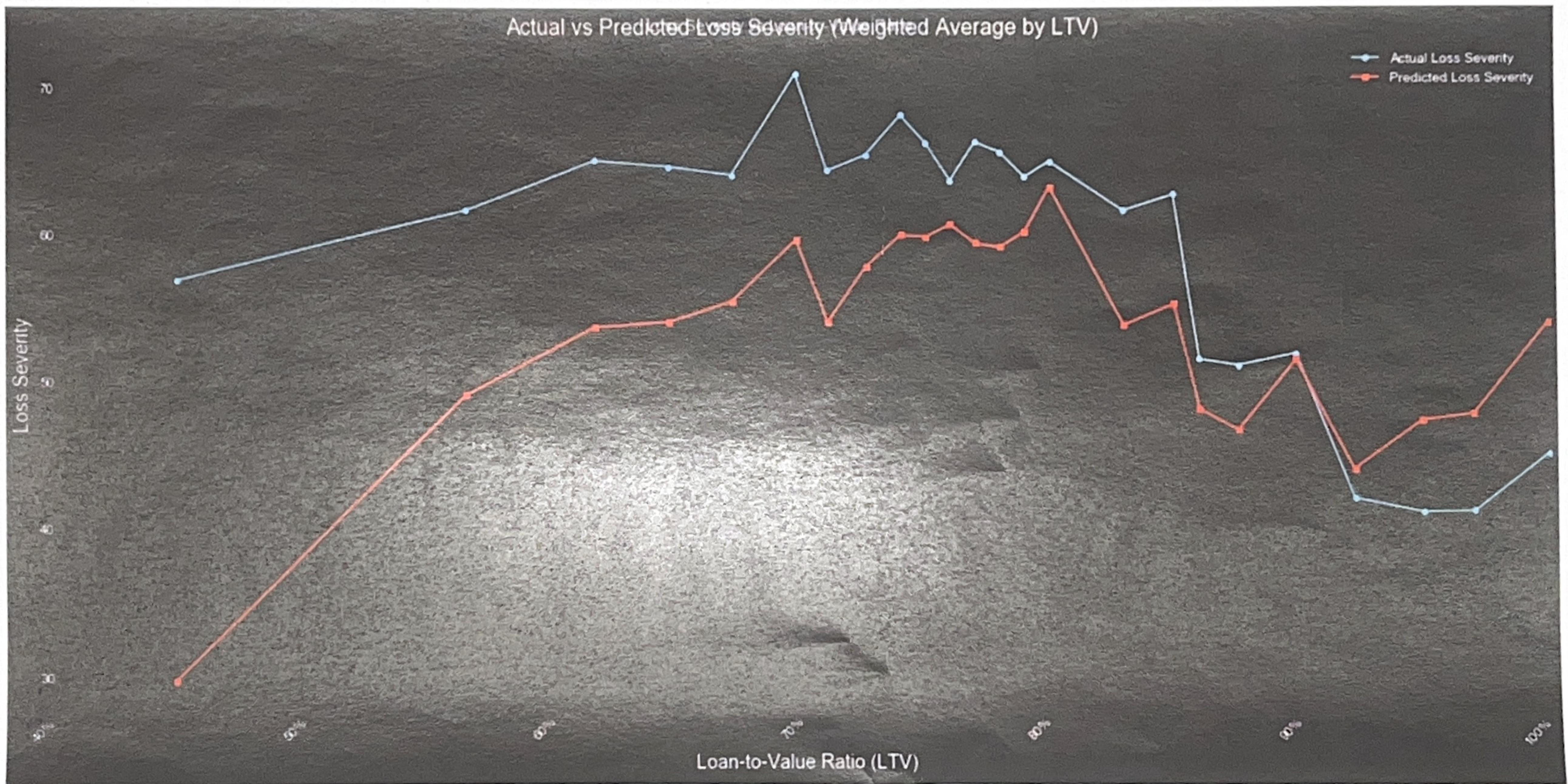




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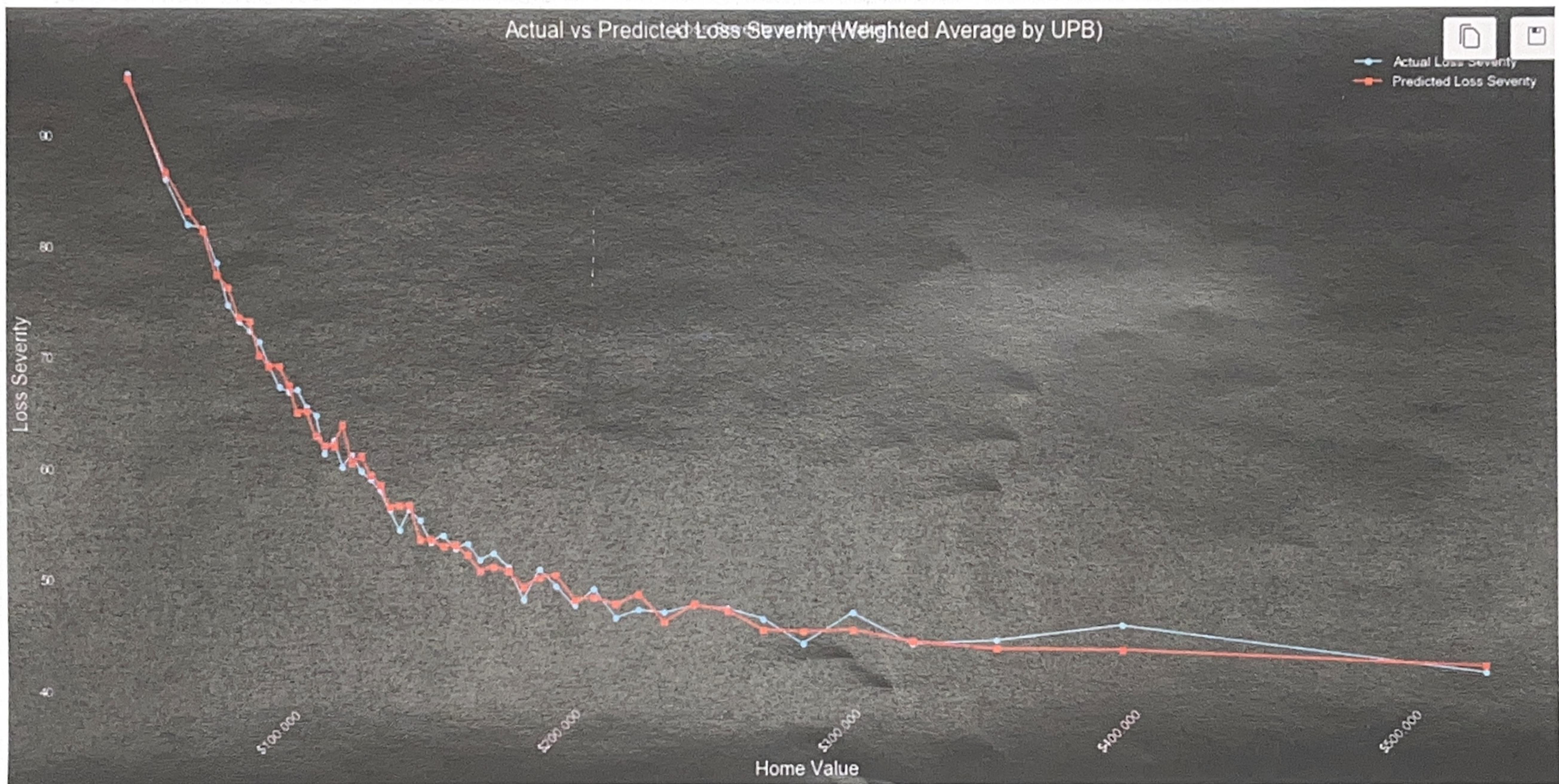
Modeling Loss Severity

Loss Severity Against LTV



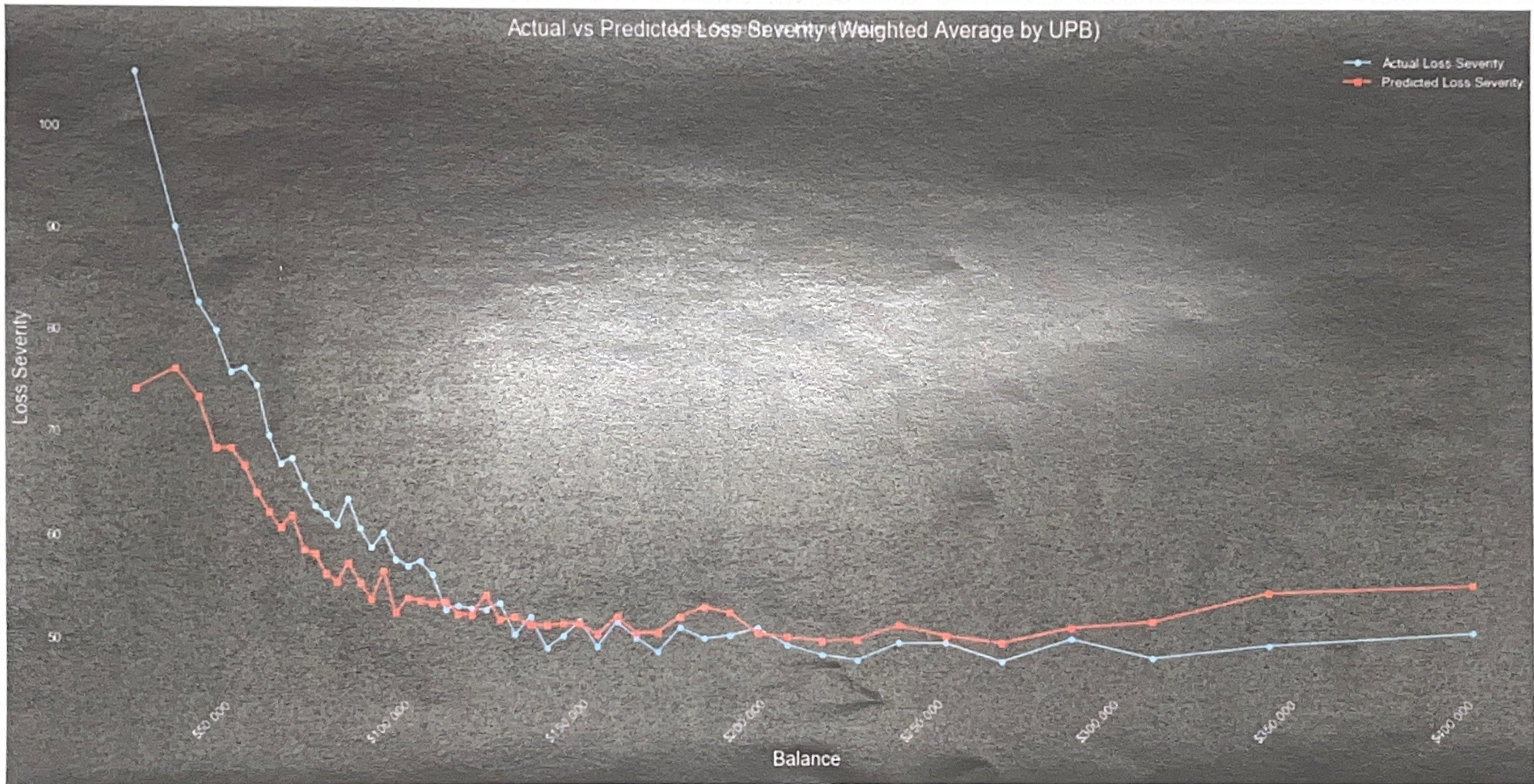
Modeling Loss Severity

Loss Severity Along Home Value



Modeling Loss Severity

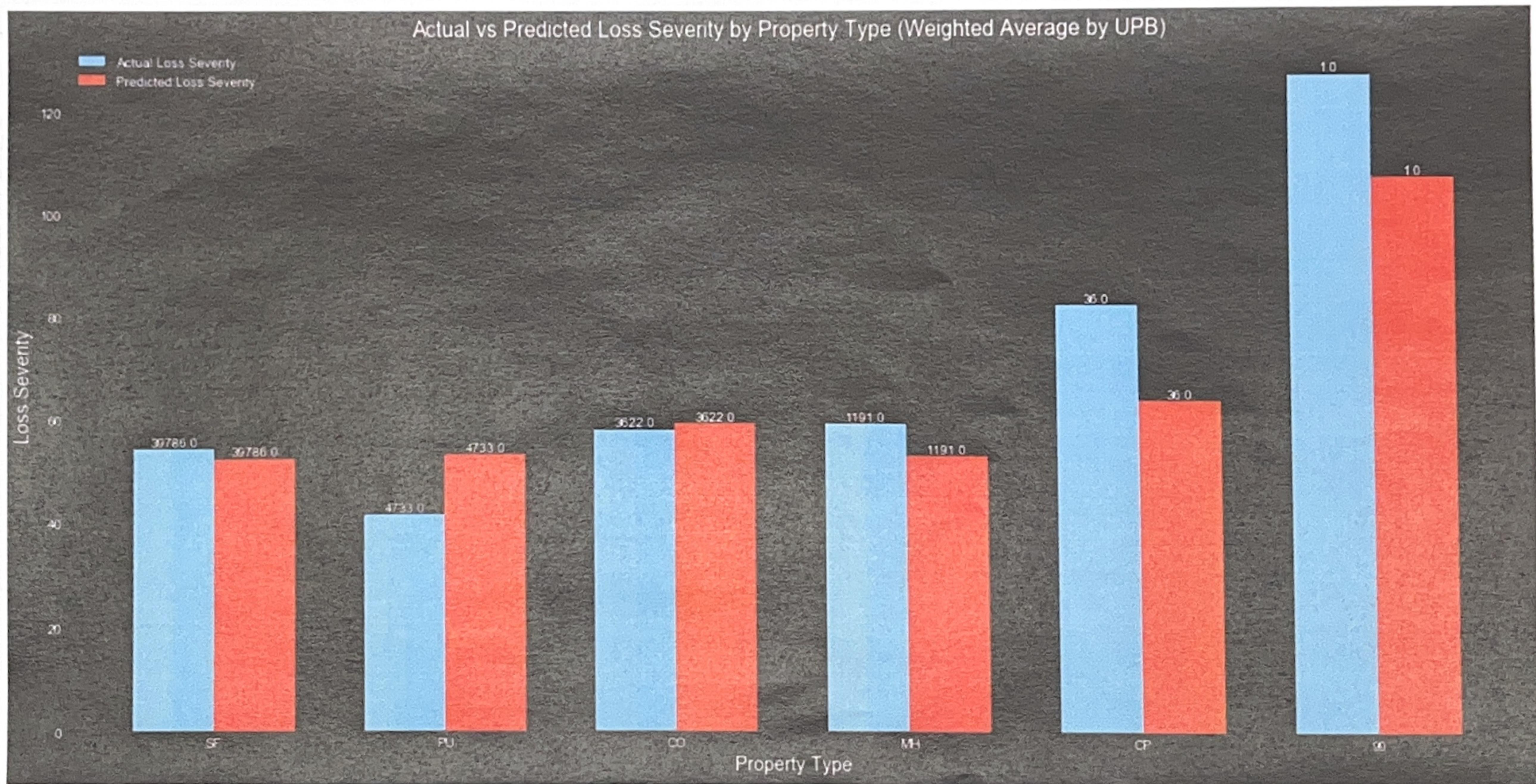
Loss Severity Along Balance





Modeling Loss Severity

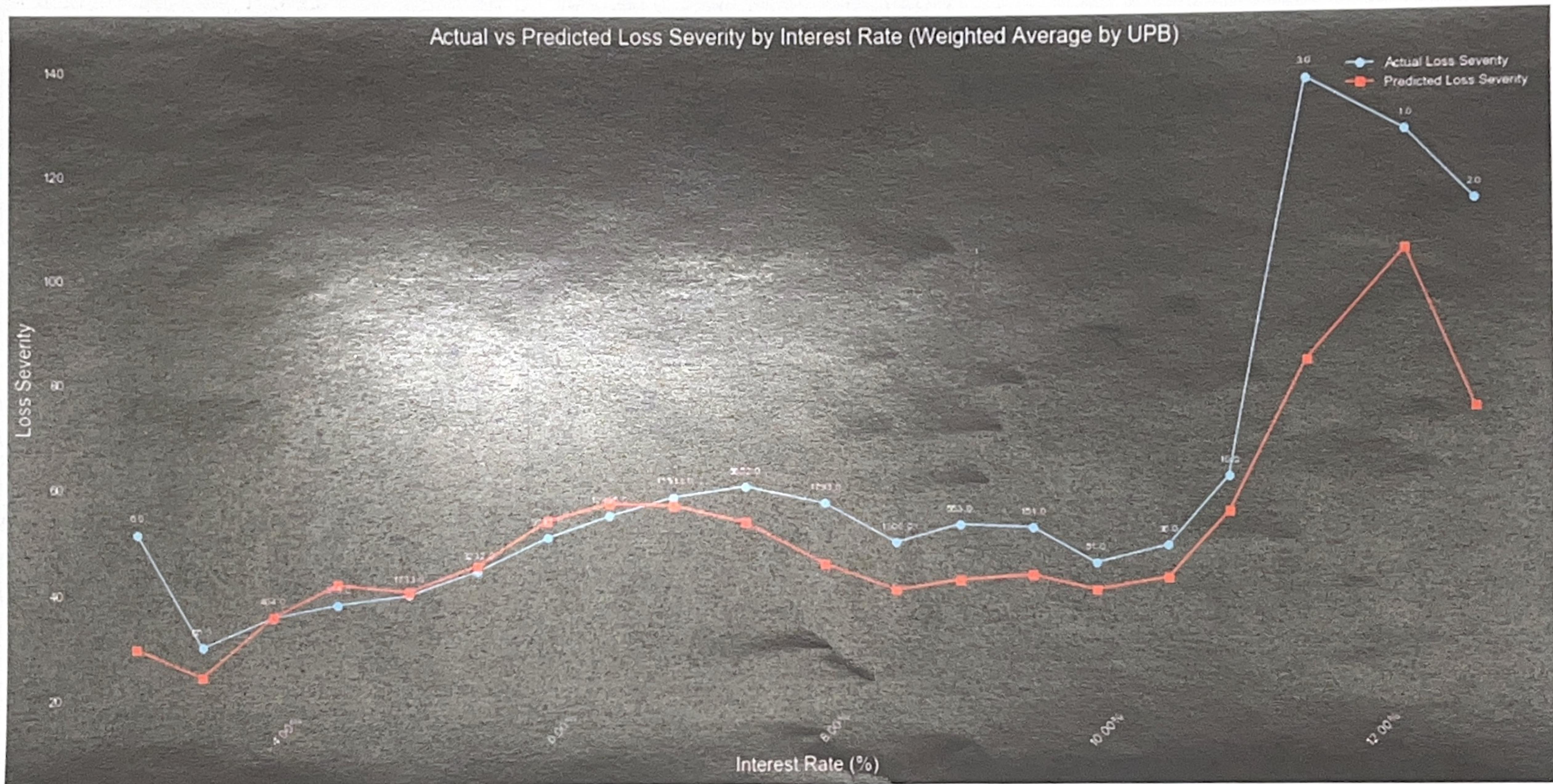
Loss Severity Property Type Plot





Modeling Loss Severity

Loss Severity Against Interest Rate



Severity Model Conclusions

- Loan Age is an unexpected contributor
- Judicial States incur higher Loss Severity
- Home Value Plays Role in Expense Predictions which is variable

Future Improvements

- Collect more data for models to be trained on
- Use Deep Learning techniques to increase model performance
- Use different features and approaches for different Mortgage products