Predicting Lenders' Decision on Home Loan Refinancing Application

A Classification Analysis

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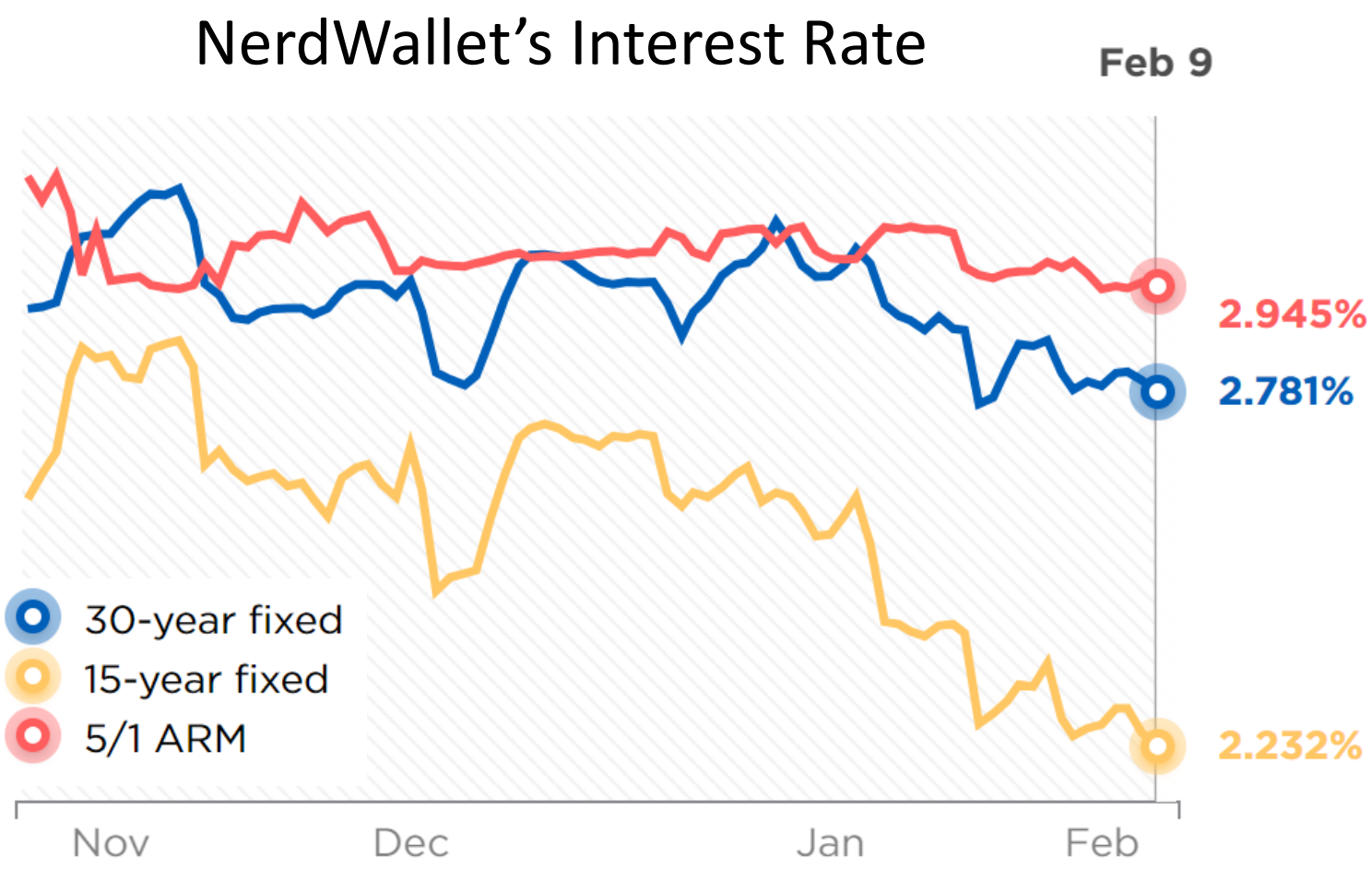
Background



Good time to refinance your home loan

Understand what and how financial features are used to make decisions

Data Collection

Consumer Financial Protection Bureau

Data Summary

State:
MASSACHUSETTS

2019

Action Taken:
1 - Loan Originated
2 - Application approved but not accepted
3 - Application denied

Loan Purpose:
31 - Refinancing

Selected Variables	# of Records	$ Amount
1 - Loan Originated, 31 - Refinancing	63,212	25,012,190,000
2 - Application approved but not accepted, 31 - Refinancing	2,003	677,885,000
3 - Application denied, 31 - Refinancing	13,405	3,905,945,000

Approved

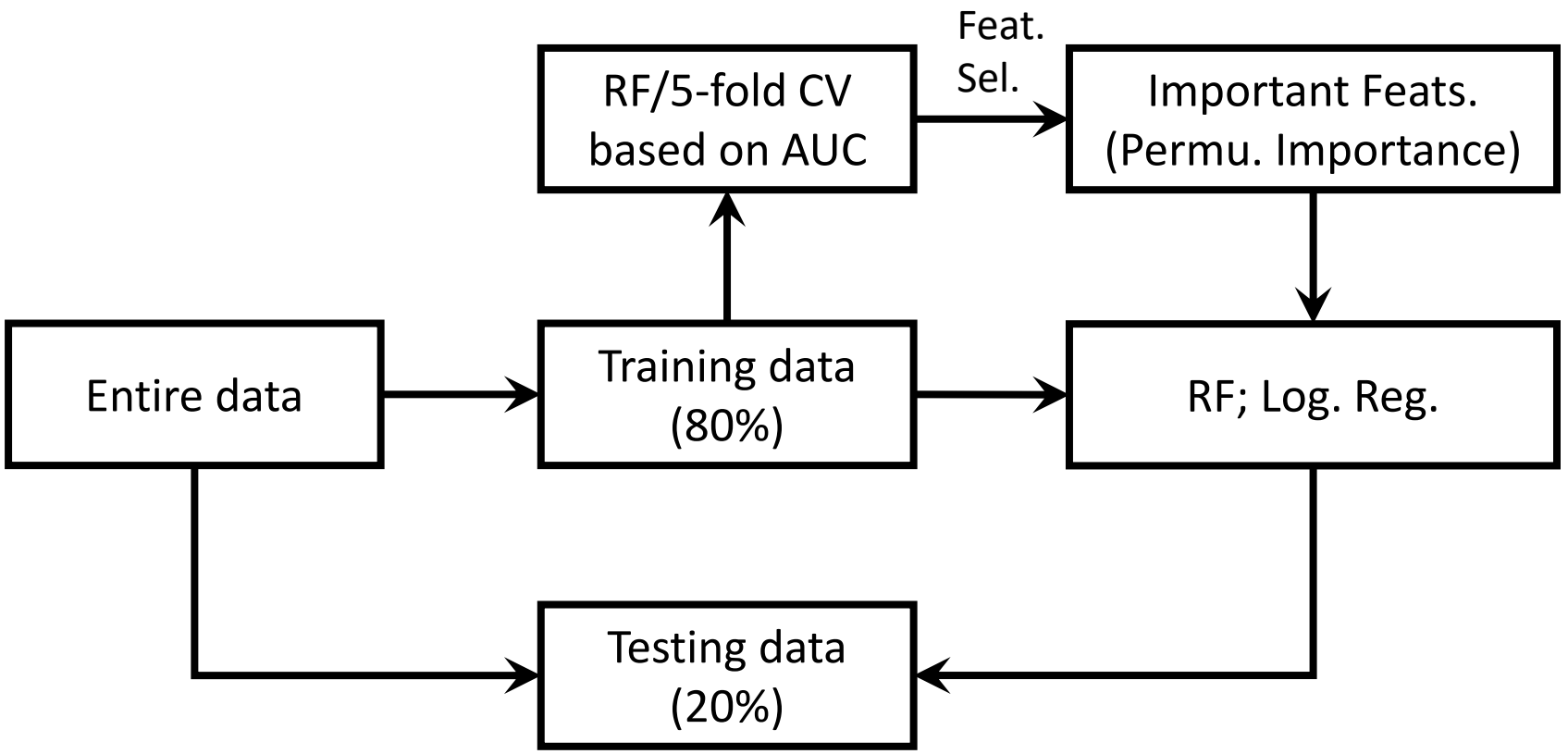
Clean data:

62310 applications:

- 51628 approvals
- 10682 denials

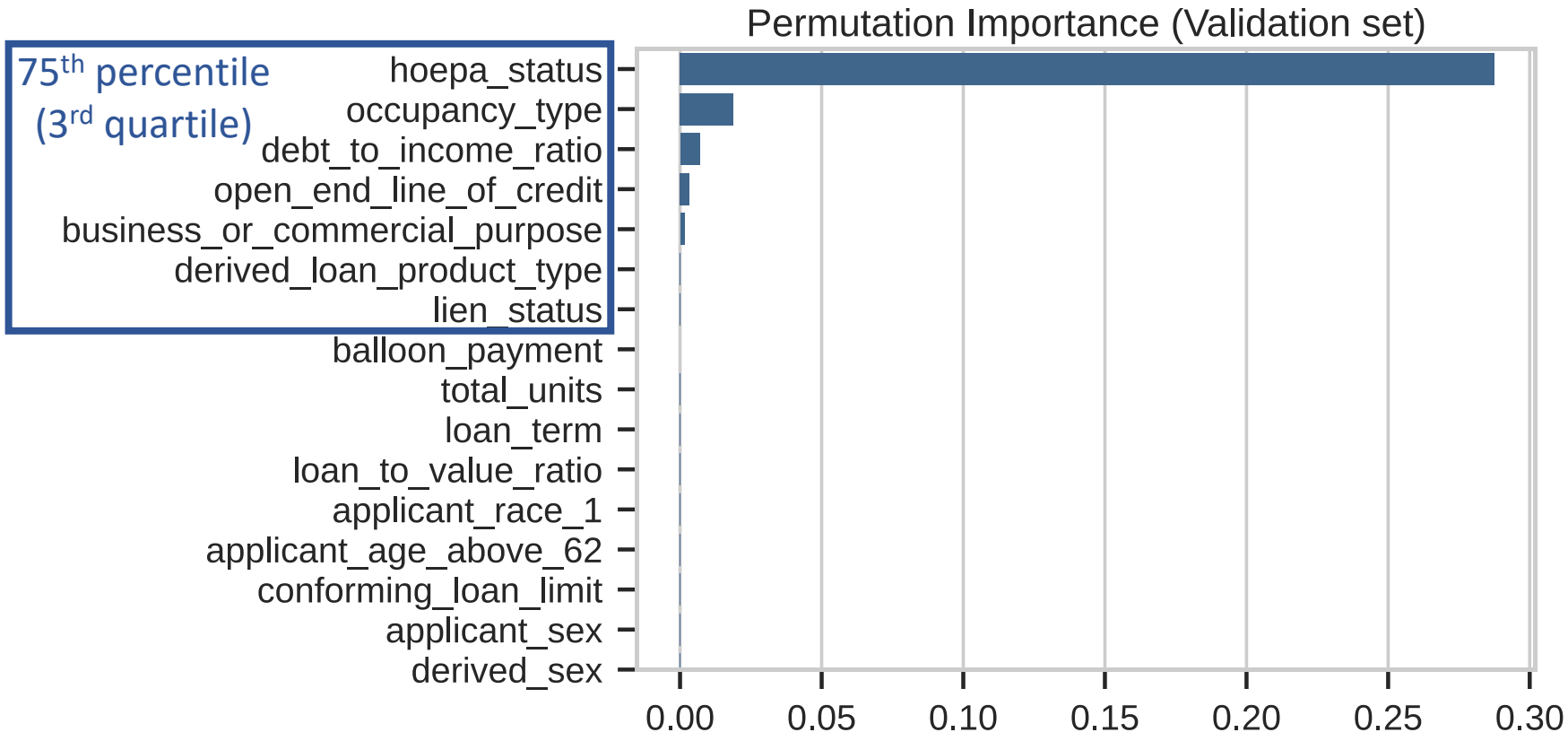
28 features

Modeling Workflow



Random Forest Feature Selection – 5-Fold Randomized Search CV

Tune hyperparams to maximize ROC-AUC (0.99):

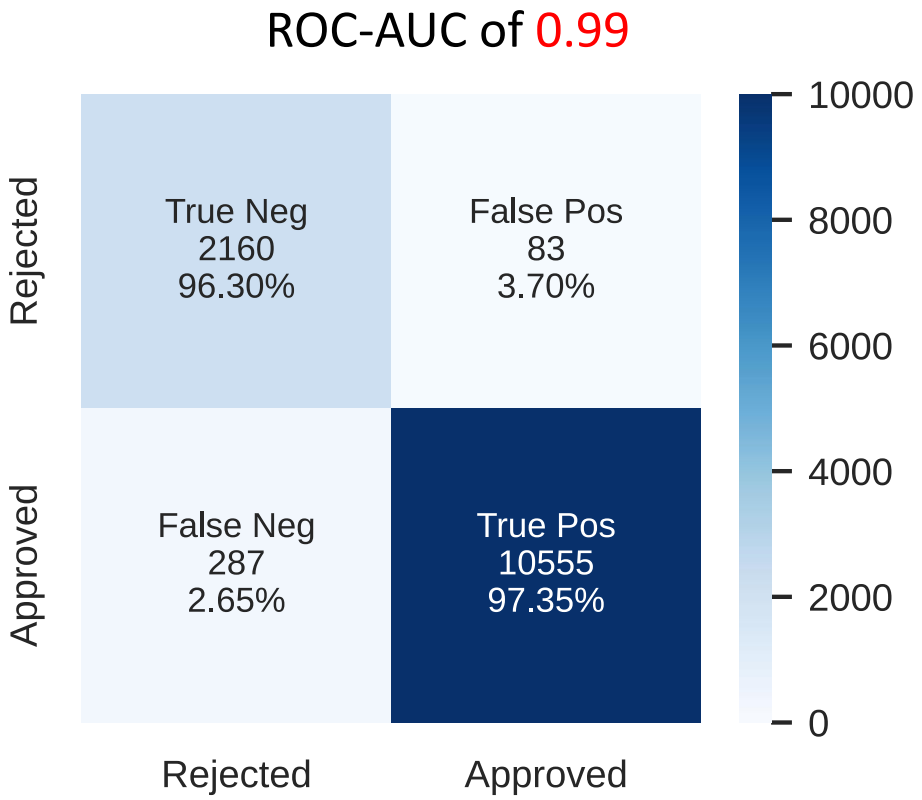


Need to know how these features play a role in decision making

Model Construction with Selected Features

All training data

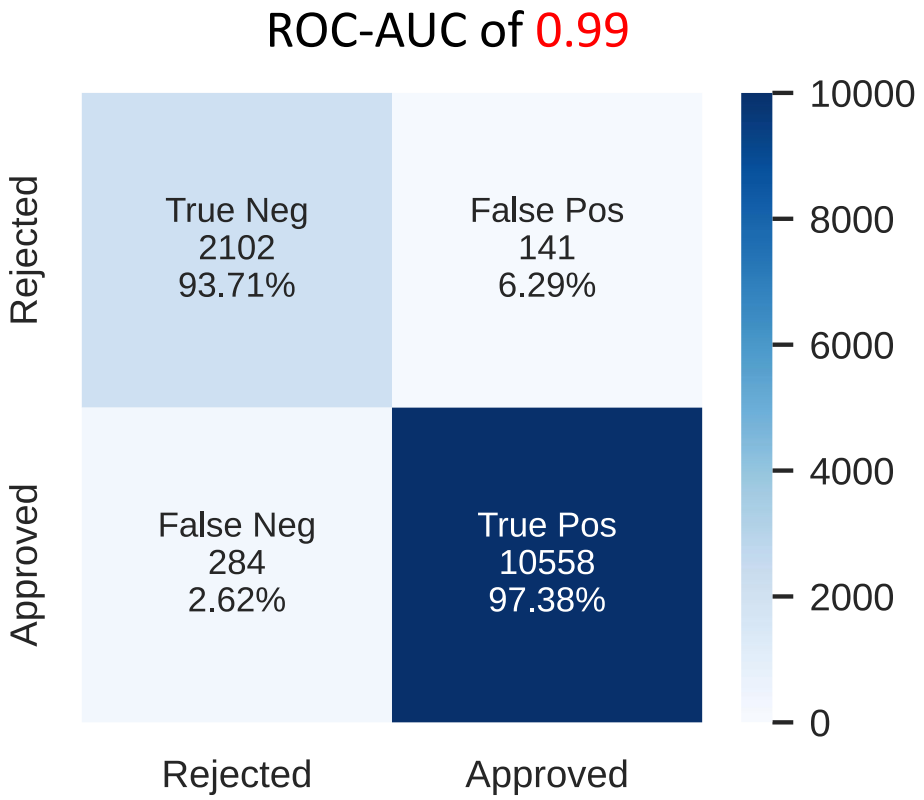
- Trained a random forest model



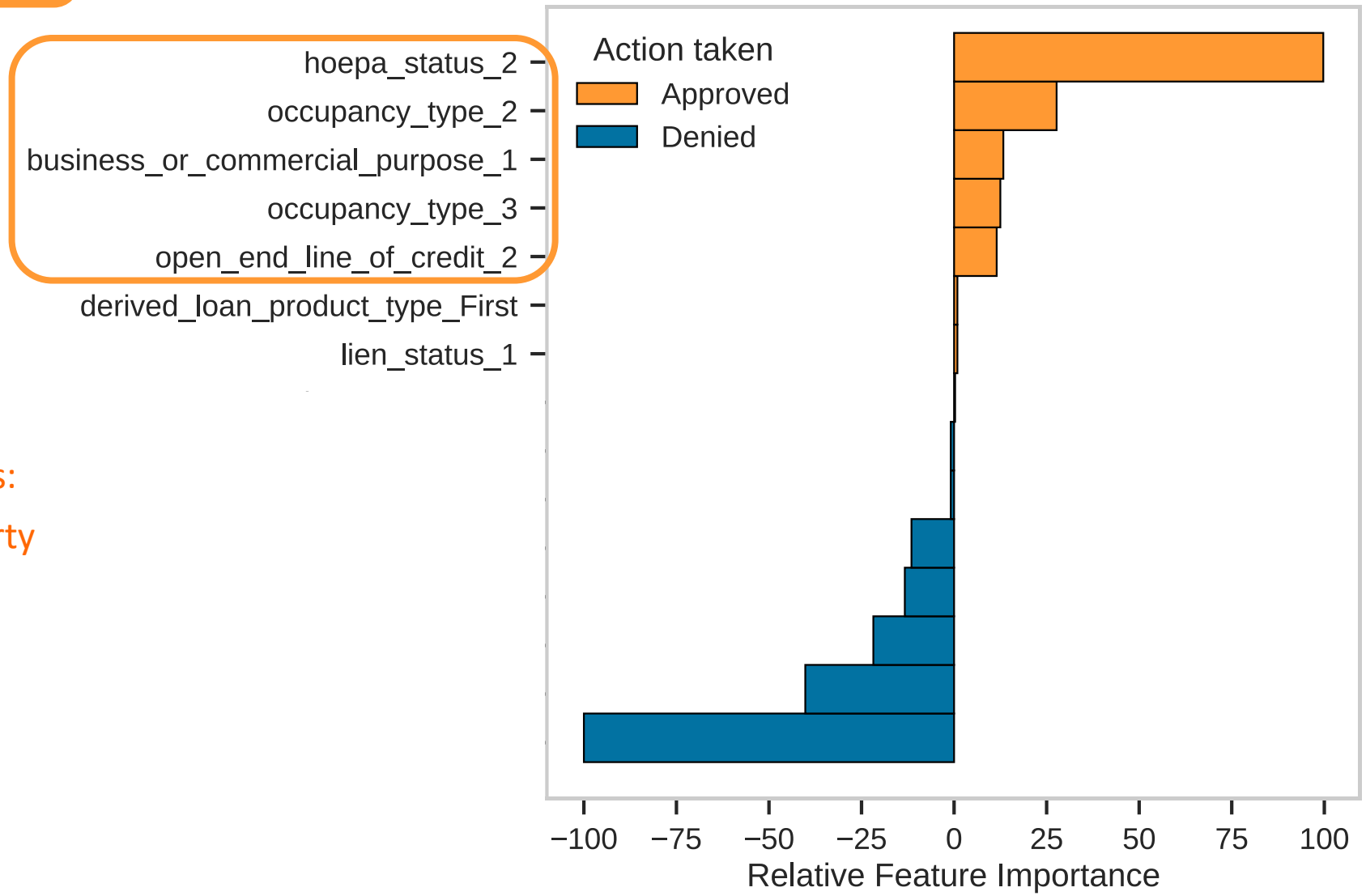
Model Construction with Selected Features

Existing training & validation data

- Tuned Log. Reg. model with 5-fold CV (regularization penalty strength, “C”)



More likely to approve



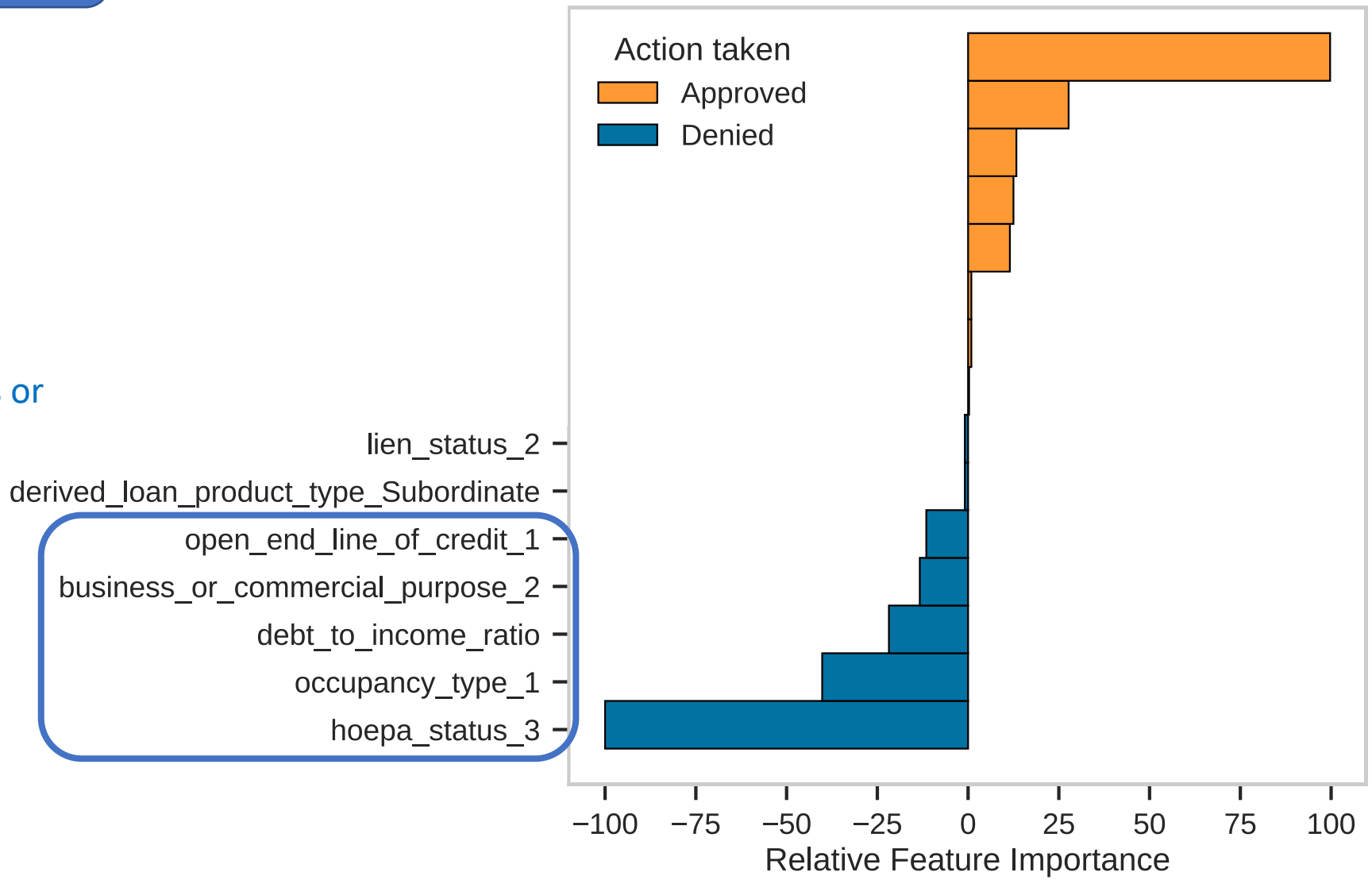
Approvals:

- Subject to HOEPA regulations:
- Second or investment property
- Primarily for a business or commercial purpose
- close-end line of credit

More likely to deny

Denials:

- Not subject to HOEPA regulations
- Principal residence
- High debt-to-income ratio
- Not primarily for a business or commercial purpose
- Open-end line of credit



Summary

- Understood how lenders make decisions on home loan refinancing
  - HOEPA Status
  - Occupancy Type
  - Business/commercial purpose
  - Whether if open-end line of credit
  - Debt to income ratio

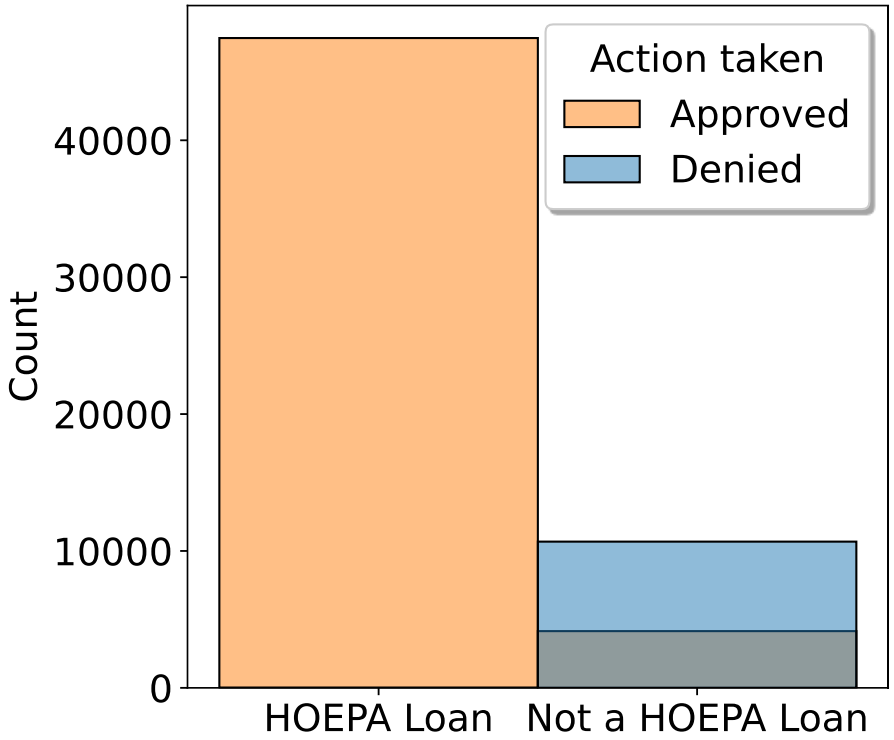
- Trained RF. and Log. Reg. models

Future work

- Investigate nationwide CFPB data
  - Including multiple loan purchases, e.g., home purchase, home improvement

- More advanced model
  - XGBoost
  - Deep neural network for more complex classification

Thank You

Appendix

HOEPA is highly separable, which explains why the AUC is as high as 0.99.