

A photograph of a family walking through a doorway. A woman with curly hair is in the center, holding the hand of a young girl in denim overalls. A young boy is walking ahead of them, carrying a backpack. They are walking from a darker room into a brighter room with large windows. The image has a dark blue overlay.

Deloitte.

Improving the Effectiveness & Fairness of Loan Requests

Team 1

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Variable Selection



Median
Home Value



Avg Credit
Score



Mortgage to
Income

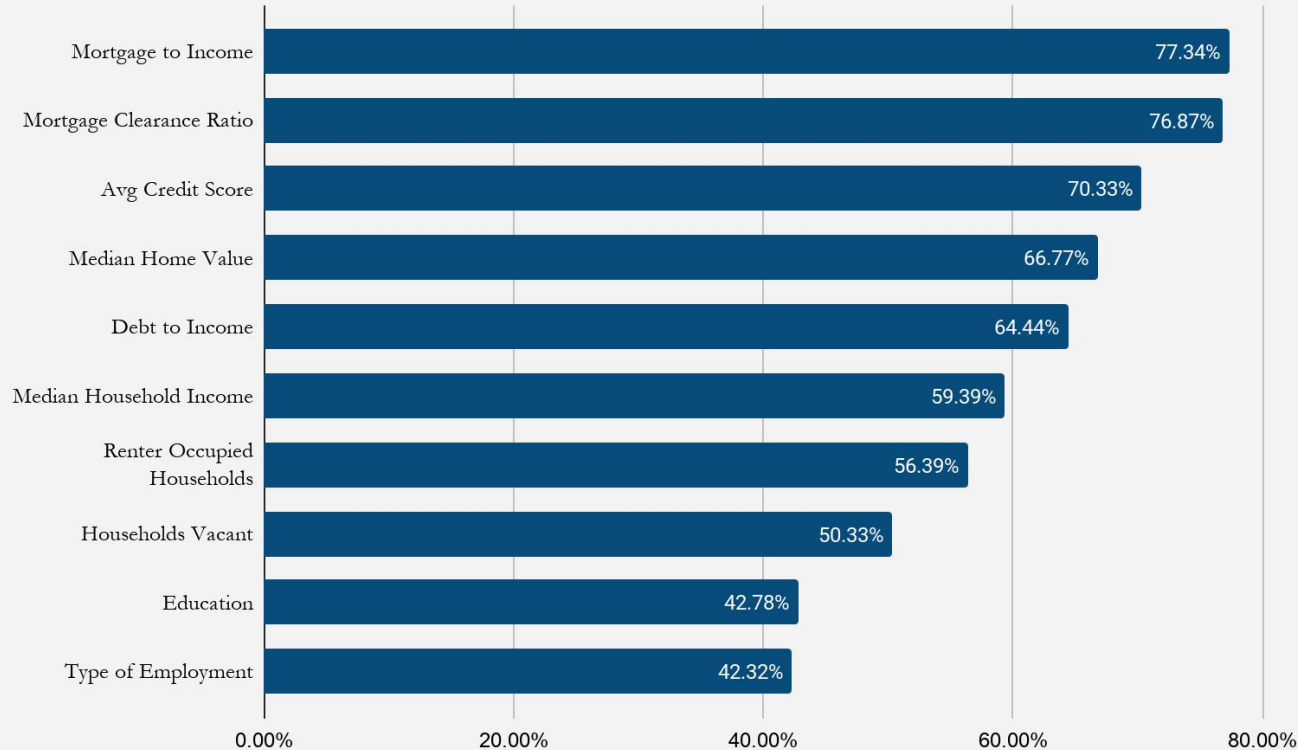


Mortgage
Clearance Ratio



Debt to
Income

Analytical Hierarchy Process



CRITERIA CONSIDERED

Efficiency
Compliance with Fair
Housing Act
Ability to reduce disparate
impact



Using a cutoff at 60%, we
selected our 5 criteria from
the highest scoring
variables in our AHP
output.

Our Created Variables

MORTGAGE CLEARANCE RATIO

Ratio of Cleared
Mortgages to Total
Number of Mortgages

By creating a relative
measure of mortgage
clearance, we can
prohibit discrimination
against larger
communities in
compliance with the
Fair Housing Act

MORTGAGE TO INCOME

Ratio of Median Home
Value to Median
Household Income

Using this metric in
place of median
household income
improves fairness by
**minimizing the
disparate impact** on
lower income markets

DEBT TO INCOME

Average Debt to
Income Ratio for Each
Location in the Data

Most commonly used
measure for mortgage
lending, adding the
objective measure will
improve effectiveness



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Thank You!
Questions

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Appendix

Appendix A

Personal Finance • Sincerely, Michelle

Credit scores are supposed to be race-neutral. That's impossible.

Blacks must make extraordinary efforts to overcome the discrimination that is often hidden in financial policies or products that are supposed to be bias-free

“The credit score is supposed to eliminate bias. ... But factors that are included or excluded in the algorithms used to create a credit score can have the same effect as lending decisions made by prejudiced White loan officers.”

“And, by the way, racist policies thwart Blacks no matter how responsible they are.”

<https://www.washingtonpost.com/business/2020/10/16/how-race-affects-your-credit-score/>

Appendix B

Snapshot: Overall Mortgage Debt

	2010	2019	2020	2019-2020 Change
Total outstanding debt	\$8.1 trillion	\$9.6 trillion	\$10.3 trillion	+\$703 billion (7%)
Total number of accounts	51.1 million	54.6 million	56.1 million	+1.5 million (3%)

Source: Experian

Since the Great Recession in the late 2000s, overall mortgage debt has ebbed and flowed, with the trend of growth seen in the past seven years coming on the heels of a half-decade contraction that preceded it. In 2008, mortgage debt hit a peak at \$8.7 trillion. Overall mortgage debt decreased for the five years that followed, shrinking to \$7.7 trillion in 2013.

Then, mortgage debt began a steady rebound, growing by \$2.6 trillion to where it stood as of Q3 2020. For context, that growth eclipses the sum total of all student loan and credit card debt combined, and it happened in just seven years.

Average Consumer FICO® Scores

	2019	2020
Average FICO® Score for consumers with a mortgage	747	753
Average FICO® Score among all consumers	703	710

Source: Experian

Consumers Increase Individual Mortgage Debt by 2%

In line with the past decade of overall growth, average individual consumer balances grew in 2020, rising to \$208,185, according to Experian data. Unlike the rise in overall debt, individual balances increased at a rate of 2%, which is similar to the annual growth seen over the past decade. Even with the moderate growth, individual mortgage balances are still the highest they have ever been.

Snapshot: Individual Mortgage Debt

	2010	2019	2020	2019-2020 Change
Avg. mortgage balance	\$187,802	\$203,296	\$208,185	+\$4,889 (+2%)

Source: Experian

As of 2020, approximately 44% of U.S. consumers have a mortgage. That's unchanged since 2019, according to Experian data. While the slice of the population with a home loan didn't change, average mortgage balances are up, which shows that consumers may be borrowing more than usual.

Appendix C

Year	Quarter	Metropolitan Statistical Areas	Debt-to-Income Ratio Low	Debt-to-Income Ratio High
2020	3	Abilene, TX (Metropolitan Statistical Area)	1.26	1.37
2020	3	Akron, OH (Metropolitan Statistical Area)	1.26	1.37
2020	3	Albany, GA (Metropolitan Statistical Area)	1.02	1.15
2020	3	Albany, OR (Metropolitan Statistical Area)	2.1	2.57
2020	3	Albany-Schenectady-Troy, NY (Metropolitan Statistical Area)	1.15	1.26
2020	3	Albuquerque, NM (Metropolitan Statistical Area)	1.63	1.81
2020	3	Alexandria, LA (Metropolitan Statistical Area)	1.37	1.49
2020	3	Allentown-Bethlehem-Easton, PA-NJ (Metropolitan Statistical Area)	1.49	1.63
2020	3	Altoona, PA (Metropolitan Statistical Area)	1.02	1.15
2020	3	Amarillo, TX (Metropolitan Statistical Area)	1.15	1.26
2020	3	Ames, IA (Metropolitan Statistical Area)	0.51	1.02
2020	3	Anchorage, AK (Metropolitan Statistical Area)	1.81	2.1
2020	3	Ann Arbor, MI (Metropolitan Statistical Area)	0.51	1.02
2020	3	Anniston-Oxford-Jacksonville, AL (Metropolitan Statistical Area)	1.26	1.37
2020	3	Appleton, WI (Metropolitan Statistical Area)	1.15	1.26
2020	3	Asheville, NC (Metropolitan Statistical Area)	1.81	2.1
2020	3	Athens-Clarke County, GA (Metropolitan Statistical Area)	1.26	1.37
2020	3	Atlanta-Sandy Springs-Roswell, GA (Metropolitan Statistical Area)	1.49	1.63
2020	3	Atlantic City-Hammonton, NJ (Metropolitan Statistical Area)	1.37	1.49
2020	3	Auburn-Opelika, AL (Metropolitan Statistical Area)	2.1	2.57

https://www.federalreserve.gov/releases/z1/dataviz/household_debt/

Appendix D

Your income. You can get a very rough estimate of your affordable home price range by multiplying your annual gross income by 2.5 (this, of course, varies depending on current interest rates, your debt and credit history).

Your credit. Generally speaking, the better your credit, the lower the cost of obtaining credit and the greater your financing options.

Current mortgage rates. Although mortgage rates are rising, they're still low – making homeownership affordable for many.

Your downpayment. You don't *need* to put 20% down, as commonly believed. In fact, the average down payment for first-time homebuyers in 2017 was 5%, and 10% for repeat buyers, according to the National Association of REALTORS®. What's more, it's possible to put down *as little as 3%*.

The type of home. If you're looking to buy a condominium, keep in mind that rates are typically higher for these loans and you'll have to budget for the cost of your monthly condominium fee.

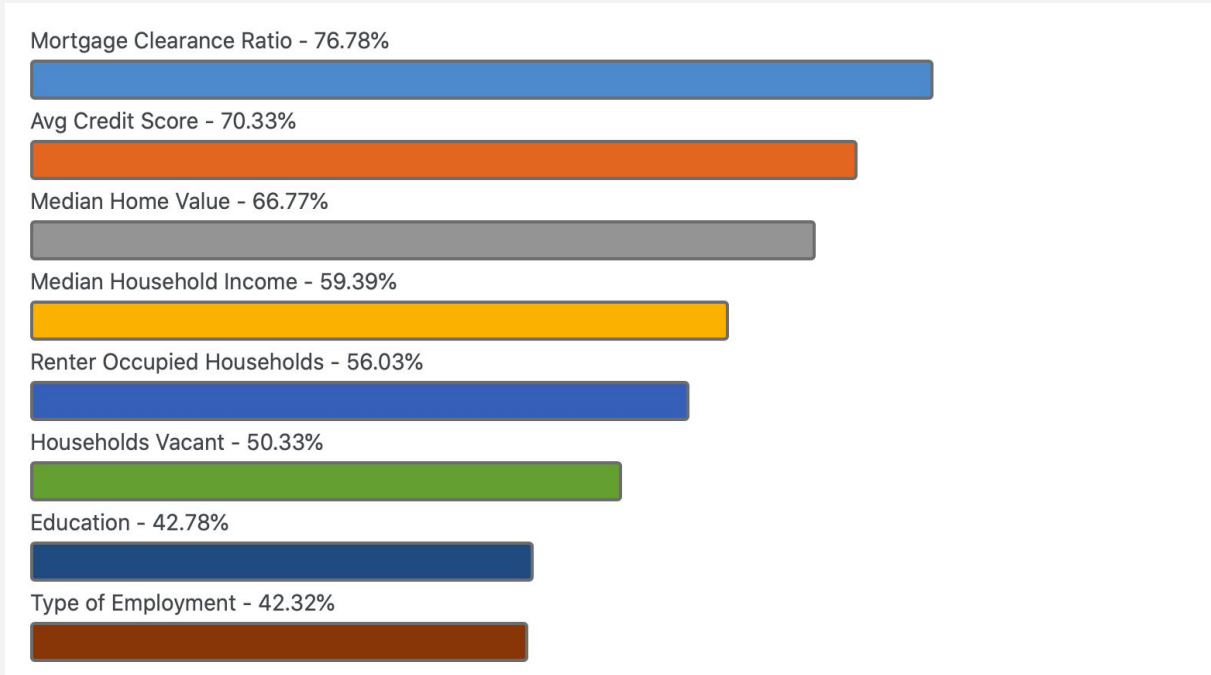
Fees and closing costs. Remember to factor in the expenses and fees you will incur for a home appraisal, a home inspection, and other professional services required to buy a home. However, in some cases, the appraisal can be waived.

The Housing Expense Ratio = Ideally, your mortgage payment (principal, interest, taxes and mortgage insurance) should be less than 28% of your monthly gross income.

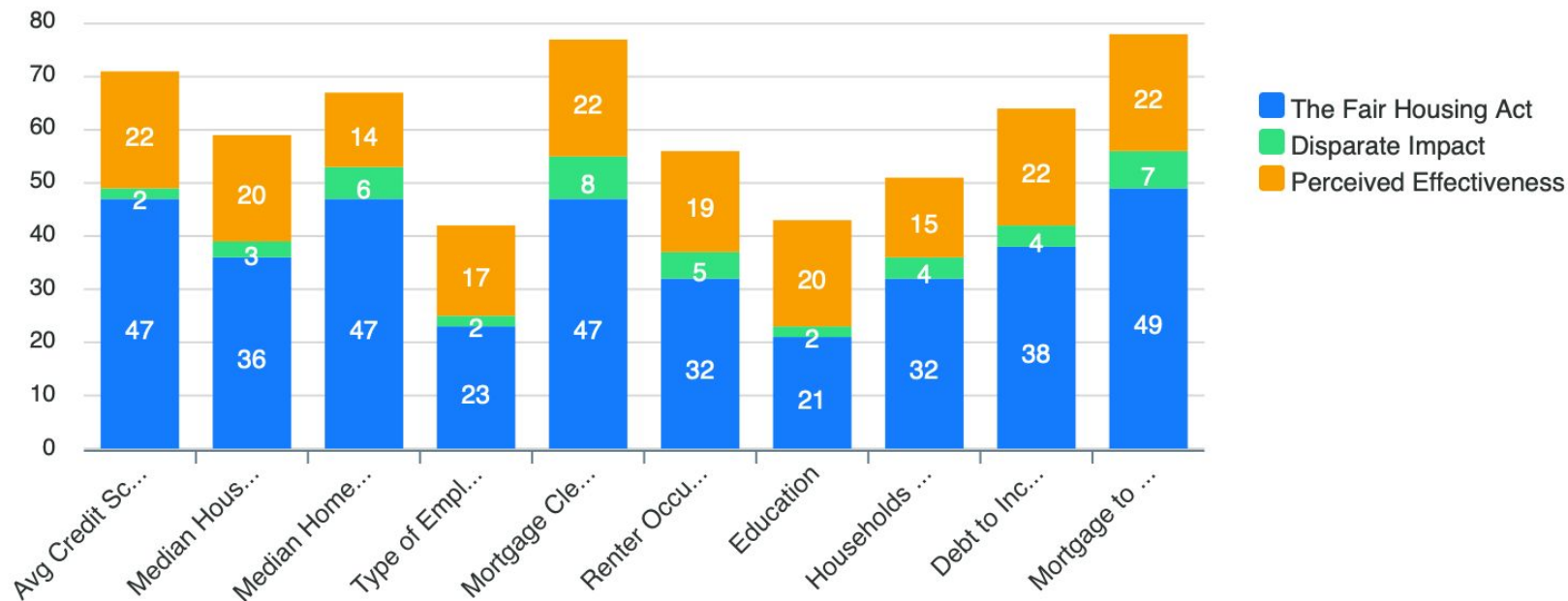
The Debt-to-Income Ratio = In most instances, your combined debt (credit cards, student loans, alimony, child support, car loans and housing expenses) should be less than 45% of your monthly gross income.

https://myhome.freddiemac.com/blog/homeownership/20181128_how_much_can_you_afford.page?

Appendix E



Appendix F



Appendix G

Mortgage to Income is your highest rating alternative!

Select the alternative you want and click save to make your decision.

Mortgage to Income : 77.34%

Mortgage Clearance Ratio : 76.78%

Avg Credit Score : 70.33%

Median Home Value : 66.77%

Debt to Income : 64.44%

Median Household Income : 59.39%

Renter Occupied Households : 56.03%

Households Vacant : 50.33%

Education : 42.78%

Type of Employment : 42.32%

Back

Clear Selection

Save

Appendix H

City	FINAL CREDIT SCORE	DTI Score	MTI Score	TOTAL SCORE	WEIGHTED SCORE	y
Montgomery	0.5	0.75	0.25	1.5	1.0283	1
Tuscaloosa	0.25	0.75	0.75	1.75	1.239175	1
Birmingham-Hoover	0.25	0.75	0.75	1.75	1.239175	1
Huntsville	0.5	0.75	0.75	2	1.415	1
Fresno	0.25	0.25	0.25	0.75	0.530275	1
Sacramento--Roseville--Arden-Arcade	0	0.25	0	0.25	0.1611	1
San Jose-Sunnyvale-Santa Clara	0	1	0	1	0.6444	0
Chico	0	0.25	0	0.25	0.1611	0
Greeley	0	0	0.25	0.25	0.19335	0
Gainesville	0	0.75	0.75	1.5	1.06335	1
Port St. Lucie	0	0	0	0	0	0
Cape Coral-Fort Myers	0	0	0.25	0.25	0.19335	0
Crestview-Fort Walton Beach-Destin	0	0	0.75	0.75	0.58005	0
Urban Honolulu	0	0	0	0	0	0
Chicago-Naperville-Elgin	0	0.75	0.75	1.5	1.06335	0
Lafayette-West Lafayette	0.25	0.75	0.75	1.75	1.239175	0
Fort Wayne	0.25	0.75	0.75	1.75	1.239175	1
South Bend-Mishawaka	0.5	0.75	0.75	2	1.415	1
Des Moines-West Des Moines	0.25	0.75	0.75	1.75	1.239175	0
Topeka	0	1	1	2	1.4178	0
Louisville/Jefferson County	0.25	0.75	0.25	1.25	0.852475	0
Shreveport-Bossier City	0.75	0.25	0.75	1.75	1.268625	0
New Orleans-Metairie	0.75	0.75	0.75	2.25	1.590825	0
Baton Rouge	0.25	0.75	0.25	1.25	0.852475	0
Flint	0.25	0.25	0.75	1.25	0.916975	1

Appendix I

Lansing-East Lansing	0	0.75	0.75	1.5	1.06335	0
Grand Rapids-Wyoming	0	0.75	0.75	1.5	1.06335	0
Duluth	0	0.75	0.75	1.5	1.06335	0
Minneapolis-St. Paul-Bloomington	0	0.75	0.75	1.5	1.06335	0
Jackson	0.75	0.75	0.75	2.25	1.590825	0
St. Louis	0.25	0.75	0.75	1.75	1.239175	0
Lincoln	0.25	0.75	0.75	1.75	1.239175	1
Buffalo-Cheektowaga-Niagara Falls	0.25	1	0	1.25	0.820225	1
Rochester	0.25	0.75	0.75	1.75	1.239175	1
New York-Newark-Jersey City	0.25	0.75	0.75	1.75	1.239175	1
Fayetteville	0.5	0	0.25	0.75	0.545	0
Raleigh	0	0.25	0.75	1	0.74115	0
Columbus	0	0.75	0.75	1.5	1.06335	0
Cincinnati	0	0.75	0.75	1.5	1.06335	0
Youngstown-Warren-Boardman	0.5	0.75	0.75	2	1.415	1
Portland-Vancouver-Hillsboro	0	0.25	0.25	0.5	0.35445	1
Allentown-Bethlehem-Easton	0.25	0.25	0.75	1.25	0.916975	1
Philadelphia-Camden-Wilmington	0.25	0.75	0.75	1.75	1.239175	1
Providence-Warwick	0.25	0.25	0.25	0.75	0.530275	1
Myrtle Beach-Conway-North Myrtle Beach	0	0	0.75	0.75	0.58005	1
Sioux Falls	0	0.75	0.75	1.5	1.06335	1
Kingsport-Bristol-Bristol	0.25	0.75	0.25	1.25	0.852475	1
Brownsville-Harlingen	0.5	0.75	0.25	1.5	1.0283	1
Killeen-Temple	0.25	0.25	0.75	1.25	0.916975	1
San Antonio-New Braunfels	0.5	0.25	0.25	1	0.7061	1
Amarillo	0.25	0.75	0.75	1.75	1.239175	1
Dallas-Fort Worth-Arlington	0.25	0.75	0.75	1.75	1.239175	1
Salt Lake City	0	0.75	0.75	1.5	1.06335	1
Virginia Beach-Norfolk-Newport News	0.25	0	0.75	1	0.755875	1
Yakima	0.25	0.75	0.25	1.25	0.852475	1

Appendix J

Buffalo-Cheektowaga-Niagara Falls	0.25	1	0	1.25	0.820225	1
Rochester	0.25	0.75	0.75	1.75	1.239175	1
New York-Newark-Jersey City	0.25	0.75	0.75	1.75	1.239175	1
Fayetteville	0.5	0	0.25	0.75	0.545	0
Raleigh	0	0.25	0.75	1	0.74115	0
Columbus	0	0.75	0.75	1.5	1.06335	0
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Sioux Falls	0	0.75	0.75	1.5	1.06335	1
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Brownsville-Harlingen	0.5	0.75	0.25	1.5	1.0283	1
Killeen-Temple	0.25	0.25	0.75	1.25	0.916975	1
San Antonio-New Braunfels	0.5	0.25	0.25	1	0.7061	1
Amarillo	0.25	0.75	0.75	1.75	1.239175	1
Dallas-Fort Worth-Arlington	0.25	0.75	0.75	1.75	1.239175	1
Salt Lake City	0	0.75	0.75	1.5	1.06335	1
Virginia Beach-Norfolk-Newport News	0.25	0	0.75	1	0.755875	1
Yakima	0.25	0.75	0.25	1.25	0.852475	1
Bellingham	0	0	0.25	0.25	0.19335	1
Green Bay	0	0.75	0.75	1.5	1.06335	1

Appendix K

```
      Min      1Q   Median      3Q      Max
-1.9085 -0.8727  0.3052   0.8095   2.2688

Coefficients: (1 not defined because of singularities)
              Estimate Std. Error z value Pr(>|z|)
(Intercept)    -2.437e+00  4.636e+00  -0.526   0.599
`Avg Sq Ft`      1.736e-03  2.082e-03   0.834   0.404
`Avg Credit Score` 8.790e-03  6.787e-03   1.295   0.195
Median_House_Hold_Income -3.940e-05  4.043e-05  -0.975   0.330
Median_Home_Value  4.023e-06  6.851e-06   0.587   0.557
Employment_Full_Time  2.789e-03  3.429e-03   0.813   0.416
Employment_Part_Time  3.518e-03  3.914e-03   0.899   0.369
Employment_No_Earnings  3.067e-03  3.496e-03   0.877   0.380
`Mortgage Clearance Rate` -8.110e+00  5.675e+00  -1.429   0.153
Renter_Occupied_Households -5.342e-04  8.679e-04  -0.615   0.538
House_Holds_Vacant    -9.471e-04  2.170e-03  -0.437   0.662
No_Highschool    -2.936e-03  4.755e-03  -0.618   0.537
Highschool    -3.299e-03  3.588e-03  -0.919   0.358
Associate_Degree -4.412e-03  5.278e-03  -0.836   0.403
Bachelors_Degree -3.312e-03  5.737e-03  -0.577   0.564
Masters    -3.612e-03  4.703e-03  -0.768   0.442
Professional -1.463e-03  7.256e-03  -0.202   0.840
Doctorate    -8.590e-03  8.418e-03  -1.021   0.307
`working Population`      NA          NA          NA          NA

(Dispersion parameter for binomial family taken to be 1)

      Null deviance: 78.157  on 56  degrees of freedom
Residual deviance: 57.097  on 39  degrees of freedom
AIC: 93.097
```