```
import pandas as pd
import numpy as np

df_train = pd.read_csv("train_realestate.csv")
df_test=  pd.read_csv("test_realestate.csv")

df_test.head()
```

```
      UID  BLOCKID  SUMLEVEL  COUNTYID  STATEID         state state_ab
\
0  255504      NaN       140       163       26      Michigan       MI

1  252676      NaN       140         1       23         Maine       ME

2  276314      NaN       140        15       42  Pennsylvania       PA

3  248614      NaN       140       231       21      Kentucky       KY

4  286865      NaN       140       355       48         Texas       TX


             city                  place     type  ... female_age_mean
\
0         Detroit  Dearborn Heights City      CDP  ...        34.78682

1          Auburn            Auburn City     City  ...        44.23451

2       Pine City              Millerton  Borough  ...        41.62426

3      Monticello        Monticello City     City  ...        44.81200

4  Corpus Christi                  Edroy     Town  ...        40.66618


   female_age_median  female_age_stdev  female_age_sample_weight  \
0           33.75000          21.58531                 416.48097
1           46.66667          22.37036                 532.03505
2           44.50000          22.86213                 453.11959
3           48.00000          21.03155                 263.94320
4           42.66667          21.30900                 709.90829

   female_age_samples  pct_own  married  married_snp  separated
divorced
0              1938.0  0.70252  0.28217      0.05910    0.03813
0.14299
1              1950.0  0.85128  0.64221      0.02338    0.00000
0.13377
2              1879.0  0.81897  0.59961      0.01746    0.01358
0.10026
3              1081.0  0.84609  0.56953      0.05492    0.04694
```

```
0.12489
4              2956.0  0.79077  0.57620      0.01726    0.00588
0.16379

[5 rows x 80 columns]
```

```
df_train.head()
```

```
      UID  BLOCKID  SUMLEVEL  COUNTYID  STATEID        state state_ab
\
0  267822      NaN       140        53       36     New York       NY

1  246444      NaN       140       141       18      Indiana       IN

2  245683      NaN       140        63       18      Indiana       IN

3  279653      NaN       140       127       72  Puerto Rico       PR

4  247218      NaN       140       161       20       Kansas       KS


         city           place   type  ... female_age_mean
female_age_median  \
0    Hamilton        Hamilton   City  ...        44.48629
45.33333
1  South Bend        Roseland   City  ...        36.48391
37.58333
2    Danville        Danville   City  ...        42.15810
42.83333
3    San Juan        Guaynabo  Urban  ...        47.77526
50.58333
4   Manhattan  Manhattan City   City  ...        24.17693
21.58333

   female_age_stdev  female_age_sample_weight  female_age_samples
pct_own  \
0          22.51276                 685.33845              2618.0
0.79046
1          23.43353                 267.23367              1284.0
0.52483
2          23.94119                 707.01963              3238.0
0.85331
3          24.32015                 362.20193              1559.0
0.65037
4          11.10484                1854.48652              3051.0
0.13046

   married  married_snp  separated  divorced
0  0.57851      0.01882    0.01240   0.08770
1  0.34886      0.01426    0.01426   0.09030
```

```
2  0.64745      0.02830    0.01607   0.10657
3  0.47257      0.02021    0.02021   0.10106
4  0.12356      0.00000    0.00000   0.03109

[5 rows x 80 columns]
```

```
print(df_test.shape, df_train.shape)
```

```
(11709, 80) (27321, 80)
```

```
df_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 27321 entries, 0 to 27320
Data columns (total 80 columns):
 #   Column                        Non-Null Count  Dtype
---  ------                        --------------  -----
 0   UID                           27321 non-null  int64
 1   BLOCKID                       0 non-null      float64
 2   SUMLEVEL                      27321 non-null  int64
 3   COUNTYID                      27321 non-null  int64
 4   STATEID                       27321 non-null  int64
 5   state                         27321 non-null  object
 6   state_ab                      27321 non-null  object
 7   city                          27321 non-null  object
 8   place                         27321 non-null  object
 9   type                          27321 non-null  object
 10  primary                       27321 non-null  object
 11  zip_code                      27321 non-null  int64
 12  area_code                     27321 non-null  int64
 13  lat                           27321 non-null  float64
 14  lng                           27321 non-null  float64
 15  ALand                         27321 non-null  float64
 16  AWater                        27321 non-null  int64
 17  pop                           27321 non-null  int64
 18  male_pop                      27321 non-null  int64
 19  female_pop                    27321 non-null  int64
 20  rent_mean                     27007 non-null  float64
 21  rent_median                   27007 non-null  float64
 22  rent_stdev                    27007 non-null  float64
 23  rent_sample_weight            27007 non-null  float64
 24  rent_samples                  27007 non-null  float64
 25  rent_gt_10                    27007 non-null  float64
 26  rent_gt_15                    27007 non-null  float64
 27  rent_gt_20                    27007 non-null  float64
 28  rent_gt_25                    27007 non-null  float64
 29  rent_gt_30                    27007 non-null  float64
 30  rent_gt_35                    27007 non-null  float64
 31  rent_gt_40                    27007 non-null  float64
 32  rent_gt_50                    27007 non-null  float64
 33  universe_samples              27321 non-null  int64
```

```
 34  used_samples                  27321 non-null  int64
 35  hi_mean                       27053 non-null  float64
 36  hi_median                     27053 non-null  float64
 37  hi_stdev                      27053 non-null  float64
 38  hi_sample_weight              27053 non-null  float64
 39  hi_samples                    27053 non-null  float64
 40  family_mean                   27023 non-null  float64
 41  family_median                 27023 non-null  float64
 42  family_stdev                  27023 non-null  float64
 43  family_sample_weight          27023 non-null  float64
 44  family_samples                27023 non-null  float64
 45  hc_mortgage_mean              26748 non-null  float64
 46  hc_mortgage_median            26748 non-null  float64
 47  hc_mortgage_stdev             26748 non-null  float64
 48  hc_mortgage_sample_weight     26748 non-null  float64
 49  hc_mortgage_samples           26748 non-null  float64
 50  hc_mean                       26721 non-null  float64
 51  hc_median                     26721 non-null  float64
 52  hc_stdev                      26721 non-null  float64
 53  hc_samples                    26721 non-null  float64
 54  hc_sample_weight              26721 non-null  float64
 55  home_equity_second_mortgage   26864 non-null  float64
 56  second_mortgage               26864 non-null  float64
 57  home_equity                   26864 non-null  float64
 58  debt                          26864 non-null  float64
 59  second_mortgage_cdf           26864 non-null  float64
 60  home_equity_cdf               26864 non-null  float64
 61  debt_cdf                      26864 non-null  float64
 62  hs_degree                     27131 non-null  float64
 63  hs_degree_male                27121 non-null  float64
 64  hs_degree_female              27098 non-null  float64
 65  male_age_mean                 27132 non-null  float64
 66  male_age_median               27132 non-null  float64
 67  male_age_stdev                27132 non-null  float64
 68  male_age_sample_weight        27132 non-null  float64
 69  male_age_samples              27132 non-null  float64
 70  female_age_mean               27115 non-null  float64
 71  female_age_median             27115 non-null  float64
 72  female_age_stdev              27115 non-null  float64
 73  female_age_sample_weight      27115 non-null  float64
 74  female_age_samples            27115 non-null  float64
 75  pct_own                       27053 non-null  float64
 76  married                       27130 non-null  float64
 77  married_snp                   27130 non-null  float64
 78  separated                     27130 non-null  float64
 79  divorced                      27130 non-null  float64
dtypes: float64(62), int64(12), object(6)
memory usage: 16.7+ MB

df_train.columns
```

```
Index(['UID', 'BLOCKID', 'SUMLEVEL', 'COUNTYID', 'STATEID', 'state',
       'state_ab', 'city', 'place', 'type', 'primary', 'zip_code',
'area_code',
       'lat', 'lng', 'ALand', 'AWater', 'pop', 'male_pop',
'female_pop',
       'rent_mean', 'rent_median', 'rent_stdev', 'rent_sample_weight',
       'rent_samples', 'rent_gt_10', 'rent_gt_15', 'rent_gt_20',
'rent_gt_25',
       'rent_gt_30', 'rent_gt_35', 'rent_gt_40', 'rent_gt_50',
       'universe_samples', 'used_samples', 'hi_mean', 'hi_median',
'hi_stdev',
       'hi_sample_weight', 'hi_samples', 'family_mean',
'family_median',
       'family_stdev', 'family_sample_weight', 'family_samples',
       'hc_mortgage_mean', 'hc_mortgage_median', 'hc_mortgage_stdev',
       'hc_mortgage_sample_weight', 'hc_mortgage_samples', 'hc_mean',
       'hc_median', 'hc_stdev', 'hc_samples', 'hc_sample_weight',
       'home_equity_second_mortgage', 'second_mortgage',
'home_equity', 'debt',
       'second_mortgage_cdf', 'home_equity_cdf', 'debt_cdf',
'hs_degree',
       'hs_degree_male', 'hs_degree_female', 'male_age_mean',
       'male_age_median', 'male_age_stdev', 'male_age_sample_weight',
       'male_age_samples', 'female_age_mean', 'female_age_median',
       'female_age_stdev', 'female_age_sample_weight',
'female_age_samples',
       'pct_own', 'married', 'married_snp', 'separated', 'divorced'],
      dtype='object')
```

```
df_test.columns
```

```
Index(['UID', 'BLOCKID', 'SUMLEVEL', 'COUNTYID', 'STATEID', 'state',
       'state_ab', 'city', 'place', 'type', 'primary', 'zip_code',
'area_code',
       'lat', 'lng', 'ALand', 'AWater', 'pop', 'male_pop',
'female_pop',
       'rent_mean', 'rent_median', 'rent_stdev', 'rent_sample_weight',
       'rent_samples', 'rent_gt_10', 'rent_gt_15', 'rent_gt_20',
'rent_gt_25',
       'rent_gt_30', 'rent_gt_35', 'rent_gt_40', 'rent_gt_50',
       'universe_samples', 'used_samples', 'hi_mean', 'hi_median',
'hi_stdev',
       'hi_sample_weight', 'hi_samples', 'family_mean',
'family_median',
       'family_stdev', 'family_sample_weight', 'family_samples',
       'hc_mortgage_mean', 'hc_mortgage_median', 'hc_mortgage_stdev',
       'hc_mortgage_sample_weight', 'hc_mortgage_samples', 'hc_mean',
       'hc_median', 'hc_stdev', 'hc_samples', 'hc_sample_weight',
       'home_equity_second_mortgage', 'second_mortgage',
'home_equity', 'debt',
       'second_mortgage_cdf', 'home_equity_cdf', 'debt_cdf',
```

```
'hs_degree',
       'hs_degree_male', 'hs_degree_female', 'male_age_mean',
       'male_age_median', 'male_age_stdev', 'male_age_sample_weight',
       'male_age_samples', 'female_age_mean', 'female_age_median',
       'female_age_stdev', 'female_age_sample_weight',
'female_age_samples',
       'pct_own', 'married', 'married_snp', 'separated', 'divorced'],
      dtype='object')
```

```
df_test.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 11709 entries, 0 to 11708
Data columns (total 80 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   UID                             11709 non-null  int64
 1   BLOCKID                         0 non-null      float64
 2   SUMLEVEL                        11709 non-null  int64
 3   COUNTYID                        11709 non-null  int64
 4   STATEID                         11709 non-null  int64
 5   state                           11709 non-null  object
 6   state_ab                        11709 non-null  object
 7   city                            11709 non-null  object
 8   place                           11709 non-null  object
 9   type                            11709 non-null  object
 10  primary                         11709 non-null  object
 11  zip_code                        11709 non-null  int64
 12  area_code                       11709 non-null  int64
 13  lat                             11709 non-null  float64
 14  lng                             11709 non-null  float64
 15  ALand                           11709 non-null  int64
 16  AWater                          11709 non-null  int64
 17  pop                             11709 non-null  int64
 18  male_pop                        11709 non-null  int64
 19  female_pop                      11709 non-null  int64
 20  rent_mean                       11561 non-null  float64
 21  rent_median                     11561 non-null  float64
 22  rent_stdev                      11561 non-null  float64
 23  rent_sample_weight              11561 non-null  float64
 24  rent_samples                    11561 non-null  float64
 25  rent_gt_10                      11560 non-null  float64
 26  rent_gt_15                      11560 non-null  float64
 27  rent_gt_20                      11560 non-null  float64
 28  rent_gt_25                      11560 non-null  float64
 29  rent_gt_30                      11560 non-null  float64
 30  rent_gt_35                      11560 non-null  float64
 31  rent_gt_40                      11560 non-null  float64
 32  rent_gt_50                      11560 non-null  float64
 33  universe_samples                11709 non-null  int64
 34  used_samples                    11709 non-null  int64
```

```
 35  hi_mean                       11587 non-null  float64
 36  hi_median                     11587 non-null  float64
 37  hi_stdev                      11587 non-null  float64
 38  hi_sample_weight              11587 non-null  float64
 39  hi_samples                    11587 non-null  float64
 40  family_mean                   11573 non-null  float64
 41  family_median                 11573 non-null  float64
 42  family_stdev                  11573 non-null  float64
 43  family_sample_weight          11573 non-null  float64
 44  family_samples                11573 non-null  float64
 45  hc_mortgage_mean              11441 non-null  float64
 46  hc_mortgage_median            11441 non-null  float64
 47  hc_mortgage_stdev             11441 non-null  float64
 48  hc_mortgage_sample_weight     11441 non-null  float64
 49  hc_mortgage_samples           11441 non-null  float64
 50  hc_mean                       11419 non-null  float64
 51  hc_median                     11419 non-null  float64
 52  hc_stdev                      11419 non-null  float64
 53  hc_samples                    11419 non-null  float64
 54  hc_sample_weight              11419 non-null  float64
 55  home_equity_second_mortgage   11489 non-null  float64
 56  second_mortgage               11489 non-null  float64
 57  home_equity                   11489 non-null  float64
 58  debt                          11489 non-null  float64
 59  second_mortgage_cdf           11489 non-null  float64
 60  home_equity_cdf               11489 non-null  float64
 61  debt_cdf                      11489 non-null  float64
 62  hs_degree                     11624 non-null  float64
 63  hs_degree_male                11620 non-null  float64
 64  hs_degree_female              11604 non-null  float64
 65  male_age_mean                 11625 non-null  float64
 66  male_age_median               11625 non-null  float64
 67  male_age_stdev                11625 non-null  float64
 68  male_age_sample_weight        11625 non-null  float64
 69  male_age_samples              11625 non-null  float64
 70  female_age_mean               11613 non-null  float64
 71  female_age_median             11613 non-null  float64
 72  female_age_stdev              11613 non-null  float64
 73  female_age_sample_weight      11613 non-null  float64
 74  female_age_samples            11613 non-null  float64
 75  pct_own                       11587 non-null  float64
 76  married                       11625 non-null  float64
 77  married_snp                   11625 non-null  float64
 78  separated                     11625 non-null  float64
 79  divorced                      11625 non-null  float64
dtypes: float64(61), int64(13), object(6)
memory usage: 7.1+ MB
```

```
df_test.columns.value_counts().sum()
```

```
80
```

```
df_train.columns.value_counts().sum()
```

```
80
```

```
df_test.isnull().sum()
```

```
UID               0
BLOCKID       11709
SUMLEVEL          0
COUNTYID          0
STATEID           0
              ...
pct_own         122
married          84
married_snp      84
separated        84
divorced         84
Length: 80, dtype: int64
```

```
 df_train.isnull().sum()
```

```
UID               0
BLOCKID       27321
SUMLEVEL          0
COUNTYID          0
STATEID           0
              ...
pct_own         268
married         191
married_snp     191
separated       191
divorced        191
Length: 80, dtype: int64
```

```
df_test.describe()
```

```
                UID  BLOCKID  SUMLEVEL      COUNTYID       STATEID  \
count   11709.000000      0.0   11709.0  11709.000000  11709.000000
mean   257525.004783      NaN     140.0     85.710650     28.489196
std     21466.372658      NaN       0.0     99.304334     16.607262
min    220336.000000      NaN     140.0      1.000000      1.000000
25%    238819.000000      NaN     140.0     29.000000     13.000000
50%    257651.000000      NaN     140.0     61.000000     28.000000
75%    276300.000000      NaN     140.0    109.000000     42.000000
max    294333.000000      NaN     140.0    810.000000     72.000000

           zip_code     area_code           lat           lng
ALand  \
count  11709.000000  11709.000000  11709.000000  11709.000000
1.170900e+04
mean   50123.418396    593.598514     37.405491    -91.340229
1.095500e+08
```

```
std    29775.134038    232.074263      5.625904     16.407818
7.624940e+08
min      601.000000    201.000000     17.965835   -166.770979
8.299000e+03
25%    25570.000000    404.000000     33.919813    -97.816561
1.718660e+06
50%    47362.000000    612.000000     38.618093    -86.643344
4.835000e+06
75%    77406.000000    787.000000     41.232973    -79.697311
3.204540e+07
max    99929.000000    989.000000     64.804269    -65.695344
5.520166e+10

       ...  female_age_mean  female_age_median  female_age_stdev  \
count  ...     11613.000000       11613.000000      11613.000000
mean   ...        40.111999          40.131864         22.148145
std    ...         5.851192           7.972026          2.554907
min    ...        15.360240          12.833330          0.737110
25%    ...        36.729210          34.750000         21.270920
50%    ...        40.196960          40.333330         22.472990
75%    ...        43.496490          45.333330         23.549450
max    ...        90.107940          90.166670         29.626680

       female_age_sample_weight  female_age_samples       pct_own  \
count              11613.000000        11613.000000  11587.000000
mean                 550.411243         2233.003186      0.634194
std                  280.992521         1072.017063      0.232232
min                    0.251910            3.000000      0.000000
25%                  363.225840         1499.000000      0.492500
50%                  509.103610         2099.000000      0.687640
75%                  685.883910         2800.000000      0.815235
max                 4145.557870        15466.000000      1.000000

            married   married_snp     separated      divorced
count  11625.000000  11625.000000  11625.000000  11625.000000
mean       0.505632      0.047960      0.019346      0.099191
std        0.139774      0.038693      0.021428      0.048525
min        0.000000      0.000000      0.000000      0.000000
25%        0.422020      0.020890      0.004500      0.064590
50%        0.525270      0.038680      0.013870      0.094350
75%        0.605660      0.065340      0.027910      0.128400
max        1.000000      0.714290      0.714290      0.362750

[8 rows x 74 columns]

df_train.describe()

                UID  BLOCKID  SUMLEVEL      COUNTYID       STATEID  \
count   27321.000000      0.0   27321.0  27321.000000  27321.000000
mean   257331.996303      NaN     140.0     85.646426     28.271806
```

```
std     21343.859725      NaN       0.0     98.333097     16.392846
min    220342.000000      NaN     140.0      1.000000      1.000000
25%    238816.000000      NaN     140.0     29.000000     13.000000
50%    257220.000000      NaN     140.0     63.000000     28.000000
75%    275818.000000      NaN     140.0    109.000000     42.000000
max    294334.000000      NaN     140.0    840.000000     72.000000

           zip_code     area_code           lat           lng
ALand  \
count  27321.000000  27321.000000  27321.000000  27321.000000
2.732100e+04
mean   50081.999524    596.507668     37.508813    -91.288394
1.295106e+08
std    29558.115660    232.497482      5.588268     16.343816
1.275531e+09
min      602.000000    201.000000     17.929085   -165.453872
4.113400e+04
25%    26554.000000    405.000000     33.899064    -97.816067
1.799408e+06
50%    47715.000000    614.000000     38.755183    -86.554374
4.866940e+06
75%    77093.000000    801.000000     41.380606    -79.782503
3.359820e+07
max    99925.000000    989.000000     67.074017    -65.379332
1.039510e+11

       ...  female_age_mean  female_age_median  female_age_stdev  \
count  ...     27115.000000       27115.000000      27115.000000
mean   ...        40.319803          40.355099         22.178745
std    ...         5.886317           8.039585          2.540257
min    ...        16.008330          13.250000          0.556780
25%    ...        36.892050          34.916670         21.312135
50%    ...        40.373320          40.583330         22.514410
75%    ...        43.567120          45.416670         23.575260
max    ...        79.837390          82.250000         30.241270

       female_age_sample_weight  female_age_samples       pct_own  \
count              27115.000000        27115.000000  27053.000000
mean                 544.238432         2208.761903      0.640434
std                  283.546896         1089.316999      0.226640
min                    0.664700            2.000000      0.000000
25%                  355.995825         1471.000000      0.502780
50%                  503.643890         2066.000000      0.690840
75%                  680.275055         2772.000000      0.817460
max                 6197.995200        27250.000000      1.000000

            married   married_snp     separated      divorced
count  27130.000000  27130.000000  27130.000000  27130.000000
mean       0.508300      0.047537      0.019089      0.100248
std        0.136860      0.037640      0.020796      0.049055
```

```
min        0.000000      0.000000      0.000000      0.000000
25%        0.425102      0.020810      0.004530      0.065800
50%        0.526665      0.038840      0.013460      0.095205
75%        0.605760      0.065100      0.027488      0.129000
max        1.000000      0.714290      0.714290      1.000000

[8 rows x 74 columns]
```

```
df_test.set_index(keys=['UID'], inplace=True)
df_train.set_index(keys=['UID'], inplace=True)

df_test.head(5)
```

```
        BLOCKID  SUMLEVEL  COUNTYID  STATEID         state state_ab  \
UID
255504      NaN       140       163       26      Michigan       MI
252676      NaN       140         1       23         Maine       ME
276314      NaN       140        15       42  Pennsylvania       PA
248614      NaN       140       231       21      Kentucky       KY
286865      NaN       140       355       48         Texas       TX

                 city                   place     type primary  ...  \
UID                                                            ...
255504        Detroit  Dearborn Heights City      CDP   tract  ...
252676         Auburn            Auburn City     City   tract  ...
276314       Pine City              Millerton  Borough   tract  ...
248614      Monticello       Monticello City     City   tract  ...
286865  Corpus Christi                 Edroy     Town   tract  ...

        female_age_mean  female_age_median  female_age_stdev  \
UID
255504         34.78682           33.75000          21.58531
252676         44.23451           46.66667          22.37036
276314         41.62426           44.50000          22.86213
248614         44.81200           48.00000          21.03155
286865         40.66618           42.66667          21.30900

        female_age_sample_weight  female_age_samples  pct_own  married
\
UID

255504                 416.48097              1938.0  0.70252  0.28217

252676                 532.03505              1950.0  0.85128  0.64221

276314                 453.11959              1879.0  0.81897  0.59961

248614                 263.94320              1081.0  0.84609  0.56953

286865                 709.90829              2956.0  0.79077  0.57620
```

```
        married_snp  separated  divorced
UID
255504      0.05910    0.03813   0.14299
252676      0.02338    0.00000   0.13377
276314      0.01746    0.01358   0.10026
248614      0.05492    0.04694   0.12489
286865      0.01726    0.00588   0.16379

[5 rows x 79 columns]
```

```
df_train.head(5)
```

```
        BLOCKID  SUMLEVEL  COUNTYID  STATEID        state state_ab  \
UID
267822      NaN       140        53       36     New York       NY
246444      NaN       140       141       18      Indiana       IN
245683      NaN       140        63       18      Indiana       IN
279653      NaN       140       127       72  Puerto Rico       PR
247218      NaN       140       161       20       Kansas       KS

              city           place   type primary  ...
female_age_mean  \
UID                                                ...

267822    Hamilton        Hamilton   City   tract  ...
44.48629
246444  South Bend        Roseland   City   tract  ...
36.48391
245683    Danville        Danville   City   tract  ...
42.15810
279653    San Juan        Guaynabo  Urban   tract  ...
47.77526
247218   Manhattan  Manhattan City   City   tract  ...
24.17693

        female_age_median  female_age_stdev  female_age_sample_weight
\
UID

267822           45.33333          22.51276                 685.33845

246444           37.58333          23.43353                 267.23367

245683           42.83333          23.94119                 707.01963

279653           50.58333          24.32015                 362.20193
```

```
247218           21.58333          11.10484                1854.48652


        female_age_samples  pct_own  married  married_snp  separated
divorced
UID

267822              2618.0  0.79046  0.57851      0.01882    0.01240
0.08770
246444              1284.0  0.52483  0.34886      0.01426    0.01426
0.09030
245683              3238.0  0.85331  0.64745      0.02830    0.01607
0.10657
279653              1559.0  0.65037  0.47257      0.02021    0.02021
0.10106
247218              3051.0  0.13046  0.12356      0.00000    0.00000
0.03109

[5 rows x 79 columns]
```

```
list_missing_df_train= df_train.isnull().sum()*100/len(df_train)

missing_values_df_train =  pd.DataFrame(list_missing_df_train,
columns= ['Percentage of missing values'])
missing_values_df_train.sort_values(by=['Percentage of missing
values'], inplace = True , ascending=False)
missing_values_df_train[missing_values_df_train['Percentage of missing
values']>0][:10]
```

```
                           Percentage of missing values
BLOCKID                                      100.000000
hc_samples                                     2.196113
hc_mean                                        2.196113
hc_median                                      2.196113
hc_stdev                                       2.196113
hc_sample_weight                               2.196113
hc_mortgage_mean                               2.097288
hc_mortgage_stdev                              2.097288
hc_mortgage_sample_weight                      2.097288
hc_mortgage_samples                            2.097288
```

```
list_missing_df_test= df_test.isnull().sum()*100/len(df_test)

missing_values_df_test = pd.DataFrame(list_missing_df_test, columns
=['Percentage of missing values'])
missing_values_df_test.sort_values(by=['Percentage of missing
values'], inplace=True, ascending=False)
missing_values_df_test[missing_values_df_test['Percentage of missing
values']>0][:10]
```

```
                          Percentage of missing values
BLOCKID                                     100.000000
hc_samples                                    2.476727
hc_mean                                       2.476727
hc_median                                     2.476727
hc_stdev                                      2.476727
hc_sample_weight                              2.476727
hc_mortgage_mean                              2.288838
hc_mortgage_stdev                             2.288838
hc_mortgage_sample_weight                     2.288838
hc_mortgage_samples                           2.288838
```

```
df_train.drop(columns= ['BLOCKID', 'SUMLEVEL'], inplace=True)
df_test.drop(columns=['BLOCKID', 'SUMLEVEL'], inplace = True)
```

```
df_test.columns
```

```
Index(['COUNTYID', 'STATEID', 'state', 'state_ab', 'city', 'place',
'type',
       'primary', 'zip_code', 'area_code', 'lat', 'lng', 'ALand',
'AWater',
       'pop', 'male_pop', 'female_pop', 'rent_mean', 'rent_median',
       'rent_stdev', 'rent_sample_weight', 'rent_samples',
'rent_gt_10',
       'rent_gt_15', 'rent_gt_20', 'rent_gt_25', 'rent_gt_30',
'rent_gt_35',
       'rent_gt_40', 'rent_gt_50', 'universe_samples', 'used_samples',
       'hi_mean', 'hi_median', 'hi_stdev', 'hi_sample_weight',
'hi_samples',
       'family_mean', 'family_median', 'family_stdev',
'family_sample_weight',
       'family_samples', 'hc_mortgage_mean', 'hc_mortgage_median',
       'hc_mortgage_stdev', 'hc_mortgage_sample_weight',
'hc_mortgage_samples',
       'hc_mean', 'hc_median', 'hc_stdev', 'hc_samples',
'hc_sample_weight',
       'home_equity_second_mortgage', 'second_mortgage',
'home_equity', 'debt',
       'second_mortgage_cdf', 'home_equity_cdf', 'debt_cdf',
'hs_degree',
       'hs_degree_male', 'hs_degree_female', 'male_age_mean',
       'male_age_median', 'male_age_stdev', 'male_age_sample_weight',
       'male_age_samples', 'female_age_mean', 'female_age_median',
       'female_age_stdev', 'female_age_sample_weight',
'female_age_samples',
       'pct_own', 'married', 'married_snp', 'separated', 'divorced'],
      dtype='object')
```

```
missing_train_cols=[]
for  col in df_train.columns:
    if df_train[col].isna().sum() !=0:
```

```
        missing_train_cols.append(col)
print(missing_train_cols)
```

```
['rent_mean', 'rent_median', 'rent_stdev', 'rent_sample_weight',
'rent_samples', 'rent_gt_10', 'rent_gt_15', 'rent_gt_20',
'rent_gt_25', 'rent_gt_30', 'rent_gt_35', 'rent_gt_40', 'rent_gt_50',
'hi_mean', 'hi_median', 'hi_stdev', 'hi_sample_weight', 'hi_samples',
'family_mean', 'family_median', 'family_stdev',
'family_sample_weight', 'family_samples', 'hc_mortgage_mean',
'hc_mortgage_median', 'hc_mortgage_stdev',
'hc_mortgage_sample_weight', 'hc_mortgage_samples', 'hc_mean',
'hc_median', 'hc_stdev', 'hc_samples', 'hc_sample_weight',
'home_equity_second_mortgage', 'second_mortgage', 'home_equity',
'debt', 'second_mortgage_cdf', 'home_equity_cdf', 'debt_cdf',
'hs_degree', 'hs_degree_male', 'hs_degree_female', 'male_age_mean',
'male_age_median', 'male_age_stdev', 'male_age_sample_weight',
'male_age_samples', 'female_age_mean', 'female_age_median',
'female_age_stdev', 'female_age_sample_weight', 'female_age_samples',
'pct_own', 'married', 'married_snp', 'separated', 'divorced']
```

```
missing_test_cols=[]
for col in df_test.columns:
    if df_test[col].isna().sum() !=0:
        missing_test_cols.append(col)
print(missing_test_cols)
```

```
['rent_mean', 'rent_median', 'rent_stdev', 'rent_sample_weight',
'rent_samples', 'rent_gt_10', 'rent_gt_15', 'rent_gt_20',
'rent_gt_25', 'rent_gt_30', 'rent_gt_35', 'rent_gt_40', 'rent_gt_50',
'hi_mean', 'hi_median', 'hi_stdev', 'hi_sample_weight', 'hi_samples',
'family_mean', 'family_median', 'family_stdev',
'family_sample_weight', 'family_samples', 'hc_mortgage_mean',
'hc_mortgage_median', 'hc_mortgage_stdev',
'hc_mortgage_sample_weight', 'hc_mortgage_samples', 'hc_mean',
'hc_median', 'hc_stdev', 'hc_samples', 'hc_sample_weight',
'home_equity_second_mortgage', 'second_mortgage', 'home_equity',
'debt', 'second_mortgage_cdf', 'home_equity_cdf', 'debt_cdf',
'hs_degree', 'hs_degree_male', 'hs_degree_female', 'male_age_mean',
'male_age_median', 'male_age_stdev', 'male_age_sample_weight',
'male_age_samples', 'female_age_mean', 'female_age_median',
'female_age_stdev', 'female_age_sample_weight', 'female_age_samples',
'pct_own', 'married', 'married_snp', 'separated', 'divorced']
```

```
for col in df_test.columns:
    if col in (missing_test_cols):
        df_test[col].replace(np.nan, df_test[col].mean(),
inplace=True)
```

```
for col in df_train.columns:
    if col in (missing_train_cols):
```

```
        df_train[col].replace(np.nan, df_train[col].mean(), inplace =
True)
```

```
df_test.isnull().sum()
```

```
COUNTYID       0
STATEID        0
state          0
state_ab       0
city           0
              ..
pct_own        0
married        0
married_snp    0
separated      0
divorced       0
Length: 77, dtype: int64
```

```
df_test.isnull().sum()
```

```
COUNTYID       0
STATEID        0
state          0
state_ab       0
city           0
              ..
pct_own        0
married        0
married_snp    0
separated      0
divorced       0
Length: 77, dtype: int64
```

```
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns

import plotly.express as px
import plotly.graph_objects as go

from pandasql import sqldf
```

```
df_test.columns
```

```
Index(['COUNTYID', 'STATEID', 'state', 'state_ab', 'city', 'place',
'type',
       'primary', 'zip_code', 'area_code', 'lat', 'lng', 'ALand',
'AWater',
       'pop', 'male_pop', 'female_pop', 'rent_mean', 'rent_median',
       'rent_stdev', 'rent_sample_weight', 'rent_samples',
'rent_gt_10',
       'rent_gt_15', 'rent_gt_20', 'rent_gt_25', 'rent_gt_30',
```

```
'rent_gt_35',
       'rent_gt_40', 'rent_gt_50', 'universe_samples', 'used_samples',
       'hi_mean', 'hi_median', 'hi_stdev', 'hi_sample_weight',
'hi_samples',
       'family_mean', 'family_median', 'family_stdev',
'family_sample_weight',
       'family_samples', 'hc_mortgage_mean', 'hc_mortgage_median',
       'hc_mortgage_stdev', 'hc_mortgage_sample_weight',
'hc_mortgage_samples',
       'hc_mean', 'hc_median', 'hc_stdev', 'hc_samples',
'hc_sample_weight',
       'home_equity_second_mortgage', 'second_mortgage',
'home_equity', 'debt',
       'second_mortgage_cdf', 'home_equity_cdf', 'debt_cdf',
'hs_degree',
       'hs_degree_male', 'hs_degree_female', 'male_age_mean',
       'male_age_median', 'male_age_stdev', 'male_age_sample_weight',
       'male_age_samples', 'female_age_mean', 'female_age_median',
       'female_age_stdev', 'female_age_sample_weight',
'female_age_samples',
       'pct_own', 'married', 'married_snp', 'separated', 'divorced'],
      dtype='object')
```

```
Q1= "select place,pct_own,second_mortgage,lat,lng from df_train where
pct_own >0.10 and second_mortgage <0.5 order by second_mortgage DESC
LIMIT 2500;"
pysqldf = lambda q: sqldf(q, globals())
df_train_location_mort=pysqldf(Q1)

len(df_train_location_mort)
```

```
2500
```

```
#length = 2500

df_train_location_mort.head()
```

	place	pct_own	second_mortgage	lat	lng
0	Worcester City	0.20247	0.43363	42.254262	-71.800347
1	Harbor Hills	0.15618	0.31818	40.751809	-73.853582
2	Glen Burnie	0.22380	0.30212	39.127273	-76.635265
3	Egypt Lake-leto	0.11618	0.28972	28.029063	-82.495395
4	Lincolnwood	0.14228	0.28899	41.967289	-87.652434

```
fig = go.Figure(data=go.Scattergeo(
    lat = df_train_location_mort['lat'],
    lon = df_train_location_mort['lng']),
    )
fig.update_layout(
    geo=dict(
        scope = 'north america',
        showland = True,
```

```
        landcolor = "rgb(212, 212, 212)",
        subunitcolor = "rgb(255, 255, 255)",
        countrycolor = "rgb(255, 255, 255)",
        showlakes = True,
        lakecolor = "rgb(255, 255, 255)",
        showsubunits = True,
        showcountries = True,
        resolution = 50,
        projection = dict(
            type = 'conic conformal',
            rotation_lon = -100
        ),
        lonaxis = dict(
            showgrid = True,
            gridwidth = 0.5,
            range= [ -140.0, -55.0 ],
            dtick = 5
        ),
        lataxis = dict (
            showgrid = True,
            gridwidth = 0.5,
            range= [ 20.0, 60.0 ],
            dtick = 5
        )
    ),
    title='Top 2,500 locations with second mortgage is the highest and
percent ownership is above 10 percent')
fig.show()
```


```
{"config":{"plotlyServerURL":"https://plot.ly"},"data":[{"lat":
[42.2542618,40.7518089,39.1272728,28.0290633,41.9672885,41.9066403,42.
7142082,43.0670633,34.0931841,37.656229,39.1213157,32.8003476,38.81917
14,39.5094376,38.2947649,41.5270157,42.3971272,38.2470347,38.8499425,4
1.7677281,41.783468,34.1039593,45.4454048,33.9555895,28.5332632,33.724
9036,35.1285876,32.2955885,47.2401479,43.9728571,38.971338,34.36362,33
.5651234,39.6599172,28.0230563,26.0073086,39.7756533,40.9199667,39.859
951,41.7454851,40.6943396,37.8326423,38.8328939,41.7235155,35.0921183,
33.8796686,39.3792483,33.9895557,40.8377899,40.8377899,35.9901296,32.6
599903,40.6406399,39.1524277,38.6614448,33.9247081,42.7289757,39.95277
32,37.3562105,36.1624293,28.5204988,38.5916036,40.0668653,47.6199882,3
3.7088571,34.0432749,40.7821699,45.6548641,39.1355543,34.2536788,34.14
94929,41.1131233,38.8879464,38.7222559,36.3189796,40.5942315,38.832772
,37.8046754,38.6037792,40.385902,37.0503105,34.2804584,40.1233788,45.5
188106,40.8897429,41.6639299,41.7052478,41.7415615,45.527539,42.722429
5,41.7902101,37.7741755,35.9982089,45.4992015,34.0122688,40.7955828,41
.7617135,38.8463903,39.6754541,41.8085114,41.2591195,41.835608,39.1886
045,33.1732234,45.1348548,41.7944972,33.7789729,37.7344919,33.7452198,
45.0360622,38.7240552,39.0901783,37.2980229,32.7840087,33.8019004,30.3
465716,40.4253305,33.9546932,41.987226,35.5325822,43.563675,47.2287315
,38.9456938,41.1706268,34.9607591,38.8688572,34.2409046,37.7109995,36.
```

8444256,39.3785915,39.9174144,35.281548,36.0446391,34.0979077,38.12954
41,33.7247482,25.8642626,33.3305333,38.5419331,38.2665083,33.0755145,4
4.9767007,34.2247342,34.2640589,40.4427091,32.7898054,41.6219893,33.58
76988,41.5449634,40.6791764,42.0227059,35.7849873,42.0298213,42.682308
9,33.7538839,40.8384785,38.0127453,33.7069847,32.4768764,34.0685435,40
.7556398,39.0087272,36.7873267,25.606452,40.6701918,40.4727644,33.6278
555,47.8581251,36.2541516,38.8313107,47.399399,40.7842611,33.6518163,3
3.7548958,34.8631405,33.1732652,33.8647762,27.9118994,37.9206017,45.54
54185,33.771918,39.0666053,39.0912204,35.9949426,38.8396609,40.0416936
,36.8973185,29.9351417,30.1702766,39.5374034,34.2046283,40.2997497,38.
910779,32.6533559,36.1633112,25.8879442,45.4851663,44.7834015,40.28499
47,34.268934,30.4228579,42.3171635,38.9002,39.7382028,38.9479653,41.86
29246,39.1318665,33.1276339,39.8986779,33.2986622,40.6893276,34.091697
5,38.7527742,26.0038057,35.3029184,41.3271237,28.0994325,40.7728319,42
.3840376,40.6637279,41.4685324,37.6970765,39.543137,29.7272676,41.8138
06,40.6816514,40.6024871,45.0095917,40.7866906,39.700231,41.9350552,33
.9001056,41.9015665,37.650262,39.4024657,37.4633117,47.1971869,33.6779
027,33.905117,25.7824844,38.8610018,41.8103984,39.4112636,39.648829,45
.204478,35.3211017,37.3702336,30.167655,34.2026924,38.8260946,38.80240
5,32.6663314,41.971339,40.6825052,39.8848582,33.6053327,44.9951749,46.
617046,33.5863884,34.1009548,38.2490976,44.8654852,34.224257,42.494882
3,39.8781135,35.0613382,39.8072621,41.8008741,39.9394959,38.7344628,40
.7437159,38.8494179,40.6272716,45.5403004,43.0602744,36.5088616,33.383
7635,33.6980366,34.9324506,47.1057867,38.0473283,34.1466652,40.7650072
,39.6282932,43.0951653,32.867998,43.1156863,33.9745825,34.0155355,34.0
456314,40.1083208,34.0571243,33.9747696,38.8768597,42.2774512,32.81297
85,41.0810691,40.0076218,39.1753881,39.5503765,40.7322124,40.1230198,3
3.9420596,41.8930097,36.8200899,38.7250775,41.6714456,42.003403,39.489
1874,34.098786,38.0264084,35.386741,29.8962526,44.8533988,35.6464434,3
3.7205506,38.8031495,31.5847415,41.4496925,38.4357606,35.2460806,38.80
7731,39.5192622,41.7064973,39.9887598,39.9087252,41.8750221,34.2135692
,34.0549939,42.3689514,43.1261759,39.920151,33.8406153,41.9753473,39.0
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2427,41.7985268,32.6397559,33.3558253,41.1916789,40.462813,41.5160928,
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058091,39.0964218,33.4884762,41.0991396,41.7832811,37.8020757,39.69939
31,36.7882746,34.1510732,39.9666126,41.7268625,42.1687441,30.2119403,4
0.0882996,30.2027914,40.7892525,33.9345319,38.333362,37.1575735,33.498
0444,33.608917,39.6280414,41.7979687,38.9041579,40.7327308,41.8174455,
33.4496873,47.0718234,41.2178042,40.4914328,39.9352608,30.1643889,34.1
104058,42.5371082,40.7595706,34.0490207,39.6491238,42.2914125,36.81161
52,40.3450536,40.19591,33.063899,41.9103131,34.1176605,30.1745516,42.0
783429,37.4123848,28.9341355,44.0411086,41.5255068,40.6616591,42.65019
23,45.4973096,41.4739462,42.4400021,38.84267,33.1075966,33.9851297,47.
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77485,33.481257,30.6919512,33.9388223,39.7206692,47.2455764,34.2670388
,41.8141492,40.6530866,42.2309589,40.1958838,33.7805453,34.214735,38.8
327451,34.1471798,64.8512872,43.0692654,41.5672397,35.1789593,41.05344
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2536,43.1010409,32.9525906,39.1334567,34.2271384,35.1740721,39.024978,
39.6608049,33.8381856,34.042074,39.6792879,42.6376032,32.8998834,28.48
01373,39.9059339,43.5978121,32.963961,34.197228,37.7909447,38.2950726,
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```
df_train['bad_debt']= df_train['second_mortgage']+
df_train['home_equity']-df_train['home_equity_second_mortgage']
```

```
df_train.columns
```

```
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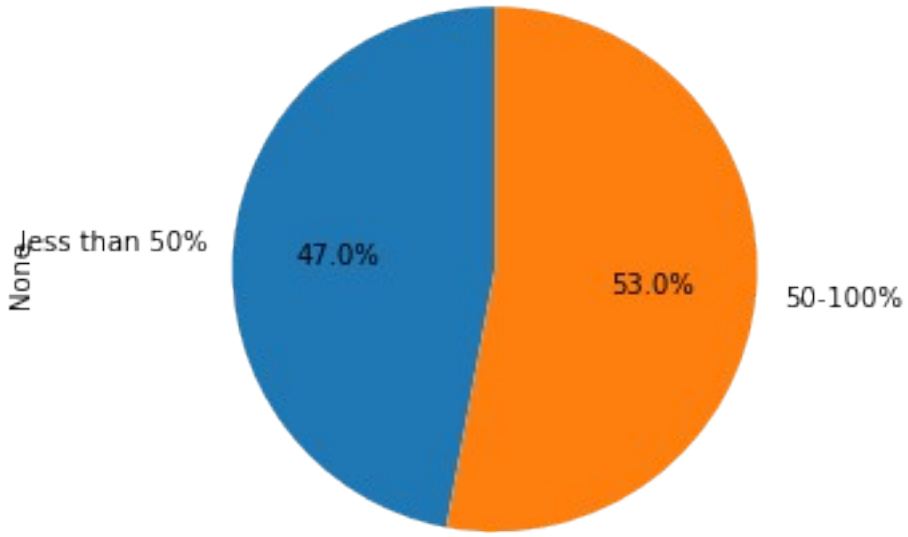
```
df_train['bins']= pd.cut(df_train['bad_debt'], bins = [0,0.10,1],
labels = ["less than 50%" , "50-100%"])
df_train.groupby(['bins']).size().plot(kind='pie', subplots=True,
startangle = 90, autopct='%1.1f%%')
plt.axis('equal')
```

```
plt.show()
```




```
cols = []
df_train.columns
```

```
Index(['COUNTYID', 'STATEID', 'state', 'state_ab', 'city', 'place',
'type',
       'primary', 'zip_code', 'area_code', 'lat', 'lng', 'ALand',
'AWater',
       'pop', 'male_pop', 'female_pop', 'rent_mean', 'rent_median',
       'rent_stdev', 'rent_sample_weight', 'rent_samples',
'rent_gt_10',
       'rent_gt_15', 'rent_gt_20', 'rent_gt_25', 'rent_gt_30',
'rent_gt_35',
       'rent_gt_40', 'rent_gt_50', 'universe_samples', 'used_samples',
       'hi_mean', 'hi_median', 'hi_stdev', 'hi_sample_weight',
'hi_samples',
       'family_mean', 'family_median', 'family_stdev',
'family_sample_weight',
       'family_samples', 'hc_mortgage_mean', 'hc_mortgage_median',
       'hc_mortgage_stdev', 'hc_mortgage_sample_weight',
'hc_mortgage_samples',
       'hc_mean', 'hc_median', 'hc_stdev', 'hc_samples',
'hc_sample_weight',
       'home_equity_second_mortgage', 'second_mortgage',
'home_equity', 'debt',
       'second_mortgage_cdf', 'home_equity_cdf', 'debt_cdf',
'hs_degree',
       'hs_degree_male', 'hs_degree_female', 'male_age_mean',
       'male_age_median', 'male_age_stdev', 'male_age_sample_weight',
       'male_age_samples', 'female_age_mean', 'female_age_median',
```

```
       'female_age_stdev', 'female_age_sample_weight',
'female_age_samples',
       'pct_own', 'married', 'married_snp', 'separated', 'divorced',
       'bad_debt', 'bins'],
      dtype='object')
```

```
cols=['second_mortgage','home_equity','debt','bad_debt']
df_box_hamilton=df_train.loc[df_train['city'] == 'Hamilton']
df_box_manhattan=df_train.loc[df_train['city'] == 'Manhattan']
df_box_city=pd.concat([df_box_hamilton,df_box_manhattan])
df_box_city.head(4)
```

```
        COUNTYID  STATEID        state state_ab      city
place  \
UID

267822        53       36     New York       NY  Hamilton
Hamilton
263797        21       34   New Jersey       NJ  Hamilton
Yardville
270979        17       39         Ohio       OH  Hamilton  Hamilton
City
259028        95       28  Mississippi       MS  Hamilton
Hamilton

           type primary  zip_code  area_code  ...  female_age_stdev  \
UID                                           ...
267822     City   tract     13346        315  ...          22.51276
263797     City   tract      8610        609  ...          24.05831
270979  Village   tract     45015        513  ...          22.66500
259028      CDP   tract     39746        662  ...          22.79602

        female_age_sample_weight  female_age_samples  pct_own  married
\
UID

267822                685.33845              2618.0  0.79046  0.57851

263797                732.58443              3124.0  0.64400  0.56377

270979                565.32725              2528.0  0.61278  0.47397

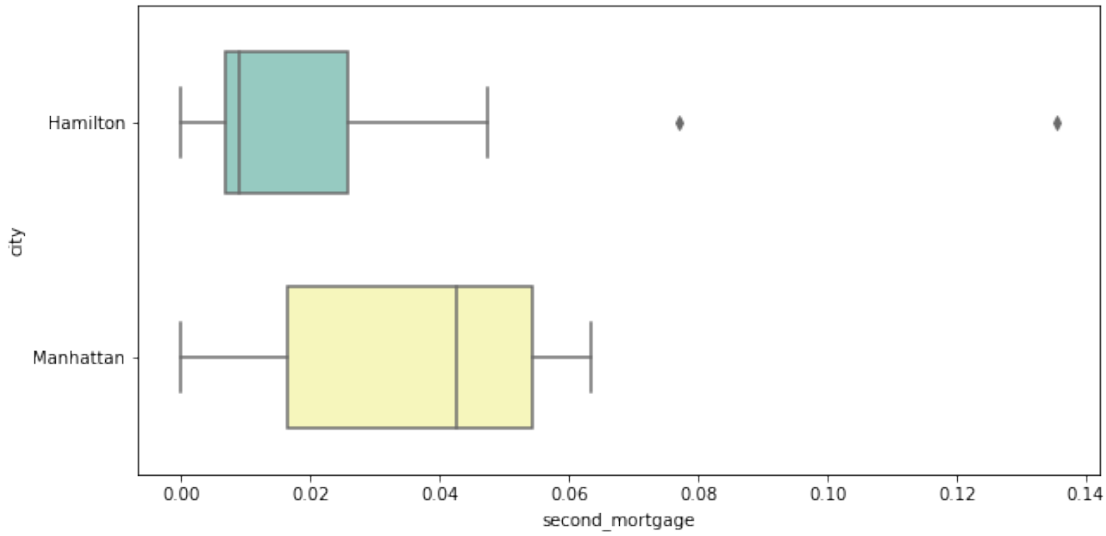
259028                483.01311              1954.0  0.83241  0.58678


        married_snp  separated  divorced  bad_debt           bins
UID
267822      0.01882    0.01240   0.08770   0.09408  less than 50%
263797      0.01980    0.00990   0.04892   0.18071        50-100%
270979      0.04419    0.02663   0.13741   0.15005        50-100%
```

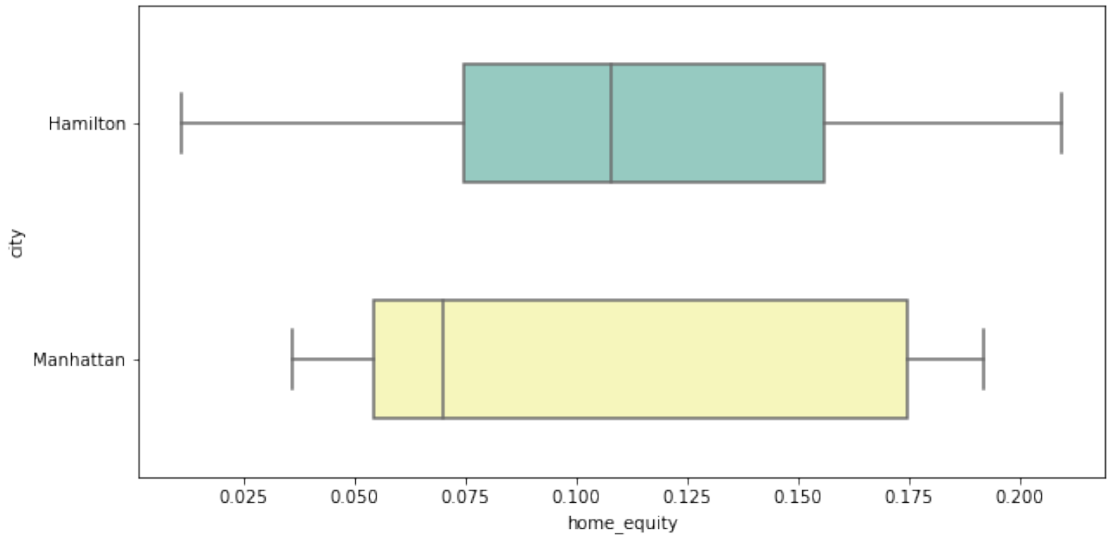
```
259028      0.01052    0.00000   0.11721   0.02130  less than 50%

[4 rows x 79 columns]
```

```
plt.figure(figsize=(10,5))
sns.boxplot(data=df_box_city , x='second_mortgage', y='city', width =
0.6, palette = "Set3")
plt.show()
```

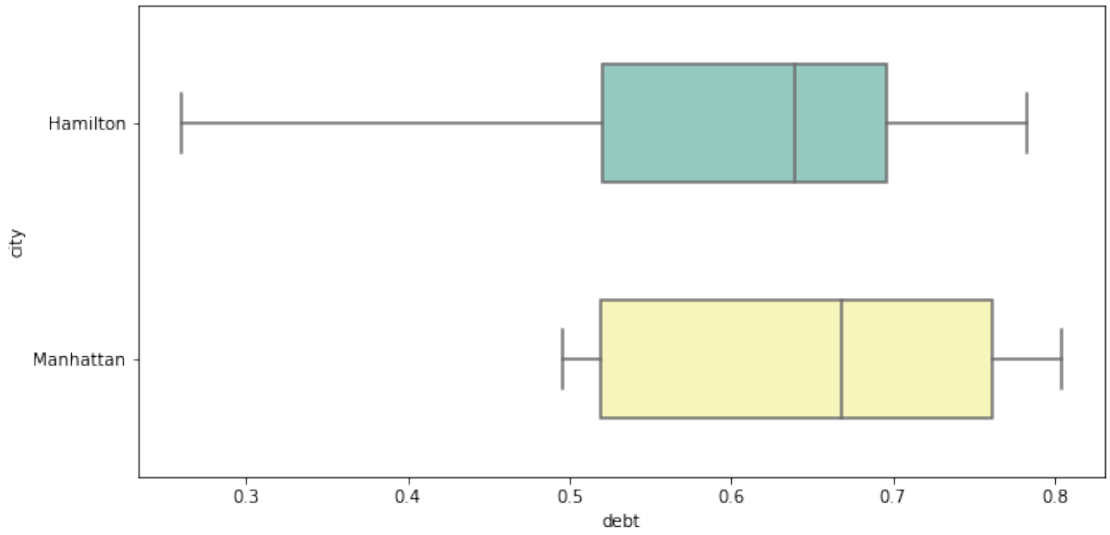



```
plt.figure(figsize=(10,5))
sns.boxplot(data=df_box_city,x='home_equity',
y='city',width=0.5,palette="Set3")
plt.show()
```

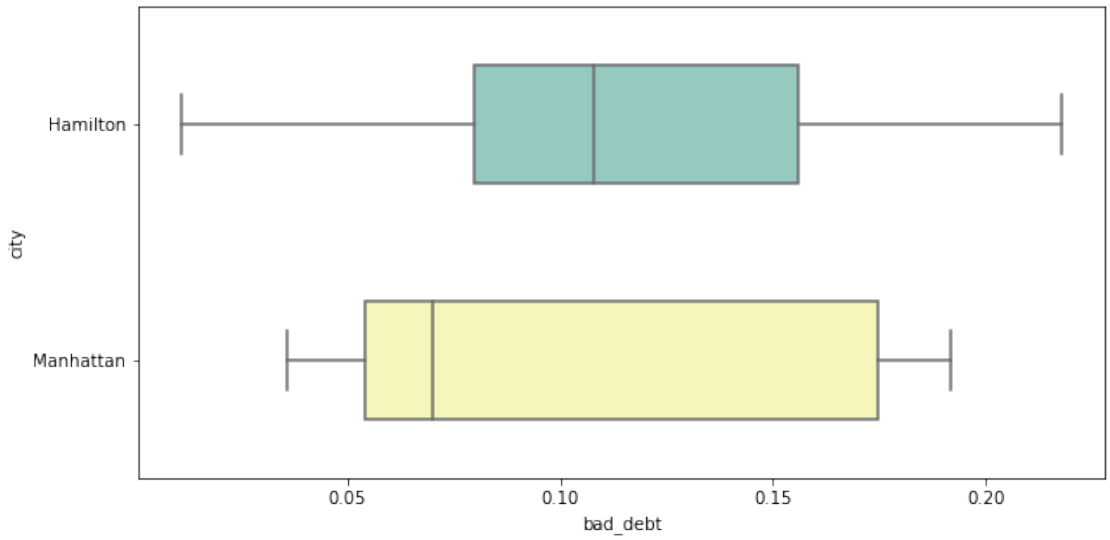



```
plt.figure(figsize=(10,5))
sns.boxplot(data=df_box_city,x='debt',
```

```
y='city',width=0.5,palette="Set3")
plt.show()
```




```
plt.figure(figsize=(10,5))
sns.boxplot(data=df_box_city,x='bad_debt',
y='city',width=0.5,palette="Set3")
plt.show()
```

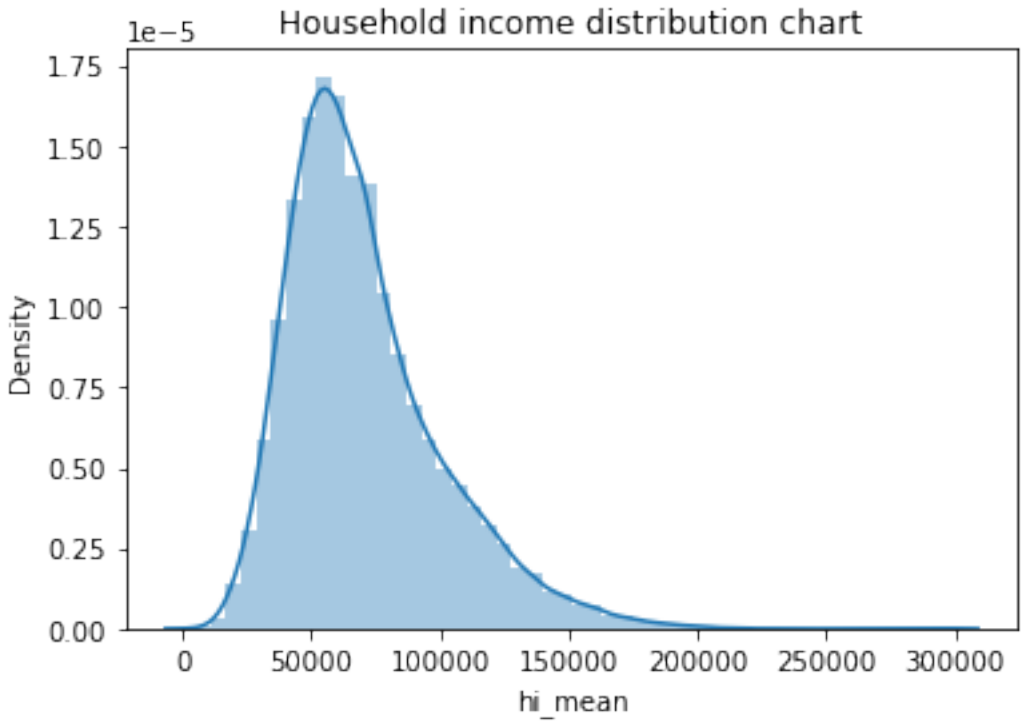


Create a collated income distribution chart for family income, house hold income, and remaining income

```
sns.distplot(df_train['hi_mean'])
plt.title('Household income distribution chart')
plt.show()
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:
```

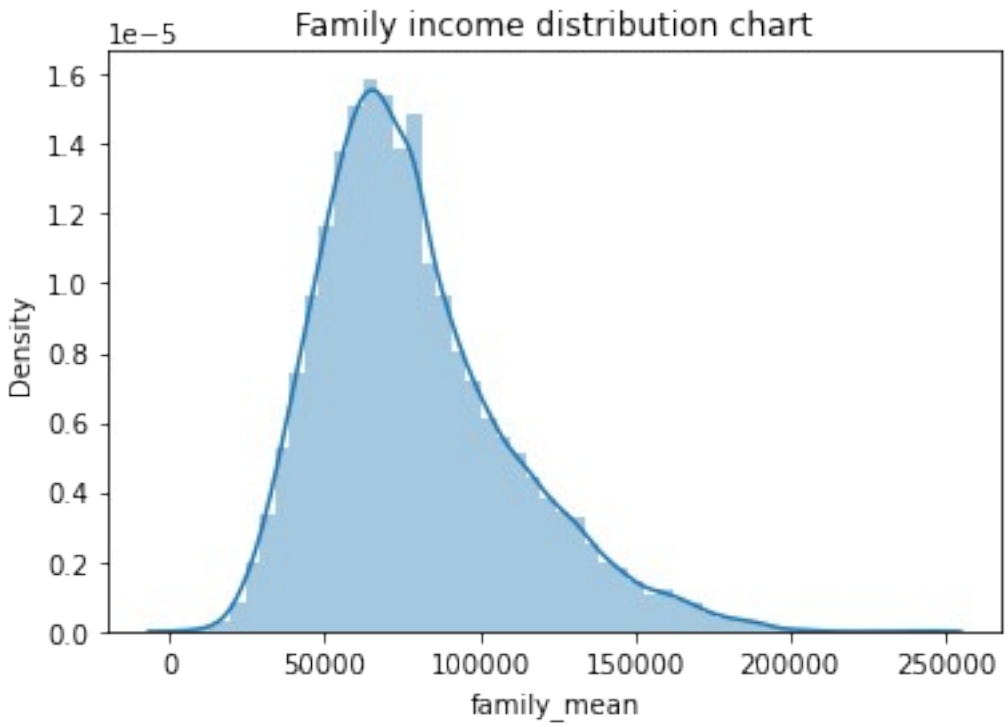
```
`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).
```




```
sns.distplot(df_train['family_mean'])
plt.title('Family income distribution chart')
plt.show()
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:

`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).
```



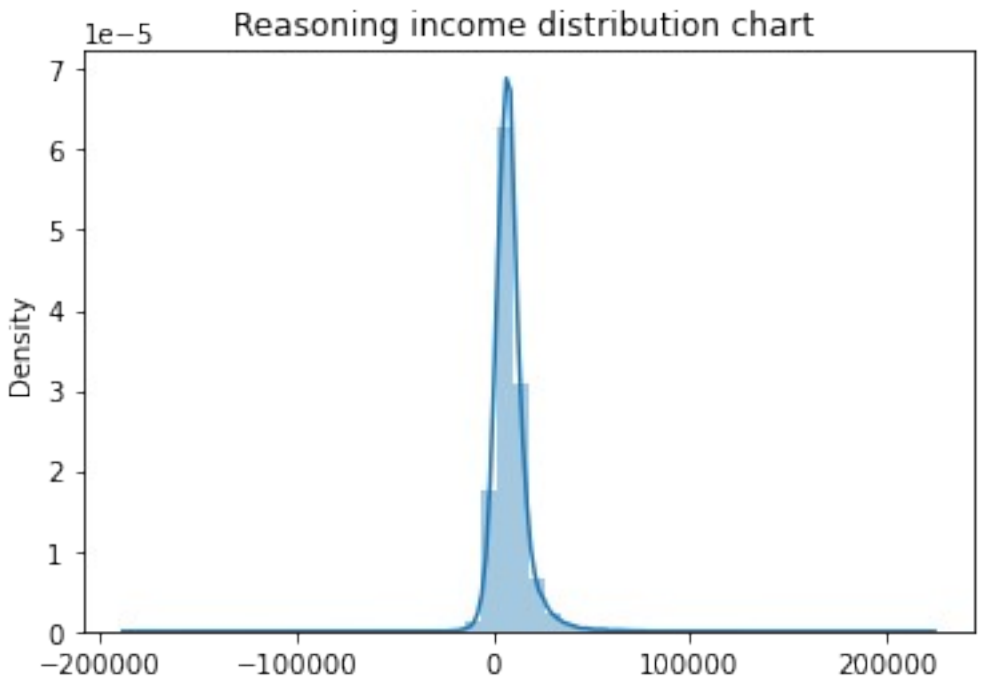

```
if 'family_mean' in df_train.columns:
    print("Yes")
else:
    print("No")
```

```
Yes
```

```
sns.distplot(df_train['family_mean']- df_train['hi_mean'])
plt.title('Reasoning income distribution chart ')
plt.show()
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:

`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).
```



Perform EDA and come out with insights into population density and age. You may have to derive new fields (make sure to weight averages for accurate measurements):

```
fig, (ax1, ax2, ax3)= plt.subplots(3,1)
sns.distplot(df_train['pop'], ax= ax1)
sns.distplot(df_train['male_pop'], ax=ax2)
sns.distplot(df_train['female_pop'], ax=ax3)
plt.subplots_adjust(wspace = 0.8 , hspace = 0.8)
plt.tight_layout()
plt.show()
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:

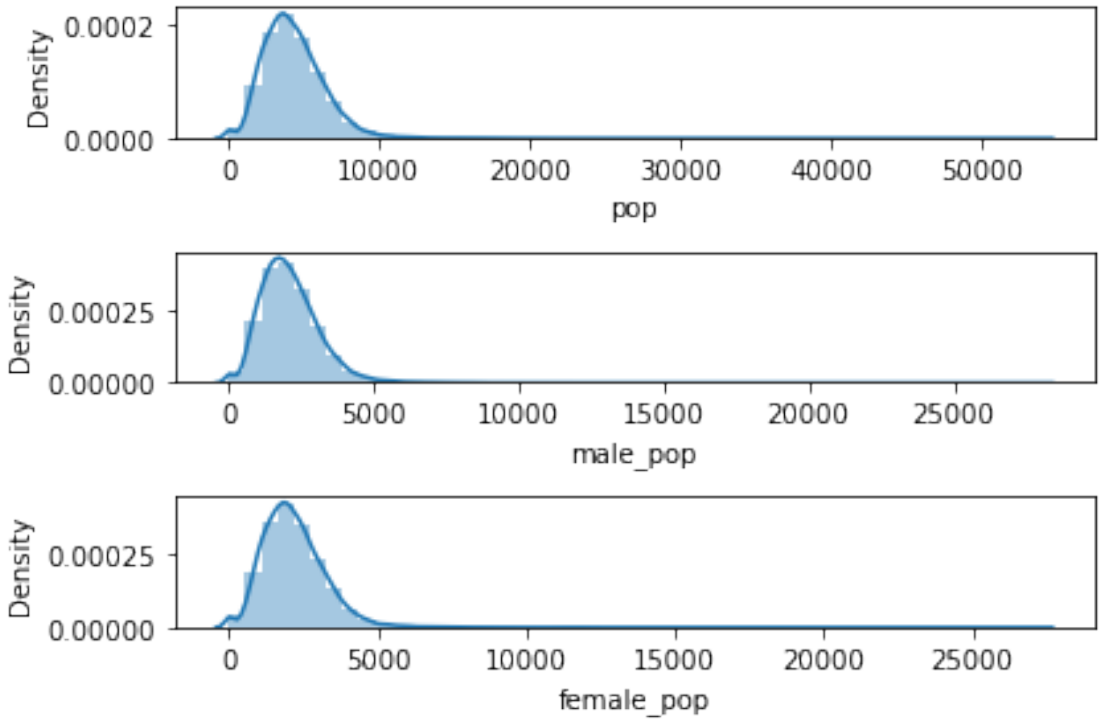
`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).

C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:

`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).

C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:
```

```
`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).
```




```
import warnings
warnings.filterwarnings("default")

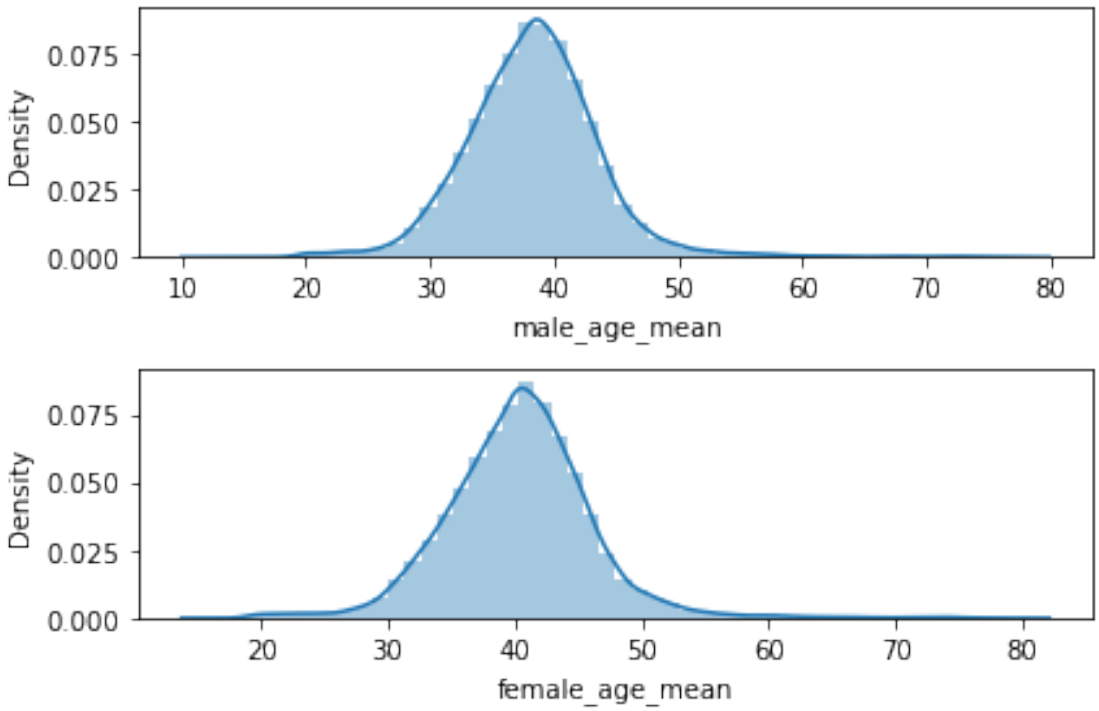
fig,(ax1, ax2)= plt.subplots(2,1)
sns.distplot(df_train['male_age_mean'], ax= ax1)
sns.distplot(df_train['female_age_mean'], ax=ax2)
plt.subplots_adjust(wspace=0.8, hspace = 0.8)
plt.tight_layout()
plt.show()
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:

`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).

C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:
```

```
`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).
```



a) Use pop and ALand variables to create a new field called population density

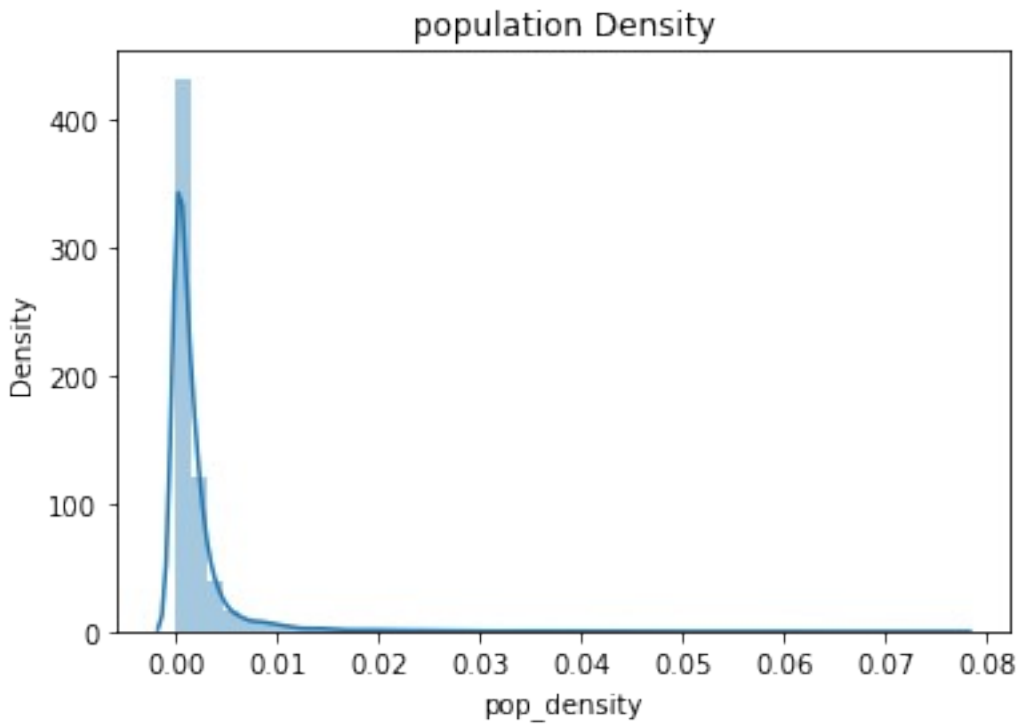
```
df_train['pop_density']= df_train['pop']/df_train['ALand']

df_test['pop_density']= df_test['pop']/df_test['ALand']

sns.distplot(df_train['pop_density'])
plt.title('population Density')
plt.show()

C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:

`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).
```



Use male_age_median, female_age_median, male_pop, and female_pop to create a new field called median age c) Visualize the findings using appropriate chart type

```
df_train['age_median']= (df_train['male_age_median']+
df_train['female_age_median'])/2
df_test['age_median']= (df_test['male_age_median']+
df_test['female_age_median'])/2
```

```
df_test[['male_age_median', 'female_age_median', 'male_pop',
'female_pop','age_median']].head()
```

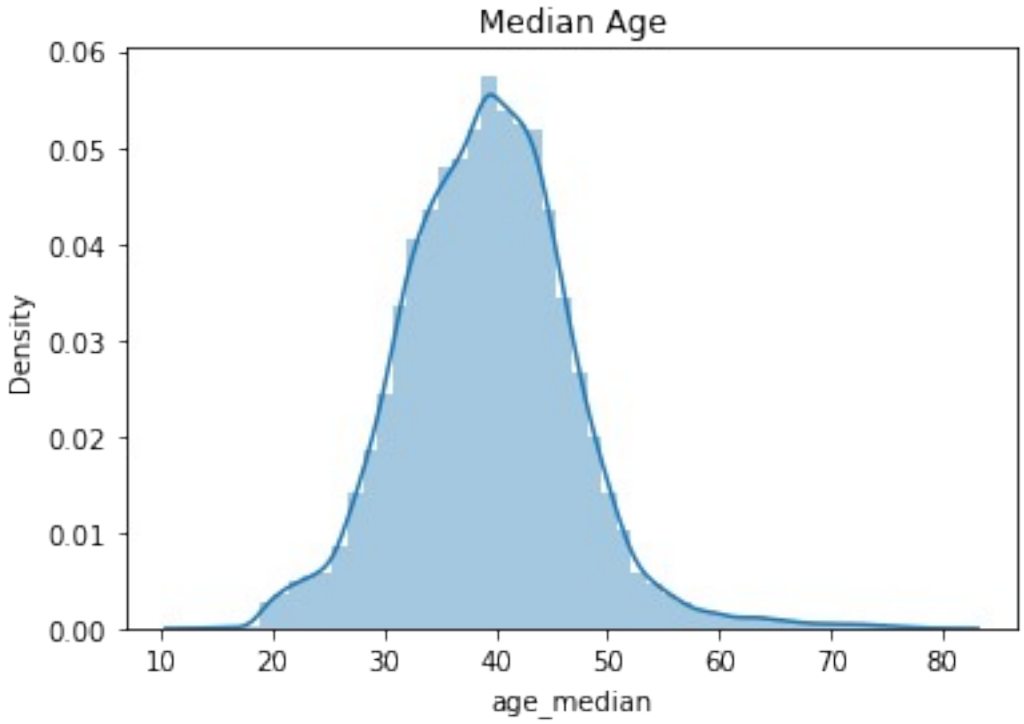
```
        male_age_median  female_age_median  male_pop  female_pop
age_median
UID

255504         27.83333           33.75000      1479        1938
30.791665
252676         46.08333           46.66667      1846        1950
46.375000
276314         41.91667           44.50000      2065        1879
43.208335
248614         43.00000           48.00000      1427        1081
45.500000
286865         43.75000           42.66667      3274        2956
43.208335
```

```
sns.distplot(df_train['age_median'])
plt.title('Median Age')
plt.show()
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:

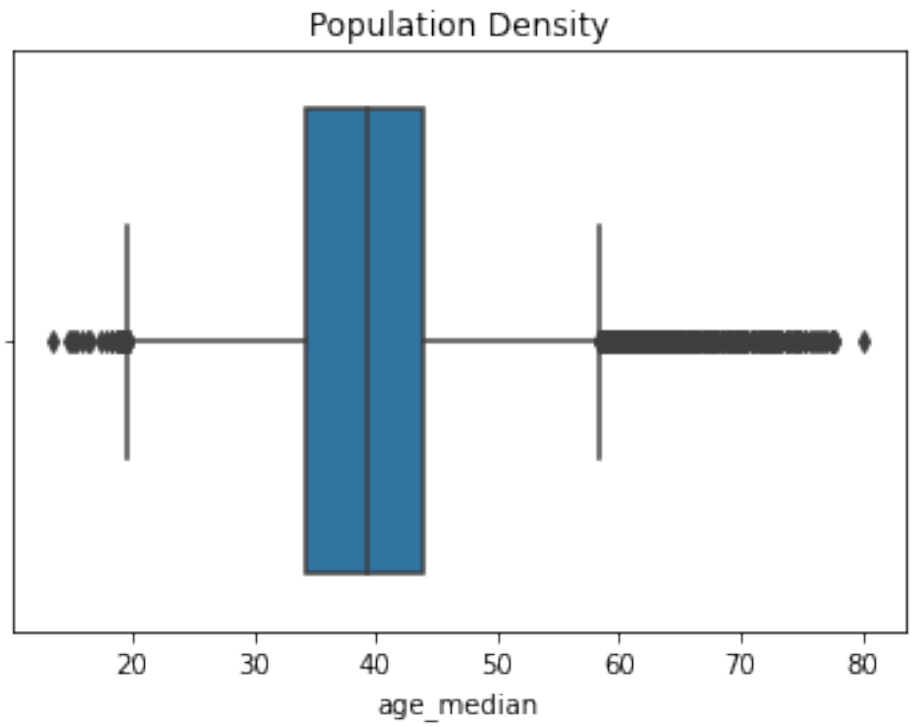
`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).
```




```
sns.boxplot(df_train['age_median'])
plt.title('Population Density')
plt.show()
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning:

Pass the following variable as a keyword arg: x. From version 0.12,
the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
```



Create bins for population into a new variable by selecting appropriate class interval so that the number of categories don't exceed 5 for the ease of analysis

```
df_train['pop'].describe()
```

```
count    27321.000000
mean      4316.032685
std       2169.226173
min          0.000000
25%       2885.000000
50%       4042.000000
75%       5430.000000
max      53812.000000
Name: pop, dtype: float64
```

```
df_train['pop_bins']= pd.cut(df_train['pop'], bins=5, labels =
['very_low', 'low','medium','high','very high'])
```

```
df_train[['pop','pop_bins']]
```

```
          pop  pop_bins
UID
267822   5230  very_low
246444   2633  very_low
245683   6881  very_low
279653   2700  very_low
247218   5637  very_low
...       ...       ...
279212   1847  very_low
```

```
277856   4155  very_low
233000   2829  very_low
287425  11542       low
265371   3726  very_low

[27321 rows x 2 columns]
```

```
df_train['pop_bins'].value_counts()
```

```
very_low     27058
low            246
medium           9
high             7
very high        1
Name: pop_bins, dtype: int64
```

Analyze the married, separated, and divorced population for these population brackets

```
df_train.groupby(by='pop_bins')[['married', 'separated',
'divorced']].count()
```

```
           married  separated  divorced
pop_bins
very_low     27058      27058     27058
low            246        246       246
medium           9          9         9
high             7          7         7
very high        1          1         1
```

```
df_train.groupby(by='pop_bins')
[['married','separated','divorced']].agg(["mean", "median"])
```

```
            married           separated            divorced
               mean    median      mean    median      mean    median
pop_bins
very_low   0.507548  0.524680  0.019126  0.013650  0.100504  0.096020
low        0.584894  0.593135  0.015833  0.011195  0.075348  0.070045
medium     0.655737  0.618710  0.005003  0.004120  0.065927  0.064890
high       0.503359  0.335660  0.008141  0.002500  0.039030  0.010320
very high  0.734740  0.734740  0.004050  0.004050  0.030360  0.030360
```

#1 Very high population group has more married people and less percantage of separated and divorced couples

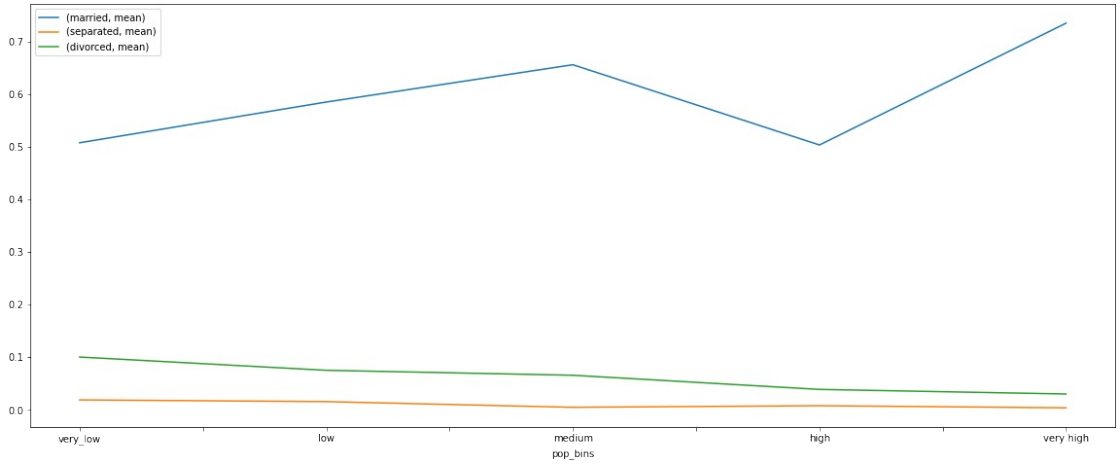
#2 In very low population groups, there are more divorced people

```
plt.figure(figsize=(10,5))

pop_bin_married= df_train.groupby(by='pop_bins')[['married',
'separated', 'divorced']].agg(["mean"])
pop_bin_married.plot(figsize=(20,8))
```

```
plt.legend(loc='best')
plt.show()
```

```
<Figure size 720x360 with 0 Axes>
```




```
rent_state_mean= df_train.groupby(by='state')
['rent_mean'].agg(["mean"])
rent_state_mean.head()
```

```
                  mean
state
Alabama       774.004927
Alaska       1185.763570
Arizona      1097.753511
Arkansas      720.918575
California   1471.133857
```

```
income_state_mean= df_train.groupby(by='state')
['family_mean'].agg(["mean"])
income_state_mean.head()
```

```
                   mean
state
Alabama      67030.064213
Alaska       92136.545109
Arizona      73328.238798
Arkansas     64765.377850
California   87655.470820
```

```
rent_perc_of_income=rent_state_mean['mean']/income_state_mean['mean']
rent_perc_of_income.head(10)
```

```
state
Alabama                 0.011547
Alaska                  0.012870
Arizona                 0.014970
Arkansas                0.011131
```

```
California              0.016783
Colorado                0.013529
Connecticut             0.012637
Delaware                0.012929
District of Columbia    0.013198
Florida                 0.015772
Name: mean, dtype: float64
```

```
sum(df_train['rent_mean'])/sum(df_train['family_mean'])
```

```
0.013358170721473864
```

Perform correlation analysis for all the relevant variables by creating a heatmap. Describe your findings.

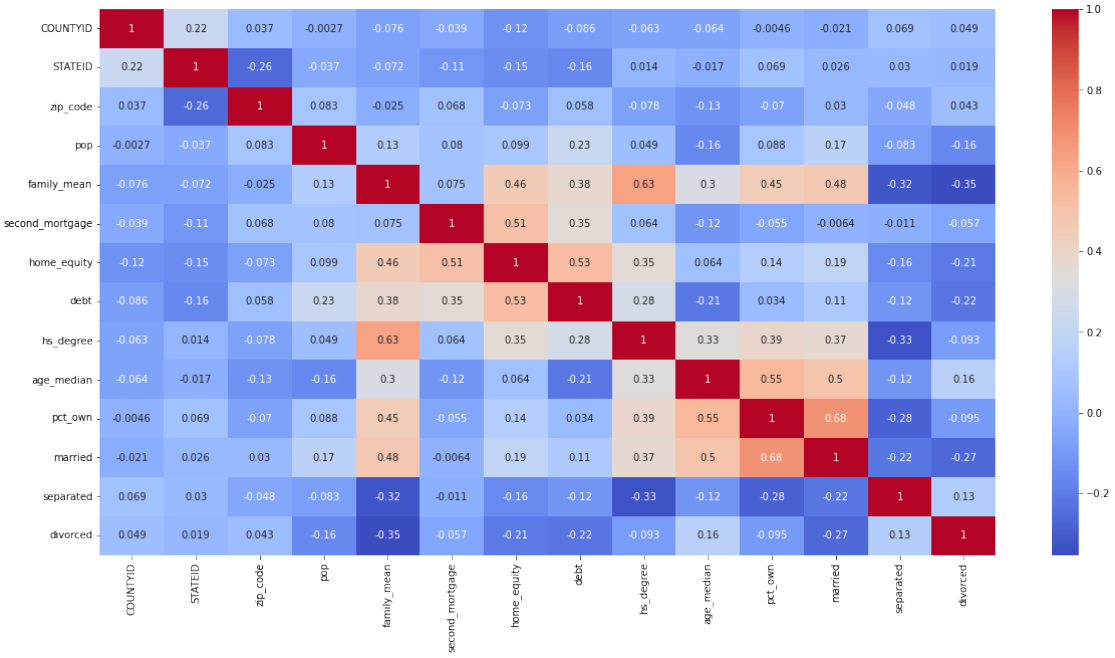
```
df_train.columns
```

```
Index(['COUNTYID', 'STATEID', 'state', 'state_ab', 'city', 'place',
'type',
       'primary', 'zip_code', 'area_code', 'lat', 'lng', 'ALand',
'AWater',
       'pop', 'male_pop', 'female_pop', 'rent_mean', 'rent_median',
       'rent_stdev', 'rent_sample_weight', 'rent_samples',
'rent_gt_10',
       'rent_gt_15', 'rent_gt_20', 'rent_gt_25', 'rent_gt_30',
'rent_gt_35',
       'rent_gt_40', 'rent_gt_50', 'universe_samples', 'used_samples',
       'hi_mean', 'hi_median', 'hi_stdev', 'hi_sample_weight',
'hi_samples',
       'family_mean', 'family_median', 'family_stdev',
'family_sample_weight',
       'family_samples', 'hc_mortgage_mean', 'hc_mortgage_median',
       'hc_mortgage_stdev', 'hc_mortgage_sample_weight',
'hc_mortgage_samples',
       'hc_mean', 'hc_median', 'hc_stdev', 'hc_samples',
'hc_sample_weight',
       'home_equity_second_mortgage', 'second_mortgage',
'home_equity', 'debt',
       'second_mortgage_cdf', 'home_equity_cdf', 'debt_cdf',
'hs_degree',
       'hs_degree_male', 'hs_degree_female', 'male_age_mean',
       'male_age_median', 'male_age_stdev', 'male_age_sample_weight',
       'male_age_samples', 'female_age_mean', 'female_age_median',
       'female_age_stdev', 'female_age_sample_weight',
'female_age_samples',
       'pct_own', 'married', 'married_snp', 'separated', 'divorced',
       'bad_debt', 'bins', 'pop_density', 'age_median', 'pop_bins'],
      dtype='object')
```

```
cor=df_train[['COUNTYID','STATEID','zip_code','type','pop',
'family_mean',
```

```
        'second_mortgage', 'home_equity', 'debt','hs_degree',
         'age_median','pct_own', 'married','separated',
'divorced']].corr()

plt.figure(figsize=(20,10))
sns.heatmap(cor, annot=True, cmap='coolwarm')
plt.show()
```



1. The economic multivariate data has a significant number of measured variables. The goal is to find where the measured variables depend on a number of smaller unobserved common factors or latent variables. 2. Each variable is assumed to be dependent upon a linear combination of the common factors, and the coefficients are known as loadings. Each measured variable also includes a component due to independent random variability, known as “specific variance” because it is specific to one variable. Obtain the common factors and then plot the loadings. Use factor analysis to find latent variables in our dataset and gain insight into the linear relationships in the data. Following are the list of latent variables:

```
from sklearn.decomposition import FactorAnalysis
from factor_analyzer import FactorAnalyzer

fa = FactorAnalyzer(n_factors=5)
fa.fit_transform(df_train.select_dtypes(exclude = ('object',
'category')))
fa.loadings_

C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
factor_analyzer.py:368: DeprecationWarning:

scipy.sum is deprecated and will be removed in SciPy 2.0.0, use
numpy.sum instead
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:563: DeprecationWarning:

scipy.diag is deprecated and will be removed in SciPy 2.0.0, use
numpy.diag instead

C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:565: DeprecationWarning:

scipy.sqrt is deprecated and will be removed in SciPy 2.0.0, use
numpy.lib.scimath.sqrt instead

C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:579: DeprecationWarning:

scipy.dot is deprecated and will be removed in SciPy 2.0.0, use
numpy.dot instead

C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:579: DeprecationWarning:

scipy.diag is deprecated and will be removed in SciPy 2.0.0, use
numpy.diag instead

C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:584: DeprecationWarning:

scipy.sqrt is deprecated and will be removed in SciPy 2.0.0, use
numpy.lib.scimath.sqrt instead

C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:584: DeprecationWarning:

scipy.diag is deprecated and will be removed in SciPy 2.0.0, use
numpy.diag instead

C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:584: DeprecationWarning:

scipy.dot is deprecated and will be removed in SciPy 2.0.0, use
numpy.dot instead

C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:585: DeprecationWarning:

scipy.dot is deprecated and will be removed in SciPy 2.0.0, use
numpy.dot instead
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:590: DeprecationWarning:

scipy.sqrt is deprecated and will be removed in SciPy 2.0.0, use
numpy.lib.scimath.sqrt instead

C:\Users\bhumi\anaconda3\lib\site-packages\factor_analyzer\
rotator.py:592: DeprecationWarning:

scipy.dot is deprecated and will be removed in SciPy 2.0.0, use
numpy.dot instead


array([[-1.12589166e-01,  1.95646468e-02, -2.39331083e-02,
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       [-1.10186763e-01,  1.33506215e-02,  2.79651243e-02,
        -1.49825864e-01,  1.10838807e-01],
       [-8.28678646e-02,  5.16372377e-02, -1.36451871e-01,
        -4.98918634e-02, -1.04024841e-01],
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       [ 9.02324715e-02, -9.72544297e-02, -6.54601315e-02,
        -1.33145899e-01, -1.48594601e-01],
       [-1.07335697e-02, -4.12376818e-02,  1.45853484e-01,
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       [-4.28796971e-02, -2.09780214e-02,  3.66726851e-02,
        -9.45597383e-02,  5.91380520e-02],
       [-2.44243003e-03, -1.53245409e-02, -2.68300902e-03,
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        -6.59923845e-03, -3.97273184e-02],
       [ 7.39808211e-02,  9.18750524e-01, -1.08834840e-01,
        -2.79371590e-02, -3.93153640e-02],
       [ 8.06598896e-02,  9.47839220e-01, -6.08006509e-02,
         1.53627095e-02, -3.86977277e-02],
       [ 7.70052137e-01,  9.84675329e-03, -3.71249754e-02,
         1.14949046e-01, -1.23784684e-01],
       [ 7.18615881e-01,  6.24980464e-03, -4.59787407e-02,
         1.09109689e-01, -1.35301911e-01],
       [ 7.07647246e-01,  2.46625399e-02, -1.00860846e-02,
         1.04472488e-01,  7.72381251e-02],
       [-1.34545492e-01,  3.36809297e-01, -4.87894959e-01,
        -4.15446166e-02,  3.17608532e-01],
       [ 2.31079697e-01,  4.37729787e-01, -6.40209196e-01,
        -2.52310925e-02,  3.47216216e-01],
       [-4.52068133e-02,  3.51263844e-02,  3.07537041e-02,
         4.44793508e-01, -1.63273411e-01],
       [-2.50717066e-02,  1.70166796e-02,  4.57227280e-02,
         6.76083904e-01, -1.55256767e-01],
```

```
[-3.90694439e-02, -1.67460866e-02,  8.13962673e-02,
  8.36389105e-01, -9.18259792e-02],
[-5.14161936e-02, -3.57207135e-02,  1.10795184e-01,
  9.25123775e-01, -4.44866508e-02],
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  9.53019931e-01, -2.21548653e-02],
[-4.57771154e-02, -5.25526111e-02,  1.41019868e-01,
  9.32702618e-01, -5.83072683e-07],
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  8.87316645e-01,  1.05894326e-02],
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  7.79023669e-01,  2.95352834e-02],
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[ 2.33057249e-01,  4.47057850e-01, -6.28263427e-01,
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[ 7.10324880e-01,  4.99730440e-02,  1.32239990e-01,
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```

```
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[ 2.40298212e-01, -3.38140094e-02,  8.31497001e-01,
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  1.64800936e-02, -4.32590999e-02],
[-3.24381907e-02,  1.11167165e-01,  7.84467399e-01,
 -4.37718588e-02, -2.80931233e-01],
[ 1.76682389e-01,  1.90494237e-01,  5.61405482e-01,
 -1.20746167e-01, -1.32570785e-01],
```

```
       [-6.37386592e-02, -7.03047926e-02, -2.68934069e-01,
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       [-1.56051271e-01, -7.08033942e-02, -1.45964500e-01,
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       [-3.56716299e-01, -5.29910748e-02,  1.47771610e-01,
         2.87196214e-02,  1.13159576e-01],
       [ 2.42173821e-01, -2.86199139e-02, -3.25958384e-02,
         1.05027822e-01, -6.55406092e-01],
       [ 3.50196758e-01, -1.05016411e-02, -3.95274124e-01,
         5.92876786e-02,  2.91651801e-01],
       [ 2.25671546e-01, -3.42672751e-02,  8.92876642e-01,
         1.12426818e-01,  2.67065205e-01]])
```

Data Modeling : Linear Regression

Build a linear Regression model to predict the total monthly expenditure for home mortgages loan. Please refer 'deplotment_RE.xlsx'. Column hc_mortgage_mean is predicted variable. This is the mean monthly mortgage and owner costs of specified geographical location. Note: Exclude loans from prediction model which have NaN (Not a Number) values for hc_mortgage_mean.

```
df_train.columns
```

```
Index(['COUNTYID', 'STATEID', 'state', 'state_ab', 'city', 'place',
'type',
       'primary', 'zip_code', 'area_code', 'lat', 'lng', 'ALand',
'AWater',
       'pop', 'male_pop', 'female_pop', 'rent_mean', 'rent_median',
       'rent_stdev', 'rent_sample_weight', 'rent_samples',
'rent_gt_10',
       'rent_gt_15', 'rent_gt_20', 'rent_gt_25', 'rent_gt_30',
'rent_gt_35',
       'rent_gt_40', 'rent_gt_50', 'universe_samples', 'used_samples',
       'hi_mean', 'hi_median', 'hi_stdev', 'hi_sample_weight',
'hi_samples',
       'family_mean', 'family_median', 'family_stdev',
'family_sample_weight',
       'family_samples', 'hc_mortgage_mean', 'hc_mortgage_median',
       'hc_mortgage_stdev', 'hc_mortgage_sample_weight',
'hc_mortgage_samples',
       'hc_mean', 'hc_median', 'hc_stdev', 'hc_samples',
'hc_sample_weight',
       'home_equity_second_mortgage', 'second_mortgage',
'home_equity', 'debt',
       'second_mortgage_cdf', 'home_equity_cdf', 'debt_cdf',
'hs_degree',
       'hs_degree_male', 'hs_degree_female', 'male_age_mean',
       'male_age_median', 'male_age_stdev', 'male_age_sample_weight',
       'male_age_samples', 'female_age_mean', 'female_age_median',
       'female_age_stdev', 'female_age_sample_weight',
```

```
'female_age_samples',
       'pct_own', 'married', 'married_snp', 'separated', 'divorced',
       'bad_debt', 'bins', 'pop_density', 'age_median', 'pop_bins'],
      dtype='object')
```

```
df_train['type'].unique()
type_dict = {'type':{'City':1,
                     'Urban':2,
                     'Town':3,
                     'CDP':4,
                     'Village':5,
                     'Borough':6}
             }
df_train.replace(type_dict, inplace=True)
```

```
df_train['type'].unique()
```

```
array([1, 2, 3, 4, 5, 6], dtype=int64)
```

```
df_test.replace(type_dict, inplace=True)
```

```
df_test['type'].unique()
```

```
array([4, 1, 6, 3, 5, 2], dtype=int64)
```

```
len(df_test)
```

```
11709
```

```
feature_cols= ['COUNTYID',
'STATEID','zip_code','type','pop','family_mean',
               'second_mortgage', 'home_equity','debt','hs_degree',

'age_median','pct_own','married','separated','divorced']
```

```
x_train = df_train[feature_cols]
y_train = df_train['hc_mortgage_mean']
```

```
x_test= df_test[feature_cols]
y_test = df_test['hc_mortgage_mean']
```

```
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score, mean_absolute_error,
mean_squared_error, accuracy_score
```

```
x_train.head()
```

```
        COUNTYID  STATEID  zip_code  type   pop  family_mean
second_mortgage  \
UID
```

```
267822        53       36     13346     1  5230  67994.14790
0.02077
246444       141       18     46616     1  2633  50670.10337
0.02222
245683        63       18     46122     1  6881  95262.51431
0.00000
279653       127       72       927     2  2700  56401.68133
0.01086
247218       161       20     66502     1  5637  54053.42396
0.05426

        home_equity     debt  hs_degree  age_median  pct_own  married
\
UID

267822      0.08919  0.52963    0.89288   44.666665  0.79046  0.57851

246444      0.04274  0.60855    0.90487   34.791665  0.52483  0.34886

245683      0.09512  0.73484    0.94288   41.833330  0.85331  0.64745

279653      0.01086  0.52714    0.91500   49.750000  0.65037  0.47257

247218      0.05426  0.51938    1.00000   22.000000  0.13046  0.12356


        separated  divorced
UID
267822    0.01240   0.08770
246444    0.01426   0.09030
245683    0.01607   0.10657
279653    0.02021   0.10106
247218    0.00000   0.03109

x_test.head()

        COUNTYID  STATEID  zip_code  type   pop   family_mean  \
UID
255504       163       26     48239     4  3417   53802.87122
252676         1       23      4210     1  3796   85642.22095
276314        15       42     14871     6  3944   65694.06582
248614       231       21     42633     1  2508   44156.38709
286865       355       48     78410     3  6230  123527.02420

        second_mortgage  home_equity     debt  hs_degree  age_median
pct_own  \
UID
```

```
255504          0.06443      0.07651  0.63624    0.91047   30.791665
0.70252
252676          0.01175      0.14375  0.64755    0.94290   46.375000
0.85128
276314          0.01316      0.06497  0.45395    0.89238   43.208335
0.81897
248614          0.00995      0.01741  0.41915    0.60908   45.500000
0.84609
286865          0.00000      0.03440  0.63188    0.86297   43.208335
0.79077

        married  separated  divorced
UID
255504  0.28217    0.03813   0.14299
252676  0.64221    0.00000   0.13377
276314  0.59961    0.01358   0.10026
248614  0.56953    0.04694   0.12489
286865  0.57620    0.00588   0.16379
```

```
sc= StandardScaler()
```

```
x_train_scaled = sc.fit_transform(x_train)
```

```
x_test = x_test.astype(int)
```

```
x_test_scaled = sc.fit_transform(x_test)
```

```
x_test_scaled.dtype
```

```
dtype('float64')
```

```
x_test_scaled = sc.fit_transform(x_test)
```

```
print("Original array: \n", x_test)
```

```
Original array:
         COUNTYID  STATEID  zip_code  type   pop  family_mean
second_mortgage  \
UID

255504       163       26     48239     4  3417        53802
0
252676         1       23      4210     1  3796        85642
0
276314        15       42     14871     6  3944        65694
0
248614       231       21     42633     1  2508        44156
0
286865       355       48     78410     3  6230       123527
0
...          ...      ...       ...   ...   ...          ...
...
```

```
238088       105       12     33810     1  5611        70786
0
242811        31       17     60609     5  2695        38912
0
250127         9       25      1841     1  7392        99484
0
241096        27       19     51401     1  5945        75066
0
287763       453       48     78745     3  4117        54913
0

        home_equity  debt  hs_degree  age_median  pct_own  married
separated  \
UID

255504            0     0          0          30        0        0
0
252676            0     0          0          46        0        0
0
276314            0     0          0          43        0        0
0
248614            0     0          0          45        0        0
0
286865            0     0          0          43        0        0
0
...             ...   ...        ...         ...      ...      ...
...
238088            0     0          0          57        0        0
0
242811            0     0          0          31        0        0
0
250127            0     0          0          39        0        0
0
241096            0     0          0          44        0        0
0
287763            0     0          0          35        0        0
0

        divorced
UID
255504         0
252676         0
276314         0
248614         0
286865         0
...          ...
238088         0
242811         0
250127         0
241096         0
```

```
287763         0

[11709 rows x 15 columns]
```

```
# regression model framework

linreg= LinearRegression()

linreg.fit(x_train_scaled, y_train)
```

```
LinearRegression()
```

```
y_pred = linreg.predict(x_test_scaled)

print("Overall R2 score of liear regression model" , r2_score(y_test,
y_pred))
print("Overall RMSE of linear regression model ",
np.sqrt(mean_squared_error(y_test, y_pred)))
```

```
Overall R2 score of liear regression model 0.36860812889746264
Overall RMSE of linear regression model  498.56236112379895
```

```
state=df_train['STATEID'].unique()
state[0:5]
```

```
array([36, 18, 72, 20,  1], dtype=int64)
```

```
for i in [20,1,45]:
    print("State ID-",i)

    x_train_nation=df_train[df_train['COUNTYID']==i][feature_cols]
    y_train_nation=df_train[df_train['COUNTYID']==i]
['hc_mortgage_mean']

    x_test_nation=df_test[df_test['COUNTYID']==i][feature_cols]
    y_test_nation=df_test[df_test['COUNTYID']==i]['hc_mortgage_mean']

    x_train_scaled_nation=sc.fit_transform(x_train_nation)
    x_test_scaled_nation=sc.fit_transform(x_test_nation)

    linreg.fit(x_train_scaled_nation,y_train_nation)
    y_pred_nation=linreg.predict(x_test_scaled_nation)

    print("Overall R2 score of linear regression model for
state,",i,":-" ,r2_score(y_test_nation,y_pred_nation))
    print("Overall RMSE of linear regression model for
state,",i,":-" ,np.sqrt(mean_squared_error(y_test_nation,y_pred_nation
)))
    print("\n")
```

```
State ID- 20
Overall R2 score of linear regression model for state, 20 :-
0.6046603766461807
Overall RMSE of linear regression model for state, 20 :-
307.97188999314733


State ID- 1
Overall R2 score of linear regression model for state, 1 :-
0.8104382475484616
Overall RMSE of linear regression model for state, 1 :-
307.8275861848435


State ID- 45
Overall R2 score of linear regression model for state, 45 :-
0.7887446497855253
Overall RMSE of linear regression model for state, 45 :-
225.69615420724128
```

```
import scipy.stats as stats

z_test = stats.zscore(x_test)
z_test
```

```
        COUNTYID   STATEID  zip_code      type       pop  family_mean
\
UID

255504  0.778341 -0.149892 -0.063291  0.967961 -0.447854    -0.782680

252676 -0.853077 -0.330544 -1.542071 -0.817367 -0.269222     0.218849

276314 -0.712090  0.813583 -1.184006  2.158179 -0.199467    -0.408617

248614  1.463134 -0.450978 -0.251577 -0.817367 -0.876286    -1.086096

286865  2.711874  1.174886  0.950047  0.372852  0.877977     1.410524

...          ...       ...       ...       ...       ...          ...

238088  0.194253 -0.992933 -0.547911 -0.817367  0.586228    -0.248447

242811 -0.550963 -0.691847  0.352174  1.563070 -0.788148    -1.251046

250127 -0.772513 -0.210110 -1.621638 -0.817367  1.425654     0.654250
```

```
241096 -0.591245 -0.571413  0.042910 -0.817367  0.743650    -0.113820

287763  3.698781  1.174886  0.961299  0.372852 -0.117928    -0.747734


        second_mortgage  home_equity      debt  hs_degree  age_median
\
UID

255504         -0.01307    -0.024458 -0.077552  -0.074134   -1.131871

252676         -0.01307    -0.024458 -0.077552  -0.074134    0.997159

276314         -0.01307    -0.024458 -0.077552  -0.074134    0.597966

248614         -0.01307    -0.024458 -0.077552  -0.074134    0.864094

286865         -0.01307    -0.024458 -0.077552  -0.074134    0.597966

...                 ...          ...       ...        ...         ...

238088         -0.01307    -0.024458 -0.077552  -0.074134    2.460866

242811         -0.01307    -0.024458 -0.077552  -0.074134   -0.998806

250127         -0.01307    -0.024458 -0.077552  -0.074134    0.065708

241096         -0.01307    -0.024458 -0.077552  -0.074134    0.731030

287763         -0.01307    -0.024458 -0.077552  -0.074134   -0.466549


         pct_own   married  separated  divorced
UID
255504 -0.035815 -0.020669        NaN       NaN
252676 -0.035815 -0.020669        NaN       NaN
276314 -0.035815 -0.020669        NaN       NaN
248614 -0.035815 -0.020669        NaN       NaN
286865 -0.035815 -0.020669        NaN       NaN
...          ...       ...        ...       ...
238088 -0.035815 -0.020669        NaN       NaN
242811 -0.035815 -0.020669        NaN       NaN
250127 -0.035815 -0.020669        NaN       NaN
241096 -0.035815 -0.020669        NaN       NaN
287763 -0.035815 -0.020669        NaN       NaN

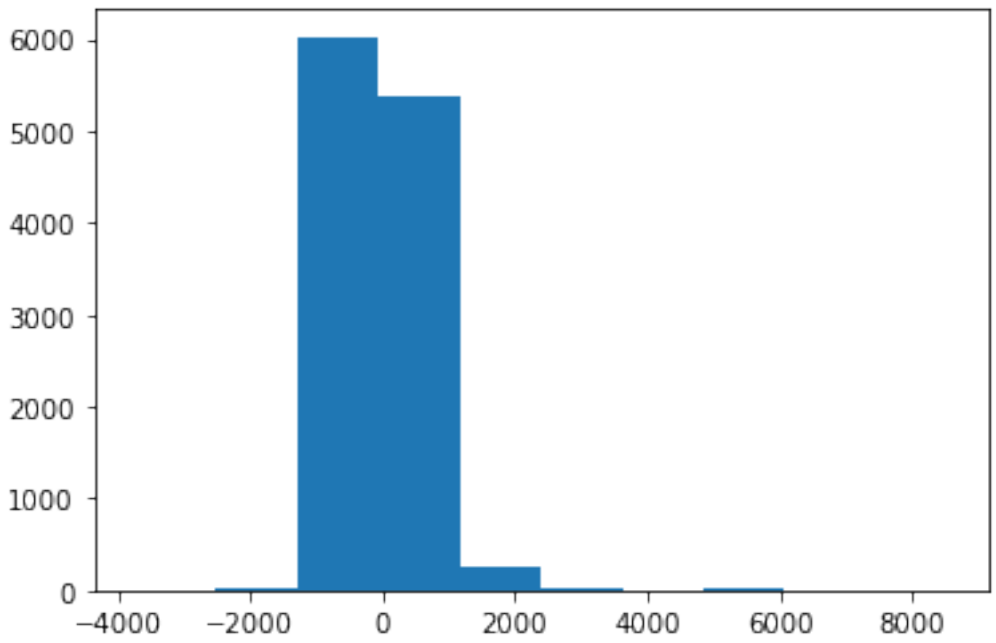
[11709 rows x 15 columns]
```

```
residuals = y_test-y_pred
residuals
```

```
UID
255504     93.706155
252676   -402.176763
276314   -116.294042
248614   -274.097891
286865   -354.341041
             ...
238088   -514.600736
242811    605.986970
250127   -314.053468
241096   -535.067349
287763    310.346698
Name: hc_mortgage_mean, Length: 11709, dtype: float64
```

```
plt.hist(residuals)
```

```
(array([3.000e+00, 1.000e+01, 6.026e+03, 5.377e+03, 2.650e+02,
1.100e+01,
        4.000e+00, 9.000e+00, 2.000e+00, 2.000e+00]),
 array([-3744.3506714 , -2517.34353672, -1290.33640205,   -
63.32926738,
         1163.6778673 ,  2390.68500197,  3617.69213665,
4844.69927132,
         6071.70640599,  7298.71354067,  8525.72067534]),
 <BarContainer object of 10 artists>)
```



(array([3.000e+00, 1.000e+01, 6.026e+03, 5.377e+03, 2.650e+02, 1.100e+01, 4.000e+00, 9.000e+00, 2.000e+00, 2.000e+00]), array([-3744.3506714 , -2517.34353672, -

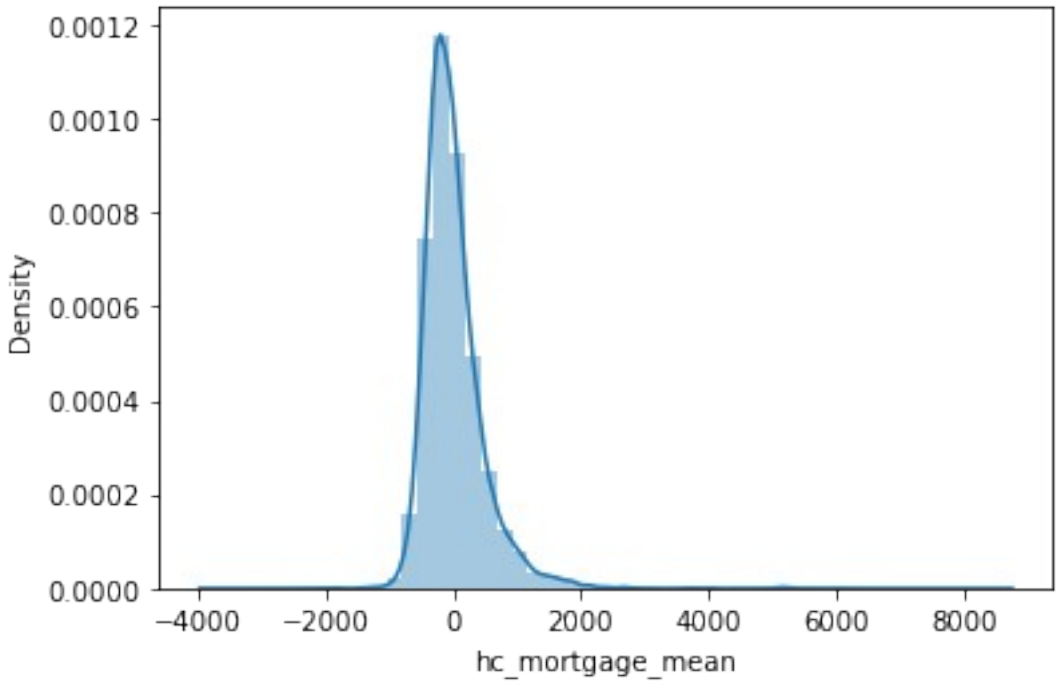
1290.33640205, -63.32926738, 1163.6778673 , 2390.68500197, 3617.69213665,
4844.69927132, 6071.70640599, 7298.71354067, 8525.72067534]),

```
sns.distplot(residuals)
```

```
C:\Users\bhumi\anaconda3\lib\site-packages\seaborn\
distributions.py:2619: FutureWarning:

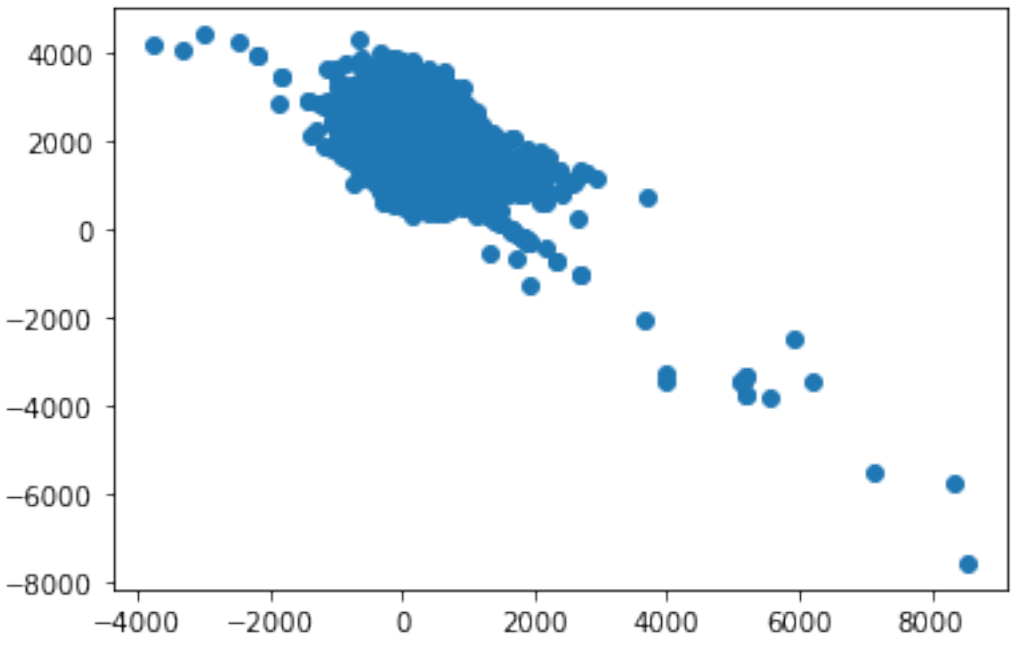
`distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-
level function with similar flexibility) or `histplot` (an axes-level
function for histograms).
```

```
<AxesSubplot:xlabel='hc_mortgage_mean', ylabel='Density'>
```




```
plt.scatter(residuals , y_pred)
```

```
<matplotlib.collections.PathCollection at 0x219df079a30>
```


4000
2000
0
−2000
−4000
−6000
−8000
−4000
−2000
0
2000
4000
6000
8000