
ADU Construction on California Home-Ownership and Wealth

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What is an ADU?

- **Accessory Dwelling Unit (ADU)** is a legal and regulatory term for a secondary house or apartment that shares the building lot of a larger, primary home.
 - they are often used to provide additional income through rent, or to house an additional family member
 - An example could be an elderly lady moving into a smaller unit in the lot of a family's main residence in order to avoid living in an assisted living facility
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Why are ADUs promising?

An innovative, affordable, and effective option for adding much-needed housing in California

- ADUs can provide a **source of income** for homeowners.
 - ADUs are built with **cost-effective wood frame construction**, which is less expensive than constructing regular houses
 - ADUs allow **extended families** to be near one another while maintaining **privacy**.
 - ADUs as one solution to increasing the supply of **affordable housing**.
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The Problem:

Though ADU's address the housing shortage, they may further increase the cost of residential land

- The Survey of Consumer Finances, released in Sept. 2020 by the Federal Reserve, found the median U.S. household net worth is \$121,700. However, the difference between the net worth of homeowners versus renters is staggering.
- In 2019, homeowners in the U.S. had a median net worth of \$255,000, while renters had a net worth of just \$6,300. That's a difference of 40x between the two groups.

source: <https://www.cnbc.com/select/average-net-worth-homeowners-renters/>

The Problem:

- Historical Precedence:
 - Vancouver, B.C, where densification has increased land values but has led to rampant land price speculation and inflation
 - Higher densities may produce more units per parcel, but the higher land values cause the critical measure—the cost per square foot of finished space—to remain the same. “Cheaper” housing simply becomes denser, smaller housing.
 - Even without higher densities, land values tended to rise faster than wages or inflation. (Californians have experienced this firsthand and passed Proposition 13 to put a brake on soaring property taxes.) Urban land is especially scarce and valuable, and becomes even more costly with improved infrastructure and services. Henry George, a famous 19th-century political economist, first described how economic growth and development can accelerate land values and cause homelessness. A hundred years later, Nobel Prize winning economist Joseph Stiglitz confirmed this phenomenon, developing what is known as the “Henry George theorem.”
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California's new ADU laws

- Laws enacted in 2020 and 2021 removed several restrictions around building ADUs (Assembly Bills 86 and 881)
 - **Owner occupancy not required to build**
 - no longer need to live in either the primary home or the unit itself to build an ADU.
 - **Size, lot, and setback requirements eased**
 - **More financial aid**
 - **Faster and easier permitting**
 - Permits must be approved or denied within 60 days - less red tape
 - **Reduced parking requirements**
 - no longer need to provide a replacement parking space

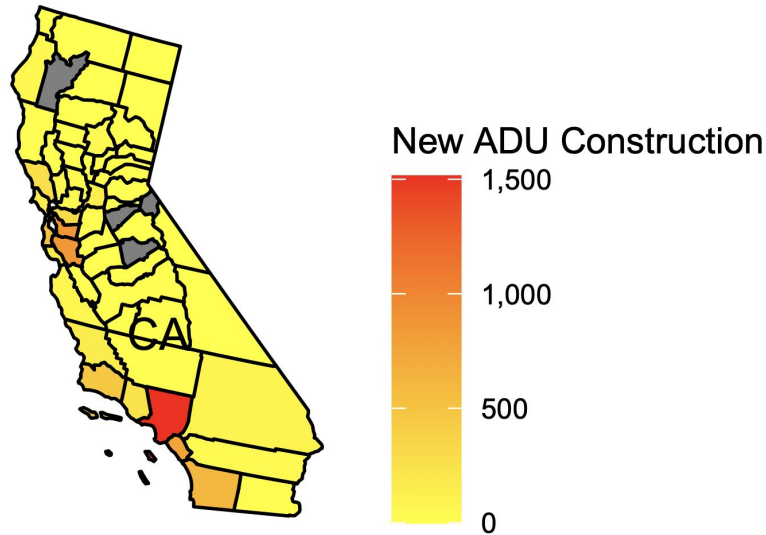
Our Objective

Show correlations between home-ownership and age-adjusted wealth

- Demonstrate that people who are not current home owners will face an even tougher time becoming homeowners (through increased property values)
 - Home ownership is one of the largest sources of retained wealth in the United States with no comparable investment vehicles
 - The people who have the highest ability to capitalize on this regulatory change will see an increase in wealth through both rent and appreciating property values
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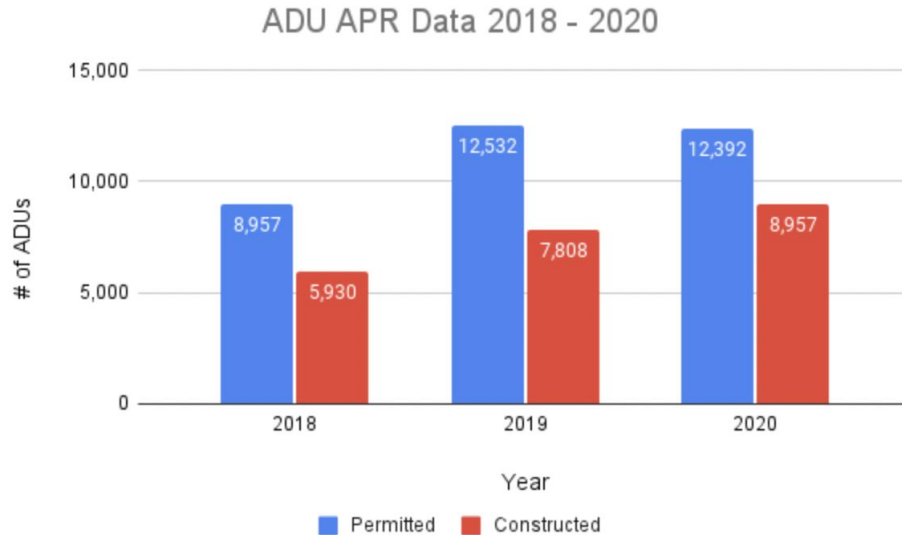
Distribution of ADU Construction in California

Where new ADUs are being built



- A lot of ADU construction is being taken place in areas with high home values and incomes (Los Angeles and San Francisco)
 - A majority of these new ADUs are being constructed in diverse neighborhoods with easy transit access
 - Found that a majority are being constructed by older individuals who are actual homeowners that pay a mortgage for their property
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Increase in ADU Construction



- Permitted ADU construction rose from 8,957 in 2018 to 12,392 in 2020 - a sign of things to come
 - Expected to increase significantly in the coming years after the passing of the new laws in 2021
 - Discrepancy between 'permitted' and 'constructed' expected to fall due to more financial aid for those in the actual construction process
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Our ADU Dataset

| | no_permits | no_constructed | lat | lng | population | density | ranking | population_16_years_and_over_in_labor_force_total_percent_labor_force_parti |
|----|------------|----------------|---------|-----------|------------|---------|---------|---|
| 1 | 0 | 0 | 34.5814 | -117.4397 | 34238 | 250 | 3 | |
| 2 | 9 | 8 | 34.151 | -118.7609 | 20269 | 1003 | 3 | |
| 3 | 65 | 28 | 37.7668 | -122.267 | 79827 | 2949 | 2 | |
| 4 | 44 | 21 | 37.8897 | -122.3018 | 20145 | 4345 | 2 | |
| 5 | 48 | 5 | 34.084 | -118.1355 | 84509 | 4275 | 2 | |
| 6 | 0 | 0 | 33.5792 | -117.7289 | 50385 | 2808 | 2 | |
| 7 | 0 | 0 | 41.4898 | -120.5516 | 2550 | 347 | 3 | |
| 8 | 7 | 4 | 38.1796 | -122.2583 | 20256 | 1285 | 3 | |
| 9 | 135 | 51 | 33.839 | -117.8574 | 353085 | 2711 | 2 | |
| 10 | 0 | 0 | 40.4497 | -122.295 | 10479 | 575 | 3 | |
| 11 | 20 | 7 | 37.9787 | -121.796 | 313532 | 1475 | 2 | |
| 12 | 0 | 0 | 34.5352 | -117.2109 | 73339 | 367 | 3 | NA |

```
> names(goated)
[1] "no_permits"
[2] "no_constructed"
[3] "lat"
[4] "lng"
[5] "population"
[6] "density"
[7] "ranking"
[8] "population_16_years_and_over_in_labor_force_total_percent_labor_force_participation_rate"
[9] "median_household_income_dollars_margin_of_error"
[10] "mean_household_income_dollars_estimate"
[11] "mean_household_income_dollars_margin_of_error"
[12] "median_family_income_dollars_estimate"
[13] "median_family_income_dollars_margin_of_error"
[14] "mean_family_income_dollars_estimate"
[15] "mean_family_income_dollars_margin_of_error"
[16] "per_capita_income_dollars_estimate"
[17] "per_capita_income_dollars_margin_of_error"
[18] "percent_of_people_in_poverty"
[19] "percent_of_families_in_poverty"
```

Housing Data

```
df = pd.read_csv('housing.csv')
df.info()
df.head()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 20640 entries, 0 to 20639
```

```
Data columns (total 10 columns):
```

| # | Column | Non-Null | Count | Dtype |
|---|--------------------|----------|----------|---------|
| 0 | longitude | 20640 | non-null | float64 |
| 1 | latitude | 20640 | non-null | float64 |
| 2 | housing_median_age | 20640 | non-null | int64 |
| 3 | total_rooms | 20640 | non-null | int64 |
| 4 | total_bedrooms | 20433 | non-null | float64 |
| 5 | population | 20640 | non-null | int64 |
| 6 | households | 20640 | non-null | int64 |
| 7 | median_income | 20640 | non-null | float64 |
| 8 | ocean_proximity | 20640 | non-null | object |
| 9 | median_house_value | 20640 | non-null | int64 |

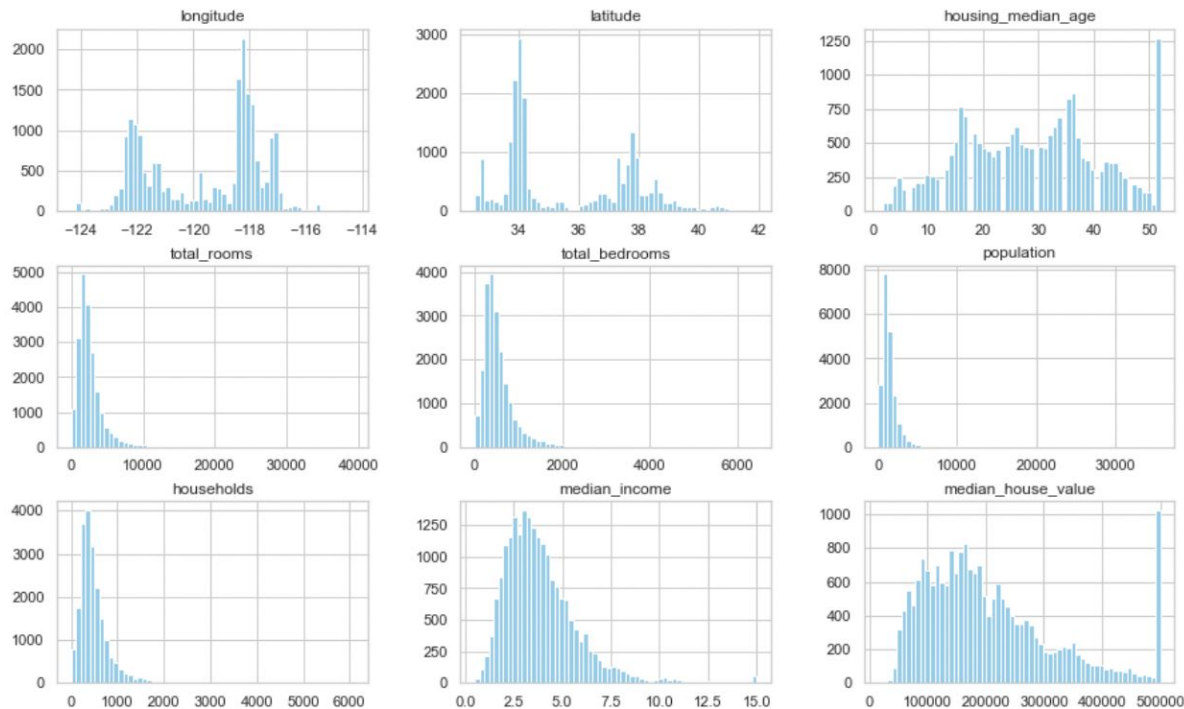
```
dtypes: float64(4), int64(5), object(1)
```

```
memory usage: 1.6+ MB
```

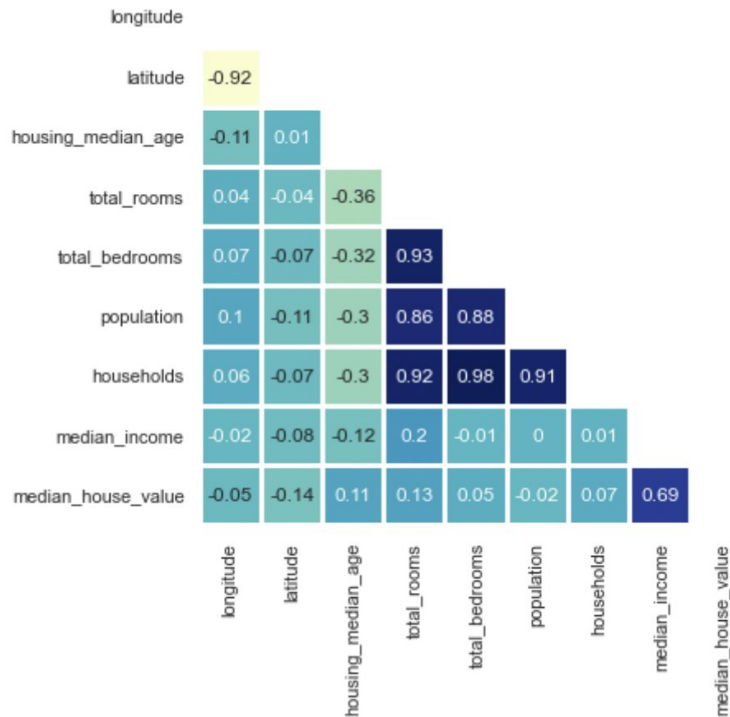
| | longitude | latitude | housing_median_age | total_rooms | total_bedrooms | population | househo |
|---|-----------|----------|--------------------|-------------|----------------|------------|---------|
| 0 | -122.23 | 37.88 | 41 | 880 | 129.0 | 322 | |
| 1 | -122.22 | 37.86 | 21 | 7099 | 1106.0 | 2401 | 1 |
| 2 | -122.24 | 37.85 | 52 | 1467 | 190.0 | 496 | |
| 3 | -122.25 | 37.85 | 52 | 1274 | 235.0 | 558 | |
| 4 | -122.25 | 37.85 | 52 | 1627 | 280.0 | 565 | : |

- Pertains to the houses found in a given California district + some summary stats about them based on 1990 census data
- Also numerical
- Input data would be all the variables prior to the actual housing prices
- Output would be “median_housing_value”
- Needs some preprocessing (NaNs, outliers, etc.)

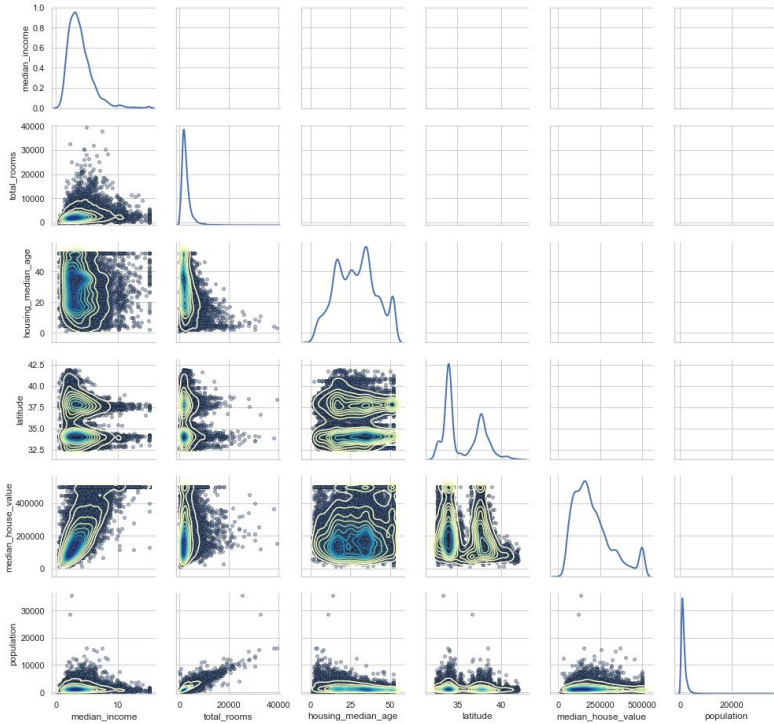
Univariate Histograms



Bivariate Correlation Matrix

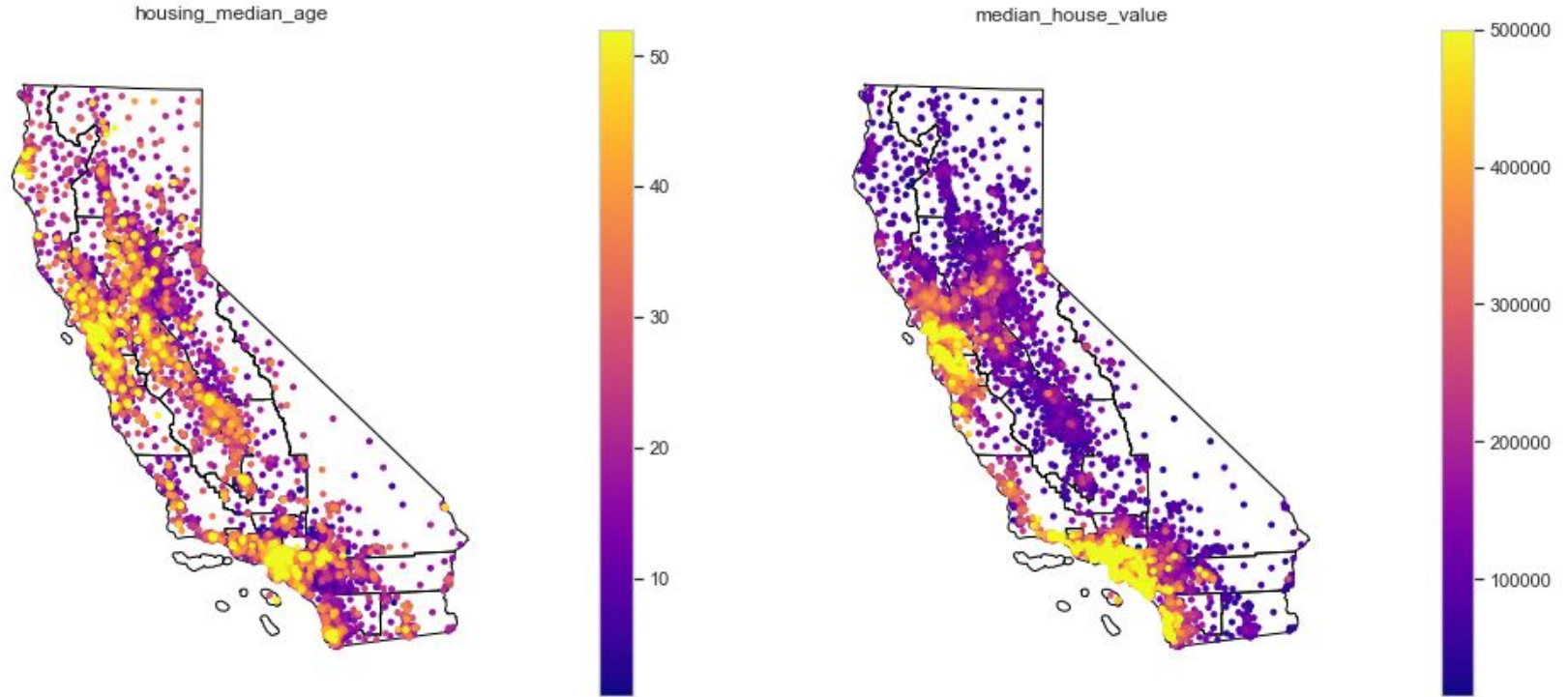


Seaborn Pairgrid w/ KDE & scatter plot of df features (KDE = Kernel Density Estimation)

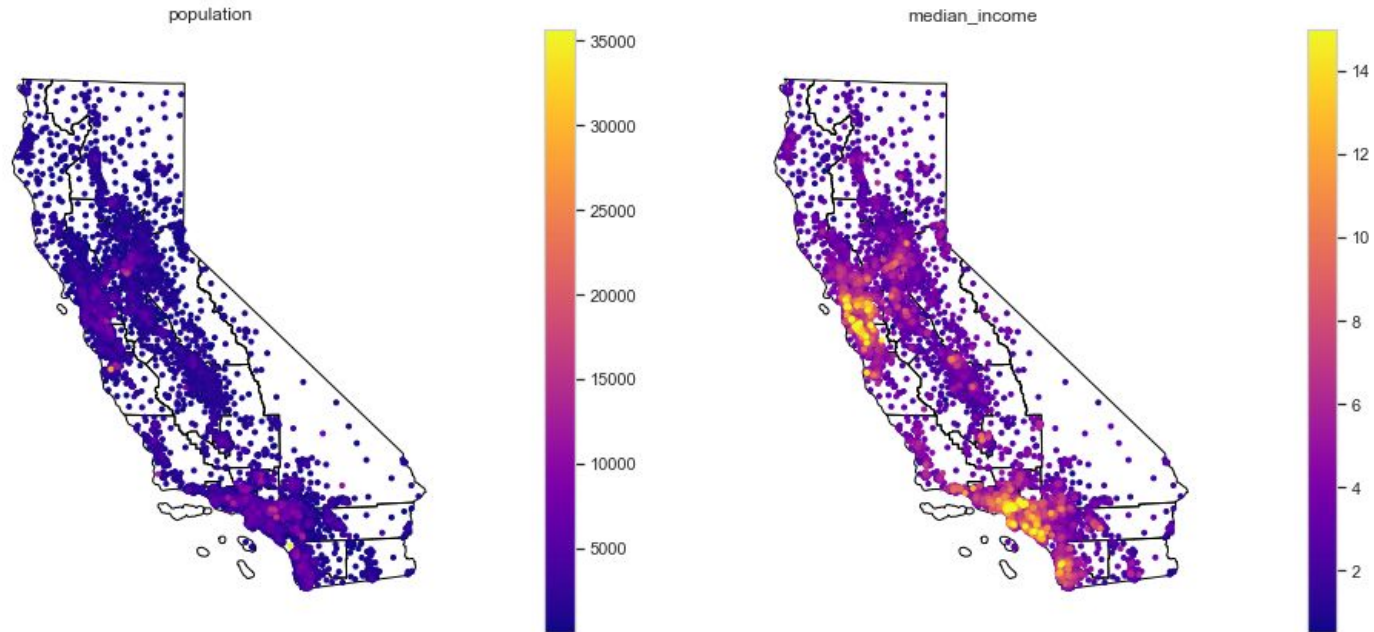


- Pair grids help us find scatter patterns in bivariate relations i.e. the variables are paired and maybe the plots can help us visualize how the variables may or may not interact
- So we want to look for:
 - Linearity
 - Clusters
 - Irregular patterns/outliers
 - ...and so on

Two Geopandas Plots Side-by-Side



Relation to income and population?



After some preprocessing steps such as:

- extracting input & output data and storing them**

In pandas dataframes

- missing value imputation**

(replaced NaNs with mean of the resp. column)

- type conversions**

- splitting data into training (80%) and test (20%) set**

- standardizing both sets**

Using ML to predict potential housing values

```
# Random Forest Regression
```

```
RRegressor = RandomForestRegressor()  
RRegressor.fit(X_train, y_train)  
predictionRF = RRegressor.predict(X_test)  
mseRF = mean_squared_error(y_test, predictionRF)
```

```
# Decision Tree Regression
```

```
DRegressor = DecisionTreeRegressor()  
DRegressor.fit(X_train, y_train)  
predictionDT = DRegressor.predict(X_test)  
mseDT = mean_squared_error(y_test, predictionDT)
```

```
# Linear Regression
```

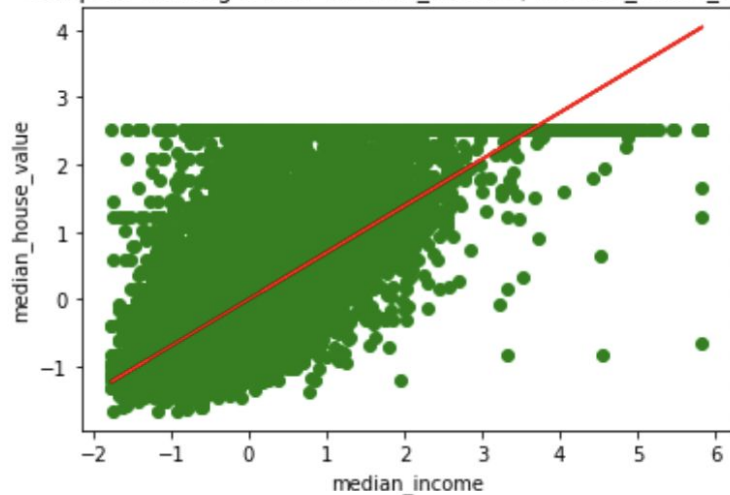
```
linearRegression = LinearRegression()  
linearRegression.fit(X_train, y_train)
```

Output:

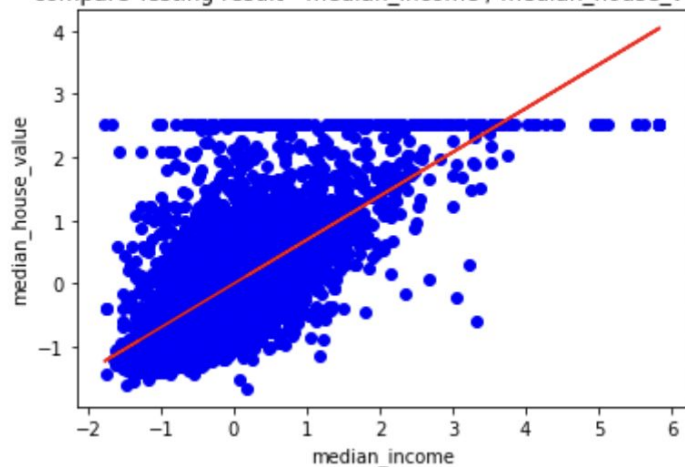
```
rmseLinear = 0.36430801042806943  
rmseDT = 0.332915806622065  
rmseRF = 0.17744570041122867
```

Model result

compare Training result - median_income / median_house_value

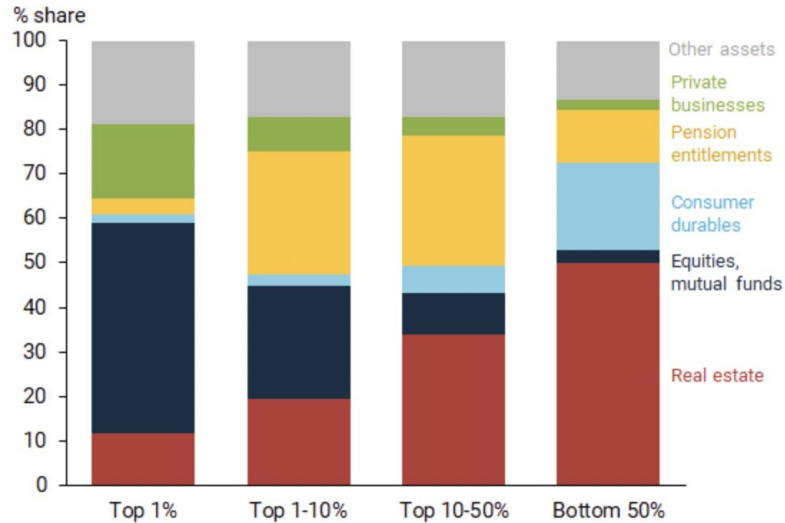


compare Testing result - median_income / median_house_value



Wealth held in real estate for average American

Types of portfolio assets across wealth distribution



- The bottom 50% of Americans have almost 50% of their share of wealth wrapped in real estate
 - With the continued implementations of ADUs we can expect this share of wealth to increase
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Future improvements

1. Having access to more recent housing prices database (preferably post-adu implementation)
 2. Being able to make temporal analysis instead of cross-sectional analysis
 3. Improving ML model and adding more robust variables
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