```
from numpy import sqrt,log,pi,exp
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt


dp=pd.read_csv('/content/housing.csv')
dp
```

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	households	median_income	median_house_value	ocean_proximity
0	-122.23	37.88	41.0	880.0	129.0	322.0	126.0	8.3252	452600.0	NEAR BAY
1	-122.22	37.86	21.0	7099.0	1106.0	2401.0	1138.0	8.3014	358500.0	NEAR BAY
2	-122.24	37.85	52.0	1467.0	190.0	496.0	177.0	7.2574	352100.0	NEAR BAY
3	-122.25	37.85	52.0	1274.0	235.0	558.0	219.0	5.6431	341300.0	NEAR BAY
4	-122.25	37.85	52.0	1627.0	280.0	565.0	259.0	3.8462	342200.0	NEAR BAY
...	...	...	...	...	...	...	...	...	...	...
20635	-121.09	39.48	25.0	1665.0	374.0	845.0	330.0	1.5603	78100.0	INLAND
20636	-121.21	39.49	18.0	697.0	150.0	356.0	114.0	2.5568	77100.0	INLAND
20637	-121.22	39.43	17.0	2254.0	485.0	1007.0	433.0	1.7000	92300.0	INLAND
20638	-121.32	39.43	18.0	1860.0	409.0	741.0	349.0	1.8672	84700.0	INLAND
20639	-121.24	39.37	16.0	2785.0	616.0	1387.0	530.0	2.3886	89400.0	INLAND

20640 rows × 10 columns

1Q

```
columns = ['latitude', 'total_rooms', 'housing_median_age', 'total_bedrooms']
for column in columns:
    if column in dp.columns:
        mean_mle = np.mean(dp[column])
        variance_mle = np.var(dp[column])
        print(f"Column: {column}")
        print(f"Mean (MLE): {mean_mle}")
        print(f"Variance (MLE): {variance_mle}\n")
    else:
        print(f"Warning: Column '{column}' not found in DataFrame.\n")
```

```
Column: latitude
Mean (MLE): 35.63186143410853
Variance (MLE): 4.562071602892517

Column: total_rooms
Mean (MLE): 2635.7630813953488
Variance (MLE): 4759214.512668024

Column: housing_median_age
```

```
Mean (MLE): 28.639486434108527
Variance (MLE): 158.38858617035862

Column: total_bedrooms
Mean (MLE): 537.8705525375618
Variance (MLE): 177556.6871536956
```

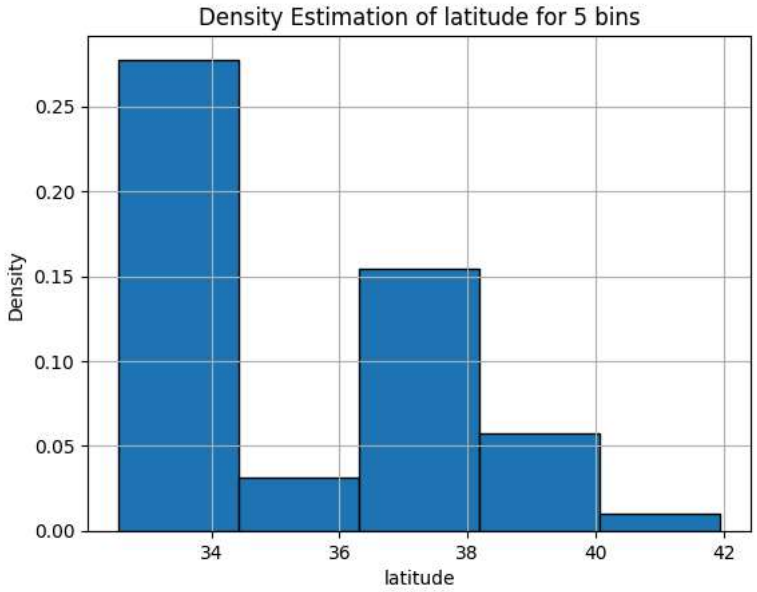
2Q

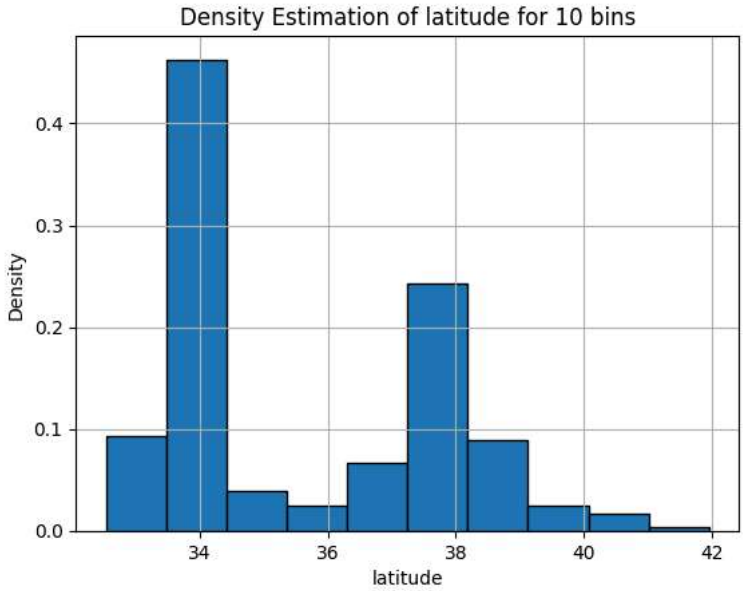
```
def FindMLEAndLLv(x):
  m = dp['latitude'].mean()
  v = dp['latitude'].var()
  mle = (1/(sqrt(2*pi*v)))*(exp(-(x-m)**2/(2*v)))
  return mle , np.log(mle)
x_values = [50,75,80]
for x in x_values:
  mle,lle = FindMLEAndLLv(x)
  print(f"The max likelyhood value of {x} is : {mle}")
  print(f"The log-likelihood value of {x} is : {lle}")
  print("\n")
```

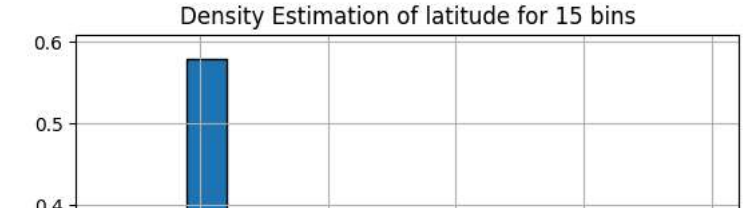
```
The max likelyhood value of 50 is : 2.7888287682024593e-11
The log-likelihood value of 50 is : -24.302814311583585


The max likelyhood value of 75 is : 3.1953586400568146e-75
The log-likelihood value of 75 is : -171.53218264261452


The max likelyhood value of 80 is : 3.775090060098623e-95
The log-likelihood value of 80 is : -217.41715959503816
```

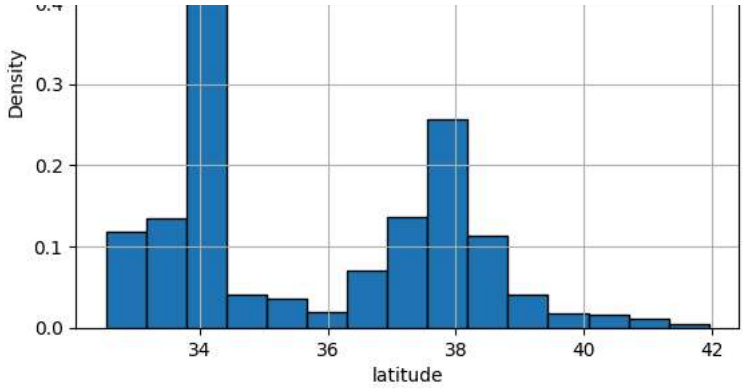
3Q

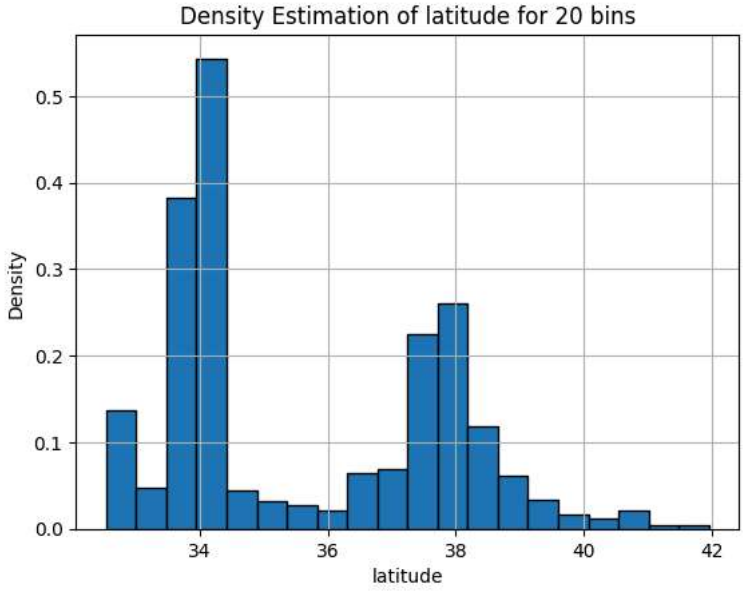
```
columns = ['latitude', 'total_rooms', 'housing_median_age', 'total_bedrooms']
bins_list = [5, 10, 15, 20]

for column in columns:
    for bins in bins_list:
        plt.hist(dp[column], bins=bins, density=True, edgecolor='black', alpha=1)
        plt.title(f'Density Estimation of {column} for {bins} bins')
        plt.xlabel(column)
        plt.ylabel('Density')
        plt.grid(True)
        plt.show()
```

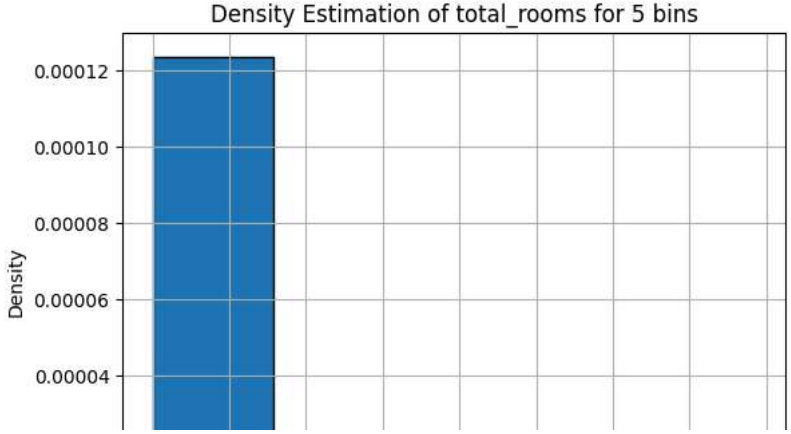

Density Estimation of latitude for 5 bins
Density
0.25
0.20
0.15
0.10
0.05
0.00
34
36
38
40
42
latitude

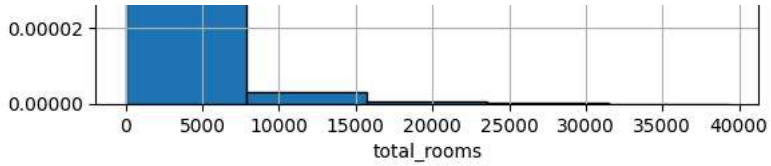

Density Estimation of latitude for 10 bins
Density
0.4
0.3
0.2
0.1
0.0
34
36
38
40
42
latitude

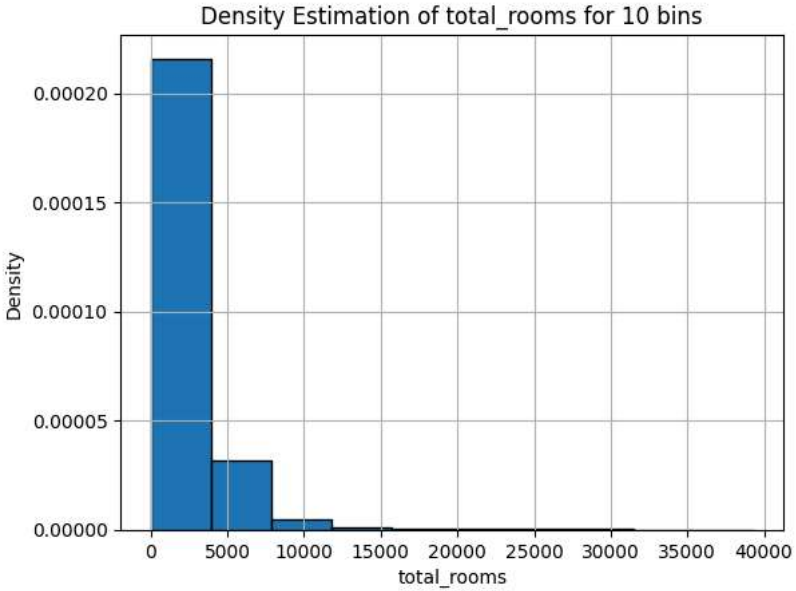

Density Estimation of latitude for 15 bins
0.6
0.5

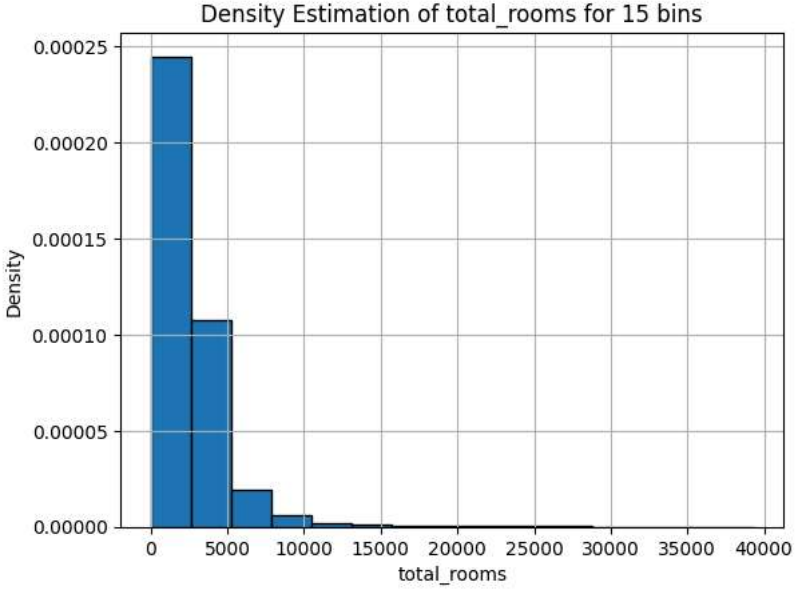

Density
0.3
0.2
0.1
0.0
34
36
38
40
42
latitude

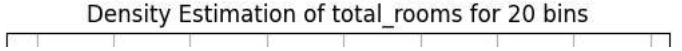

Density Estimation of latitude for 20 bins
Density
0.5
0.4
0.3
0.2
0.1
0.0
34
36
38
40
42
latitude

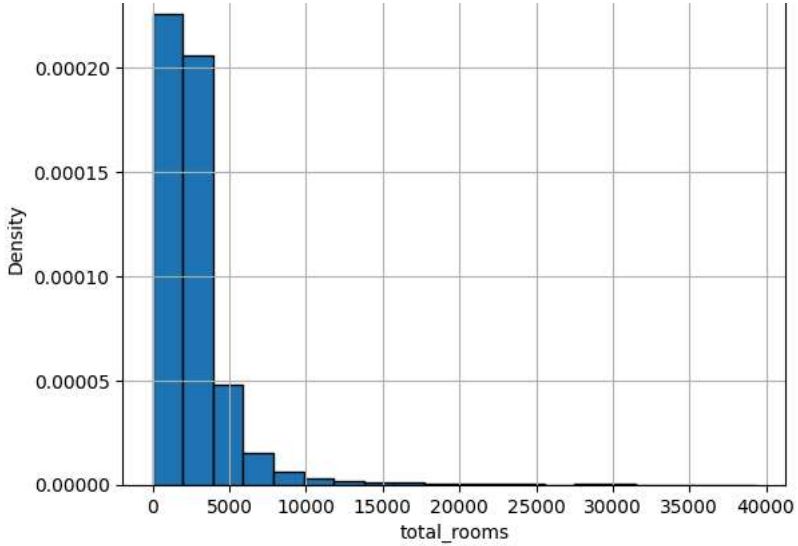

Density Estimation of total_rooms for 5 bins
Density
0.00012
0.00010
0.00008
0.00006
0.00004

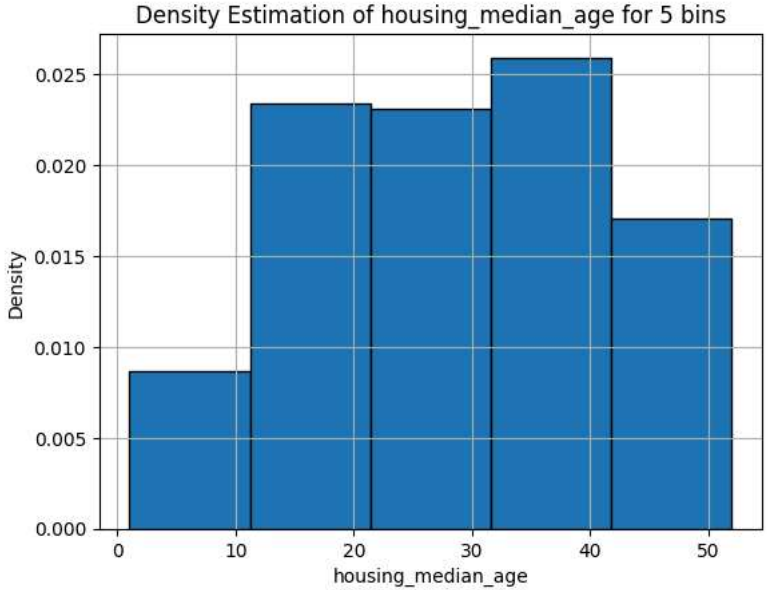

0.00002
0.00000
0
5000
10000
15000
20000
25000
30000
35000
40000
total_rooms

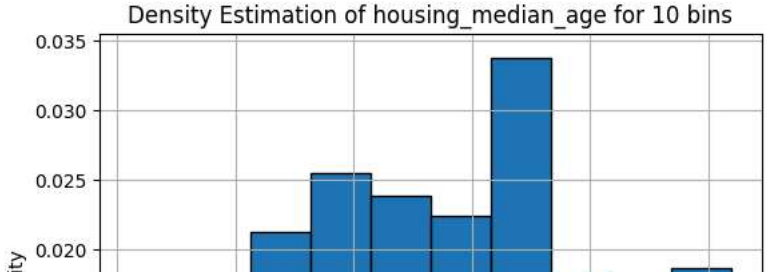

Density Estimation of total_rooms for 10 bins
Density
0.00020
0.00015
0.00010
0.00005
0.00000
0
5000
10000
15000
20000
25000
30000
35000
40000
total_rooms

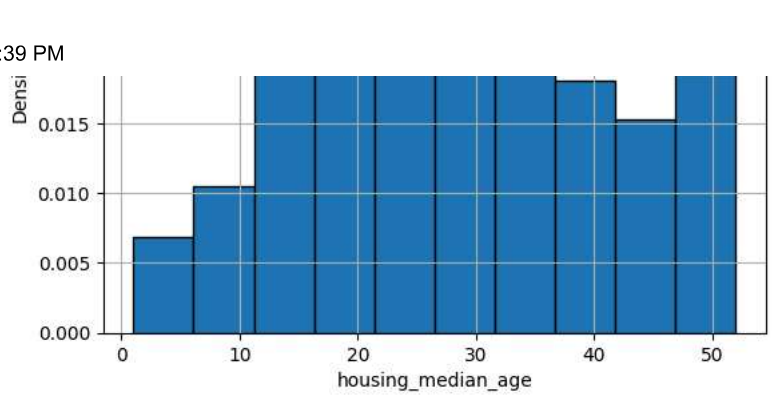

Density Estimation of total_rooms for 15 bins
Density
0.00025
0.00020
0.00015
0.00010
0.00005
0.00000
0
5000
10000
15000
20000
25000
30000
35000
40000
total_rooms

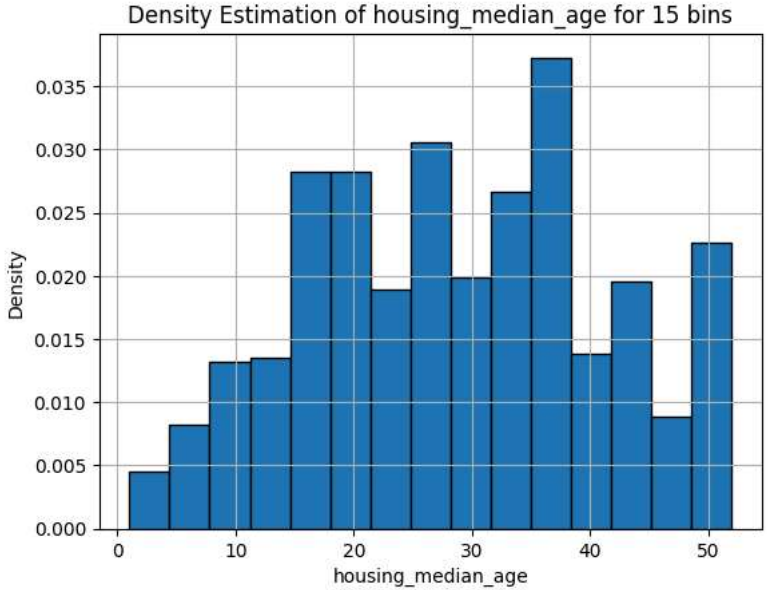

Density Estimation of total_rooms for 20 bins

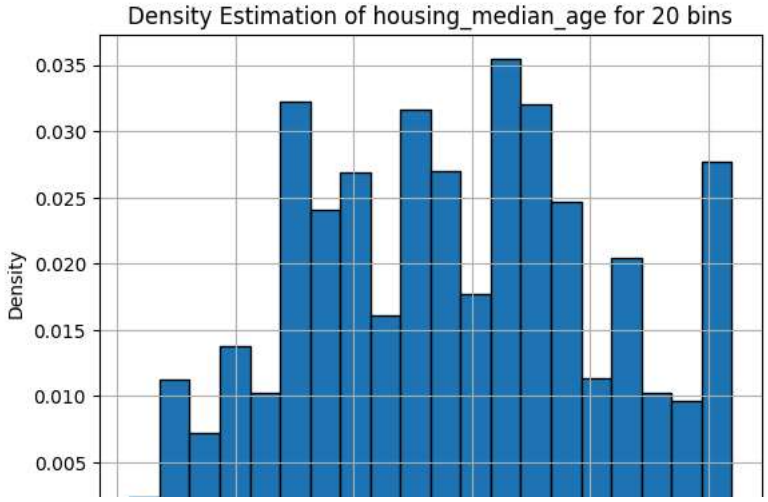

0.00020
0.00015
0.00010
0.00005
0.00000
Density
0
5000
10000
15000
20000
25000
30000
35000
40000
total_rooms


Density Estimation of housing_median_age for 5 bins
0.025
0.020
0.015
0.010
0.005
0.000
Density
0
10
20
30
40
50
housing_median_age

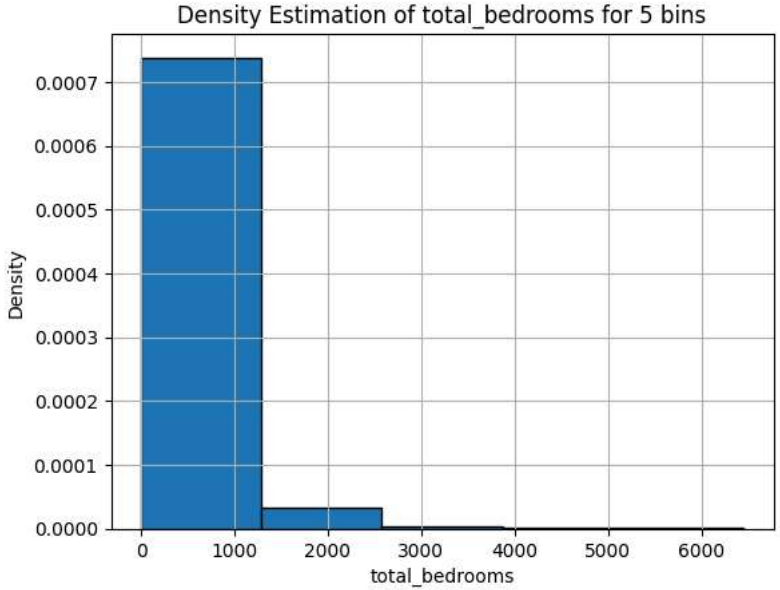

Density Estimation of housing_median_age for 10 bins
0.035
0.030
0.025
0.020

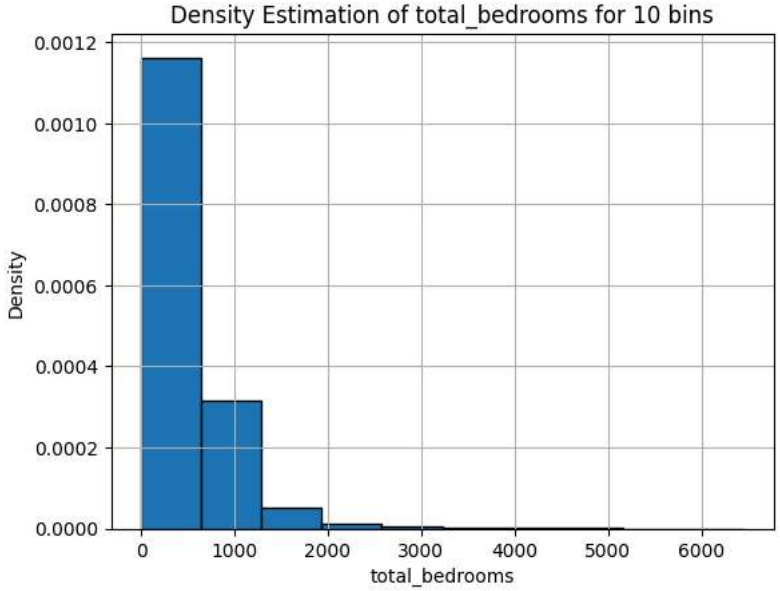

Densi
0.015
0.010
0.005
0.000
0
10
20
30
40
50
housing_median_age

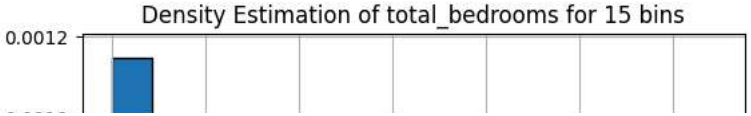

Density Estimation of housing_median_age for 15 bins
Density
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
10
20
30
40
50
housing_median_age

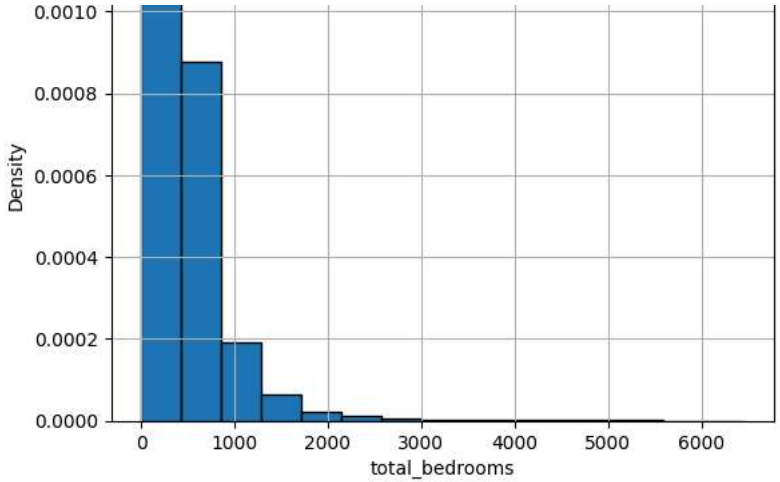

Density Estimation of housing_median_age for 20 bins
Density
0.035
0.030
0.025
0.020
0.015
0.010
0.005

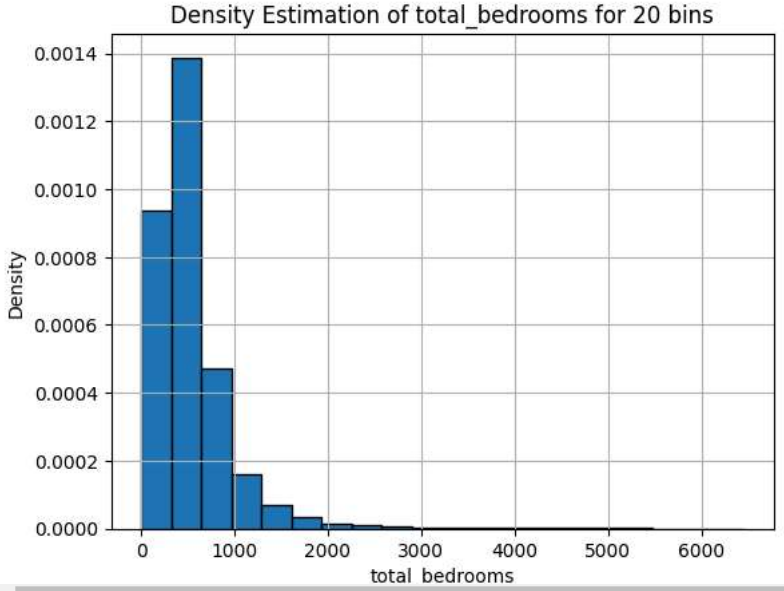

0.000
0
10
20
30
40
50
housing_median_age


Density Estimation of total_bedrooms for 5 bins
Density
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0
1000
2000
3000
4000
5000
6000
total_bedrooms


Density Estimation of total_bedrooms for 10 bins
Density
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
0
1000
2000
3000
4000
5000
6000
total_bedrooms


Density Estimation of total_bedrooms for 15 bins
0.0012


0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Density
0
1000
2000
3000
4000
5000
6000
total_bedrooms


Density Estimation of total_bedrooms for 20 bins
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Density
0
1000
2000
3000
4000
5000
6000
total_bedrooms

DONE BY KODAM SHISHIR BHAGATH [2303A52164]