



# Factors Influencing Mortgage Decisions

# Overview

Key Recommendations

Numerical Predictors

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Summary



# Key Recommendations

1

Offer flexible loan terms and origination charges.

2

Advertise flexible payment options for qualifying mortgage recipients to help ease the burden of paying off a home.

3

Design counseling services to guide homeowners in making informed decisions when purchasing a home.





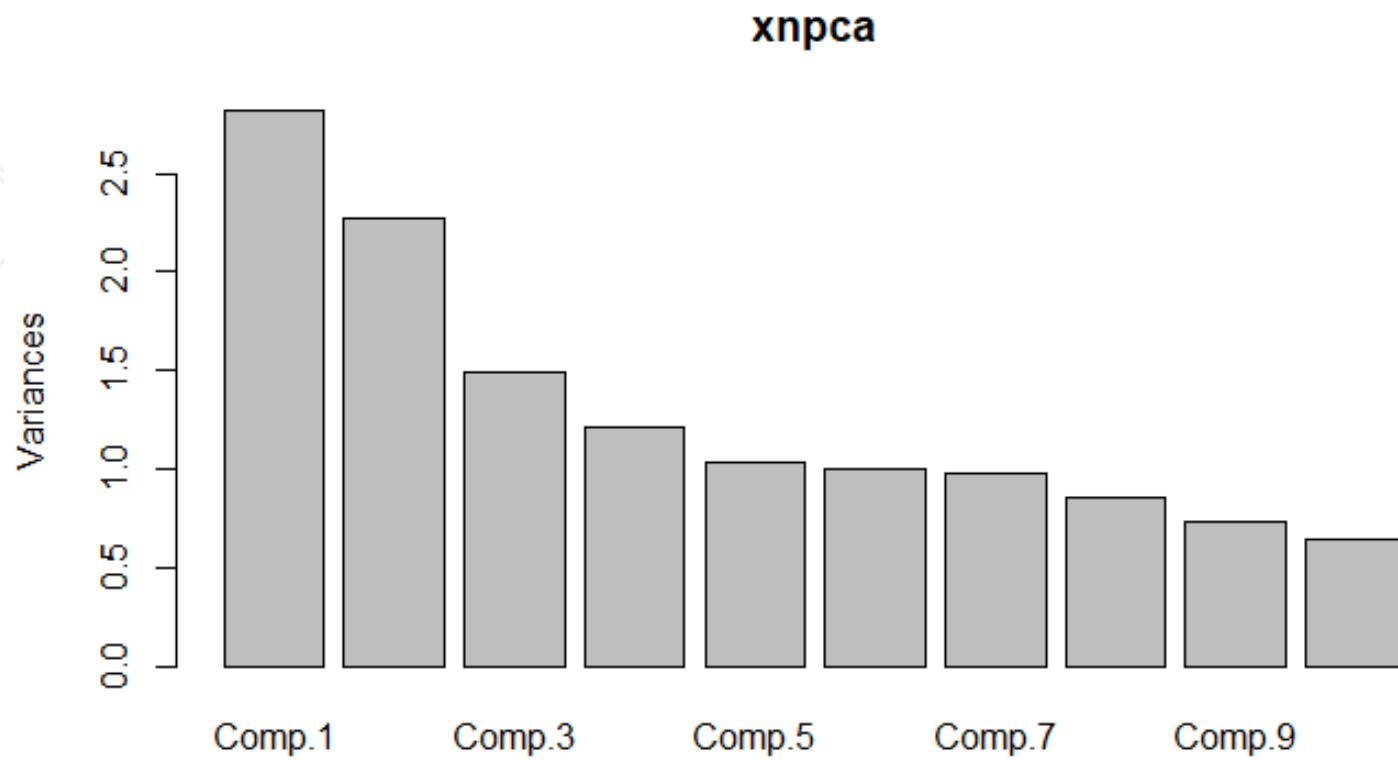
# Numerical Predictors

# Numeric Predictors (HMDA)

**We will use the following methods to find the variables that affect the loan amounts:**

- **Normalized Principal Component Analysis**
- **Factor Analysis**
- **Newton-Raphson Method**
- **Variable Shrinkage**
  - **Lasso**
  - **Elastic Net**
  - **Ridge**

# NPCA (HMDA)



Loadings:

	Comp.1	Comp.2	Comp.3	Comp.4	Comp.5	Comp.6	Comp.7	Comp.8	Comp.9	Comp.10
derived_msa_md	0.108	0.155	0.479	0.356	0.216			0.408		0.379
loan_amount	-0.197	-0.559	0.135					0.187	0.170	
interest_rate			0.139	-0.298	0.145		0.862	-0.178	0.276	
origination_charges		-0.281		0.419	0.146		0.381	-0.120	-0.738	
loan_term		-0.199	-0.146	0.589				-0.510	0.532	
property_value	-0.188	-0.517	0.209	-0.147				0.328	0.138	
income						0.981	-0.134	-0.110		
tract_population	-0.496	0.156	-0.253					0.165		
tract_minority_population_percent		-0.101	-0.596		-0.110	0.107	0.193	0.488	0.168	-0.281
ffiec_msa_md_median_family_income		-0.294	-0.292	-0.442	0.286		-0.130	-0.229		0.489
tract_to_msa_income_percentage	-0.277	-0.165	0.389	-0.114	-0.365			-0.203		-0.471
tract_owner_occupied_units	-0.534	0.207			0.155					
tract_one_to_four_family_homes	-0.477	0.274			0.254					
tract_median_age_of_housing_units	0.232				0.755		-0.175			-0.559
	Comp.11	Comp.12	Comp.13	Comp.14						
derived_msa_md	0.490									
loan_amount	-0.190		0.717							
interest_rate										
origination_charges										
loan_term			-0.167							
property_value	-0.227		-0.667							
income										
tract_population	0.147	0.742		-0.225						
tract_minority_population_percent	0.334	-0.298		0.110						
ffiec_msa_md_median_family_income	0.446	-0.119								
tract_to_msa_income_percentage	0.542	-0.111		-0.152						
tract_owner_occupied_units		-0.148		0.784						
tract_one_to_four_family_homes	-0.181	-0.543		-0.535						
tract_median_age_of_housing_units		0.105								

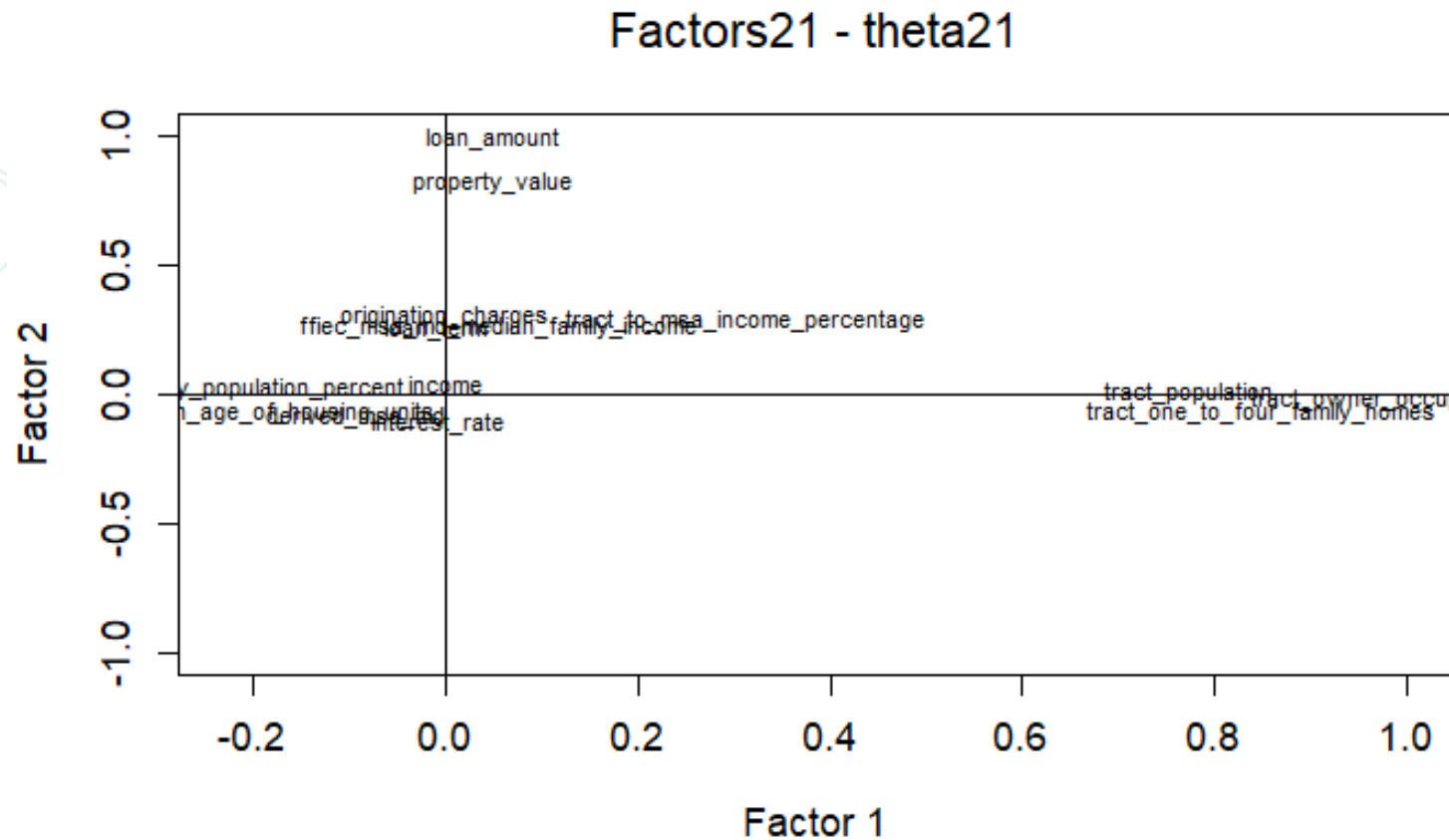
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# NPCA (HMDA)

- The tract population, tract owner-occupied units, and the number of one-to-four family homes show strong negative associations within the first principal component (PC1).
- There is a strong negative association between property value and loan amount within the second principal component (PC2).
- The tract population, tract owner-occupied units, one-to-four family homes, property value, and loan amount are the most influential within the data.



# Factor Analysis (HMDA)



# Factor Analysis (HMDA)

- Tract population, tract one-to-four family homes, and tract owner occupancy have a positive association in the first factor.
- The loan amount and property value have the most significant association in the second factor.
- Comparing these results to those from NPCA, we find that the factors align with the principal components, with the same variables being grouped together in each factor.

# Newton-Raphson Method (HMDA)

- The most significant impact on the loan amount was income
  - This is expected, as a person's income directly influences how much they can borrow.
- The next most influential predictors are property value, origination charges, and loan term.

	0.0359
derived_msa_md	0.0409
interest_rate	0.0440
origination_charges	0.1539
loan_term	0.1473
property_value	0.6551
income	45.2324
tract_population	-0.0337
tract_minority_population_percent	-0.0280
ffiec_msa_md_median_family_income	0.0250
tract_to_msa_income_percentage	0.0084
tract_owner_occupied_units	0.0439
tract_one_to_four_family_homes	-0.0149
tract_median_age_of_housing_units	-0.0019

# Lasso Variable Shrinkage (HMDA)

- Income is the most significant predictor of loan amount as well as property value, origination charges, and loan term.
- All other variables have minimal or no effect on the loan amount.

```
tract_minority_population_percent -0.0315
...2 0.0000
tract_population 0.0000
tract_one_to_four_family_homes 0.0000
tract_median_age_of_housing_units 0.0000
tract_owner_occupied_units 0.0022
tract_to_msa_income_percentage 0.0064
ffiec_msa_md_median_family_income 0.0153
derived_msa_md 0.0235
interest_rate 0.0258
(Intercept) 0.0433
loan_term 0.1419
origination_charges 0.1490
property_value 0.6514
income 44.5521
```



# Ridge Variable Shrinkage (HMDA)

- As with Lasso, the income remains the most influential predictor followed by the property value, origination charges, and loan term.

```
tract_population -0.0315
tract_minority_population_percent -0.0273
tract_one_to_four_family_homes -0.0115
tract_median_age_of_housing_units -0.0029
...5 0.0000
tract_to_msa_income_percentage 0.0124
ffiec_msa_md_median_family_income 0.0263
(Intercept) 0.0383
derived_msa_md 0.0387
tract_owner_occupied_units 0.0393
interest_rate 0.0432
loan_term 0.1452
origination_charges 0.1529
property_value 0.6427
income 45.9669
```

# Elastic Net Variable Shrinkage (HMDA)

- As before, the income serves as the most significant variable followed by the property value, origination charges, and loan term.

```
tract_minority_population_percent -0.0313
...2 0.0000
tract_population 0.0000
tract_one_to_four_family_homes 0.0000
tract_median_age_of_housing_units 0.0000
tract_owner_occupied_units 0.0030
tract_to_msa_income_percentage 0.0087
ffiec_msa_md_median_family_income 0.0167
derived_msa_md 0.0243
interest_rate 0.0273
(Intercept) 0.0439
loan_term 0.1413
origination_charges 0.1491
property_value 0.6455
income 45.0145
```



# Categorical Predictors

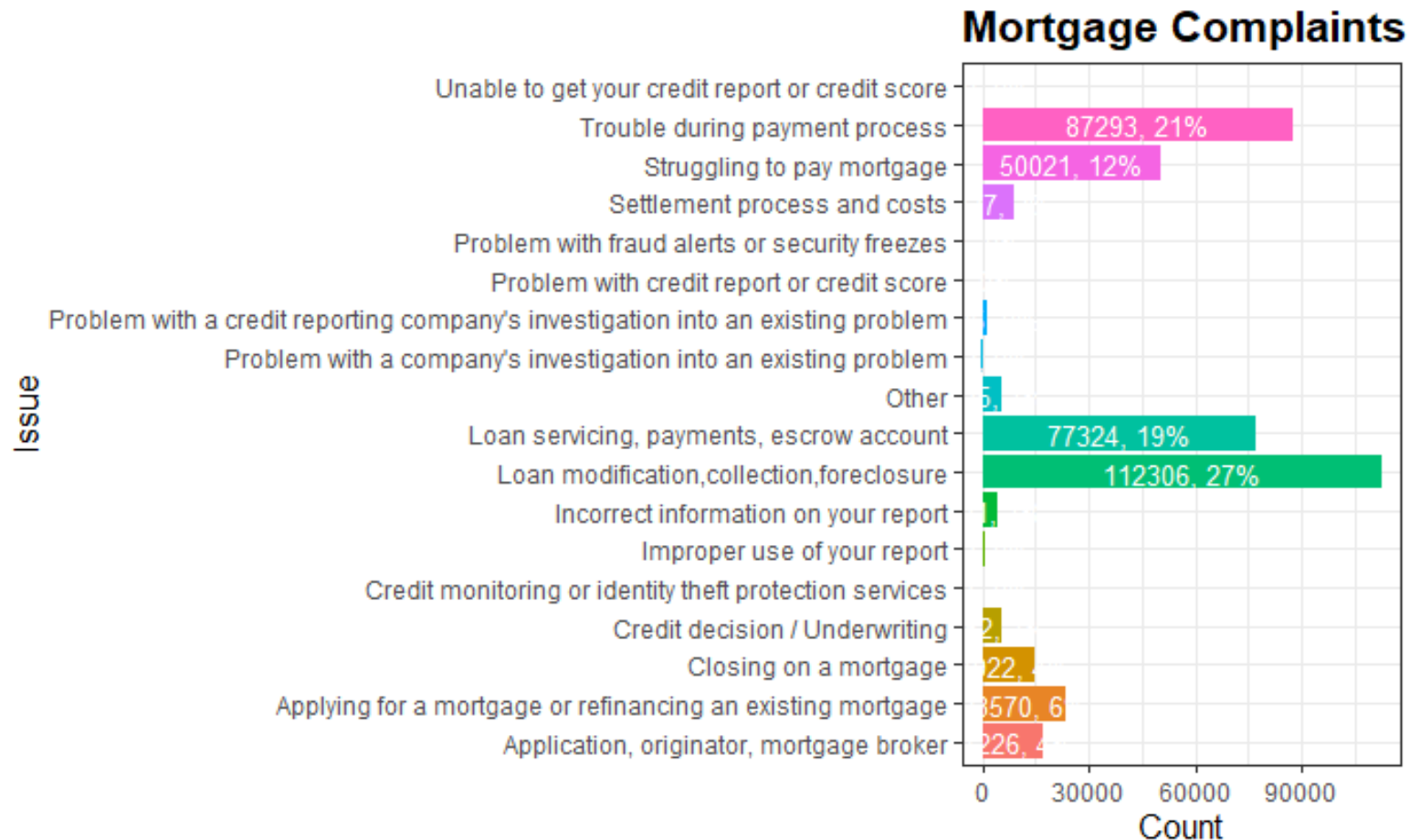
# Categorical Predictors (HMDA)

1. Using Stepwise Forward Feature Selection, the top three variables that had the greatest positive influence on the borrowing amount all included the occupancy type for the loan.
  - Specifically, type 3 and type 1 occupancy type.
2. Thus, whether the mortgage is for a house that is primary residence, or a house that will be used as an investment property, it may lead to higher loan amounts.



# Categorical Predictors (Complaints)

A visualization of the most common complaints.



# Categorical Predictors (Complaints)

## 1. The three most reported complaints for mortgages included:

- Loan Modifications, Collections, and Foreclosures
- Trouble during payment process
- Loan Servicing, Payments, Escrow Accounts

## 2. Financial institution should offer:

- More flexible payment options for customers
- Offer services to counsel homeowners in the best options for buying a house.

# References

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# Thank you

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