# Introduction

The American dream of homeownership is not only the key to build a stable platform for one’s family and wealth accumulation but also a core element of building connected communities and a stronger economy. Homeownership entails responsible individuals, enables more control over lives and increases a sense of well-being and civic involvement (volunteer work and community engagements). Studies also suggest a lower crime rate and drug usage among homeowners. Successful mortgage approval is more often a primary key to an individual’s ability to buy a home.

Although mortgage lending decisions should be primarily based on applicant’s worthiness to make the repayments and on the sufficiency that underpinning collateral is granting enough protection to the mortgage lender that makes the risk viable, not all Americans experience the same access and equal opportunities to mortgages. According to the US Census Bureau of Housing Vacancy and Homeownership, in 1990 overall homeownership rate was 64.2% while the same was 75.2%, 43.4% and 42.4% for Non-Hispanic White (**White**), Non-Hispanic Black (**Black**) and Hispanic individuals respectively[1].

One of the primary reason behind this divide among ownership rates is the racial discrimination in mortgage lending decisions. Multiple laws are developed to curb this racial disparity that deprives minority races of an opportunity to become a cohesive part of America, however, the divide continues to exists. Therefore, it is imperative to understand/study this racial divide in mortgage lending practices.

We aim to explore racial disparities in mortgage lending decisions by researching: Impact of race on mortgage loan approval? And whether racial discrimination varies within similarly able applicant’s characteristics. Our study contributes to the existing body of knowledge by providing the empirical evidence for the existence of the racial divide. It answers questions such as: Do Non-Hispanic Whites have higher approval rate from Non-Hispanic Blacks or Hispanic? What is the probability of loan approval for Married and similarly able White applicant in comparison to Black or Hispanic counterpart?

In our research, we estimate mortgage lending approval (Approve or Reject) after controlling for Loan-to-Value percentage, Other Obligations, Marital Status and Credit Guidelines across White, Black and Hispanic individuals. We find loan approval to be positively biased for White applicants in comparison to Black and Hispanic counterparts i.e. odds of loan approval for White applicants is at least 2 times greater in comparison to Black and Hispanic counterparts.

# Econometrics Model and Estimation Method

We aim to estimate Mortgage Lending Decision for individuals among various races, and since the outcome is binary i.e. Loan Approve or Loan Reject, it is more appropriate to use Logit and Probit models. We use Maximum Likelihood Estimation method to estimate parameters in both of our models. Our model comprises of the following independent variables: Loan amount to Value(**LTV**), Other Obligations(**DTI** - debt-to-income), Credit Guidelines and Marital Status.

We use Loan-to-Value in percentage rather than the proportion to obtain more meaningful odds ratios from the Logit Model. To account for racially discriminating behavior in loan approval practices, we find Credit Guidelines as an appropriate indicator. In order to differentiate between a single applicant and joint applicants, we use Marital status as an independent variable in our model. After we control for LTV, DTI and Marital Status, our model enables us to estimate mortgage lending decision among three different Races: Non-Hispanic White (Reference Category), Hispanic and Non-Hispanic Black.

# Data

Our data is a subset of the data that was collected in 1990 by financial institutions operating in the Boston Metropolitan Statistical Area (MSA) upon the request of Federal Reserve Bank of Boston [2]. This data is a city level random sample of household units; while we aim to estimate the approval probability at an individual level. Therefore, our data set is a subset of original Boston city data at an individual level. This data includes loan application specific characteristics such as race/ethnicity, marital status, gender, creditworthiness, other obligations and loan amount to value.

To free our data set from inconsistencies, we exclude records where: Gender is anything but Male or Female, Marital Status is anything but Married or Single and Credit history meeting the guidelines is anything but Yes or No, leaving us with 1,969 individuals from the total of 1,989 individuals in the initial dataset. Loan-to-Value measures borrower’s stake in the property. This factor indicates the risk that a lender is taking while lending the money to a borrower. In general, loan-to-value up to 80% is acceptable by traditional mortgage lenders while higher values (e.g. 120% = property value + refurbishment cost) are acceptable by private lenders secured by mortgage insurance. Thus, we have restricted loan-to-value ratio up to 1.2 or 120% (filtering 15 records).

Other obligations are indicators for an individual’s capability to make the repayments (likelihood of default), individual with higher debt-to-income ratio are less likely to repay in time. Conforming lenders like banks are likely to accept DTI in the range of 28% to 36%, while non-conforming lenders like private mortgage lenders (Quicken Loans) will be more flexible and are likely to accept a range of 36% to 44% [2]. To include, all such lenders in our research we are restricting Other Obligations to 50%. This gives us our final sample of 1,916 individuals, which comprise of 85% Non-Hispanic Whites, 5.37% Hispanics and 9.65% Non-Hispanic Blacks.

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| **Table 1: Descriptive Statistics** | | | | |
| **Variable** | **Overall** | **Non-Hispanic White** | **Hispanic** | **Non-Hispanic Black** |
| **Loan Amount To Value (in %)** |  |  |  |  |
| Mean (SD) | 76.26 (17) | 75.01 (17.41) | 84.24 (11.47) | 82.84 (12.81) |
| Min - Max | 2.11 – 120 | 2.11 – 120 | 40.09 – 111.43 | 28.99 – 100.35 |
| **Other Obligations (in %)** |  |  |  |  |
| Mean (SD) | 31.84 (7.27) | 31.53 (7.22) | 32.73 (7.48) | 34.07 (7.16) |
| Min - Max | 0 – 49 | 0 – 49 | 14.60 – 49 | 5.6 – 48 |
| Approve (%) | 88.57% | 91.46% | 79.61% | 68.11% |
| Credit Guidelines (%) | 91.96% | 94.35% | 86.41% | 74.05% |
| Married (%) | 66.13% | 66.15% | 71.84% | 62.7% |
| Sample Size (n) | 1916 | 1628 | 103 | 185 |

Table 1 represents the descriptive statistics of our overall sample dataset and by race/ethnicity. In this table, we observe that on an average loan-to-value is smallest for Whites(75%) in comparison to Blacks(82.8%) and Hispanic(84.2%) individuals. Intuitively this makes sense as White loan applicants, in general, are wealthier, thus have more stakes in the borrowed property.

Furthermore, we observe that the minimum LTV for White applicants is very small 2.11% in comparison to other races i.e. 1.35% of White applicants applied for loan less than 3 standard deviations i.e. LTV < 22.77%. Also, 40.78% of Hispanic applicants have applied for a loan greater than 90% of the property value (LTV > 0.9), while only 20.21% of White applicants applied for the same.

We find that the economic disparity among races is also evident from the minimum DTI in our data set. Hispanic applicants have highest minimum DTI while White applicants have lowest. We observe that White applicants have a loan approval rate of 91.46%, while the same for Blacks and Hispanics is 68.11% and 79.61% respectively. This means that approval rate for Blacks is almost 22 percentage points less than Whites. Also, the approval rate among White applicants who do not meet Credit Guidelines is 28.26% while the same for Blacks and Hispanics is 10.42% and 21.4% respectively. These resonate with our initial hypothesis for racial discrimination in mortgage lending practices. In addition, we find that among all races loan approval rate for Married applicants is higher in comparison to Single Individuals.

# Results

**Logit Model**

Table 2 below represents our lending decision estimates for Logit model. Based on these estimates, we observe that LTV and DTI have a negative relationship with loan approval, which suggests that higher the values of these two variables lower is the probability of loan approval. Also, Marital Status has a positive relationship with loan approval, that means the probability of loan approval of a Married applicant is higher than that of a Single. All three of these variables are statistically significant at 5% level.

Further, we find that Credit Guidelines is statistically significant at 0.1% level and has a positive relationship with loan approval. This makes sense as applicants who meet the credit guidelines will have a higher probability of loan approval. In addition, coefficients on Black (significant at 0.1% level) and Hispanic (significant at 5% level) variables have negative sign thereby meaning that on an average, Whites have a higher probability of loan approval in comparison to Blacks and Hispanics respectively after controlling for other variables in the model.

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| **Table 2: Estimated Logit Model** | | |
|  | Dependent Variable: Approve | |
| **Estimated Co-efficient** | **Odds Ratio** |
| (Intercept) | 0.9808 | 2.667 |
|  | (0.7272) |  |
| Other Obligations(DTI) | -0.0273\* | 0.973 |
|  | (0.0136) |  |
| Loan to Value(LTV) | -0.0163\* | 0.984 |
|  | (0.0071) |  |
| Married | 0.4875\* | 1.628 |
|  | (0.1898) |  |
| Credit Guidelines | 3.8542\*\*\* | 47.190 |
|  | (0.2278) |  |
| Black | -0.9015\*\*\* | 0.406 |
|  | (0.2491) |  |
| Hispanic | -0.7210\* | 0.486 |
|  | (0.3410) |  |
| No. of Observations | 1916 |  |
| Log-Likelihood | -443.3147 |  |
| *Notes:  Standard Errors are parenthesis.*  *\*\*\* significant at 0.1%, \*\* significant at 1%, \* significant at 5%*  *Reference category is White.* | | |

As seen from the odds ratio in the table above, the variables with an odd ratio less than 1 decrease the odds of loan approval while greater than 1 increases the odds of loan approval. Therefore, controlling for other variables, increase in 1% point in DTI leads to an estimated decrease of 2.7% in the odds of approval. Similarly, holding everything else constant, increase in 1% point in LTV leads to an estimated decrease of 1.6% in the odds of approval.

Controlling for other variables, married applicants face an estimate of 1.63 times greater odds of loan approval than Single applicants; while applicants who meet the credit guidelines have an estimate of 47.19 times higher odds of loan approval than the applicants who do not meet the credit guidelines. We find that after controlling for all other variables, odds of loan approval for White applicants are 2.46 times and 2.06 times greater in comparison to Blacks and Hispanics respectively. This provides evidence to reject our null hypothesis (H0 = Racial Discrimination doesn’t exist) wherein White applicants are being favored for loan approval while Blacks and Hispanics are denied more often.

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| **Table 3**: Predicted Probability of Loan Approval (Logit Model) | | | |
|  | **Race** | | |
|  | White | Hispanic | Black |
| Married & Meeting Credit Guidelines | 0.9603 | 0.9217 | 0.9076 |
| Married & Not Meeting Credit Guidelines | 0.3390 | 0.1996 | 0.1723 |
| Single & Meeting Credit Guidelines | 0.9370 | 0.8785 | 0.8578 |
| Single & Not Meeting Credit Guidelines | 0.2395 | 0.1328 | 0.1134 |
| Note: Mean DTI: 32.39% , Mean LTV: 77.03 %  DTI and LTV are evaluated at the mean of the entire valid data set | | | |

Table 3 represents the predicted probability of some prototypical individuals across different races from Logit model. This table again resonates that Black and Hispanic applicants are less likely to receive loan approval in comparison to their White counterparts. We observe that White Married applicants who do not meet the credit guidelines (with DTI and LTV evaluated at the mean of entire valid data set) have approximately 17% point higher probability of loan approval than similar Black applicants. However, the gap is narrow for White Married applicants who meet credit guidelines (with DTI and LTV evaluated at the mean) i.e. 6% point in comparison to similar Black applicants.

**Probit Model**

Table 4 details the estimates from the Probit model. All the coefficient estimates in this model follow same sign (hence similar relationship direction) and statistical significance as in Logit model estimates apart from DTI. We find that DTI in this model is statistically significant only at 10% level. Since in both of our models coefficient estimates have same sign and these relationship directions make sense in the real world, we conclude that our estimates from both models are robust.

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| **Table 4: Estimated Probit Model** | |
|  | Dependent Variable: Approve |
| **Estimated Co-efficient** |
| (Intercept) | 0.3005 |
|  | (0.3533) |
| Other Obligations(DTI) | -0.0126. |
|  | (0.0067) |
| Loan to Value(LTV) | -0.0077\* |
|  | (0.0033) |
| Married | 0.2400\* |
|  | (0.0936) |
| Credit Guidelines | 2.2202\*\*\* |
|  | (0.1269) |
| Black | -0.4646\*\*\* |
|  | (0.1308) |
| Hispanic | -0.3771\* |
|  | (0.1744) |
| No. of Observations | 1916 |
| Log-Likelihood | -443.148 |
| *Notes:  Standard Errors are in parenthesis.*  *\*\*\* significant at 0.1%, \* significant at 5%, . significant at 10%*  *Reference category is White.* | |

Table 5 represents the predicted probability of some prototypical individuals across different races from Probit model. Similar to Logit model racial discrimination is also apparent from these results. White Single applicants who do meet the credit guidelines are approximately twice as likely to receive loan approval than similar Black and Hispanic applicants (with DTI and LTV evaluated at the mean). Further, White Single applicants who meet the credit guidelines have 8% point and 6% point higher probability of loan approval than their Black and Hispanic counterparts.

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| **Table 5**: Predicted Probability of Loan Approval (Probit Model) | | | |
|  | **Race** | | |
|  | White | Hispanic | Black |
| Married & Meeting Credit Guidelines | 0.9610 | 0.9171 | 0.9029 |
| Married & Not Meeting Credit Guidelines | 0.3237 | 0.2020 | 0.1782 |
| Single & Meeting Credit Guidelines | 0.9361 | 0.8740 | 0.8550 |
| Single & Not Meeting Credit Guidelines | 0.2428 | 0.1413 | 0.1226 |
| Note: Mean DTI: 32.39%, Mean LTV: 77.03 %  DTI and LTV are evaluated at the mean of the entire valid data set | | | |

# Conclusion

Our study concludes on the existence of racial discrimination in Mortgage Lending Practices. Furthermore, this racial discrimination exists even across a spectrum of equal potential applicants (statistically significant estimates and viable probabilities) i.e. Whites have a higher probability of loan approval than their Black and Hispanic counterparts.

Historically, US is struggling to implement fair mortgage lending practices across the board to eliminate racial bias and provide equal opportunities to minorities. In 1990, the mortgage approval rate for White applicants was twice as much as for the Blacks (our research) and even after three decades, Blacks still face denial rate twice high as that of Whites (2013 – Denial rate Blacks: 24%, Hispanics: 20% and Whites: 12%) [3].

We find that, after controlling for loan-to-value, other obligations, marital status and credit guidelines, Whites are favored most in loan approval while a higher percentage of Black and Hispanic applicants are denied the same. We also find evidence of racial discrimination even within various loan applicant’s characteristics.

The extent of racial discrimination in Mortgage Lending practices is not fully explained by our research owing to missing specification like applicant’s education level, age, family size, income stability, property location, loan term and loan type – fixed or floating etc. that can have a major impact on the loan approval. We find our initial beliefs of racial discrimination in US mortgage Lending Practices to be valid from this study (statistically significant results and viable probabilities).

# References

[1] https://www.census.gov/data/tables/time-series/dec/coh-owner.html; https://www.census.gov/hhes/www/housing/census/historic/ownrate.html

[2] http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.489.6540&rep=rep1&type=pdf

[3] https://www.urban.org/sites/default/files/publication/33501/2000031-A-Better-Measure-of-Mortgage-Application-Denial-Rates.pdf

[4] https://www.ffiec.gov/hmcrpr/hmda03.pdf#table1