EDA

importing libraries/modules

In [5]:
```
!pip install xgboost
```

```
Requirement already satisfied: xgboost in c:\users\weite\anaconda3\lib\site-packages
(2.1.1)
Requirement already satisfied: numpy in c:\users\weite\anaconda3\lib\site-packages (fr
om xgboost) (1.26.4)
Requirement already satisfied: scipy in c:\users\weite\anaconda3\lib\site-packages (fr
om xgboost) (1.11.4)
```

In [52]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

import sklearn
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score

import xgboost
from xgboost import XGBRegressor


import warnings
warnings.filterwarnings('ignore')
```

loading dataset

In [53]:
```
df = pd.read_csv('USA_Housing.csv')
df
```

Out[53]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Ferry Apt. 674\nLaurabury, N 3701.
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Elizabeth Stravenue\nDanieltown, WI 06482...
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nFPO AE 09386
...	...	...	...	...	...	...	...
4995	60567.944140	7.830362	6.137356	3.46	22837.361035	1.060194e+06	USNS Williams\nFPO AP 30153-7653
4996	78491.275435	6.999135	6.576763	4.02	25616.115489	1.482618e+06	PSC 9258, Box 8489\nAPO AA 42991-3352
4997	63390.686886	7.250591	4.805081	2.13	33266.145490	1.030730e+06	4215 Tracy Garden Suite 076\nJoshualand, VA 01...
4998	68001.331235	5.534388	7.130144	5.44	42625.620156	1.198657e+06	USS Wallace\nFPO AE 73316
4999	65510.581804	5.992305	6.792336	4.07	46501.283803	1.298950e+06	37778 George Ridges Apt. 509\nEast Holly, NV 2...

5000 rows × 7 columns

In [54]:
```
df.shape
```

Out[54]:
```
(5000, 7)
```

In [55]:
```
df.tail(10)
```

Out[55]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
4990	52723.876555	5.452237	8.124571	6.39	14802.088438	4.795006e+05	86727 Kelly Plaza\nLake Veronica, IL 04474
4991	74102.191890	5.657841	7.683993	3.13	24041.270592	1.263721e+06	2871 John Lodge\nAmychester, GU 61734-5597
4992	87499.125743	6.403473	4.836091	4.02	40815.199679	1.568701e+06	Unit 2096 Bo 9559\nDPO AE 80983 879
4993	69639.140896	5.007510	7.778375	6.05	54056.128430	1.381831e+06	5259 David Causeway Apt. 975\nSouth Alexstad, ...
4994	73060.846226	5.293682	6.312253	4.16	22695.695480	9.053549e+05	5224 Lamb Passage\nNancystad, GA 16579
4995	60567.944140	7.830362	6.137356	3.46	22837.361035	1.060194e+06	USNS Williams\nFPO AP 30153-7653
4996	78491.275435	6.999135	6.576763	4.02	25616.115489	1.482618e+06	PSC 9258, Box 8489\nAPO AA 42991-3352
4997	63390.686886	7.250591	4.805081	2.13	33266.145490	1.030730e+06	4215 Tracy Garden Suite 076\nJoshualand, VA 01...
4998	68001.331235	5.534388	7.130144	5.44	42625.620156	1.198657e+06	USS Wallace\nFPO AE 73316
4999	65510.581804	5.992305	6.792336	4.07	46501.283803	1.298950e+06	37778 George Ridges Apt. 509\nEast Holly, NV 2...

In [56]:
```
df.head()
```

Out[56]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Ferry Apt. 674\nLaurabury, NE 3701...
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Elizabeth Stravenue\nDanieltown, WI 06482...
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nFPO AE 09386

In [57]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5000 entries, 0 to 4999
Data columns (total 7 columns):
 #   Column                        Non-Null Count  Dtype  
---  ------                        --------------  -----  
 0   Avg. Area Income              5000 non-null   float64
 1   Avg. Area House Age           5000 non-null   float64
 2   Avg. Area Number of Rooms     5000 non-null   float64
 3   Avg. Area Number of Bedrooms  5000 non-null   float64
 4   Area Population               5000 non-null   float64
 5   Price                         5000 non-null   float64
 6   Address                       5000 non-null   object 
dtypes: float64(6), object(1)
memory usage: 273.6+ KB
```

In [58]:
```
df.columns
```

Out[58]:
```
Index(['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of Rooms',
       'Avg. Area Number of Bedrooms', 'Area Population', 'Price', 'Address'],
      dtype='object')
```

In [59]:
```
df.describe()
```

Out[59]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price
count	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5.000000e+03
mean	68583.108984	5.977222	6.987792	3.981330	36163.516039	1.232073e+06
std	10657.991214	0.991456	1.005833	1.234137	9925.650114	3.531176e+05
min	17796.631190	2.644304	3.236194	2.000000	172.610686	1.593866e+04
25%	61480.562388	5.322283	6.299250	3.140000	29403.928702	9.975771e+05
50%	68804.286404	5.970429	7.002902	4.050000	36199.406689	1.232669e+06
75%	75783.338666	6.650808	7.665871	4.490000	42861.290769	1.471210e+06
max	107701.748378	9.519088	10.759588	6.500000	69621.713378	2.469066e+06

In [60]:
```
df.nunique()
```

Out[60]:
```
Avg. Area Income                5000
Avg. Area House Age             5000
Avg. Area Number of Rooms       5000
Avg. Area Number of Bedrooms     255
Area Population                 5000
Price                           5000
Address                         5000
dtype: int64
```

In [61]:
```
df['Avg. Area Income']
```

Out[61]:
```
0       79545.458574
1       79248.642455
2       61287.067179
3       63345.240046
4       59982.197226
           ...
4995    60567.944140
4996    78491.275435
4997    63390.686886
4998    68001.331235
4999    65510.581804
Name: Avg. Area Income, Length: 5000, dtype: float64
```

handling missig data

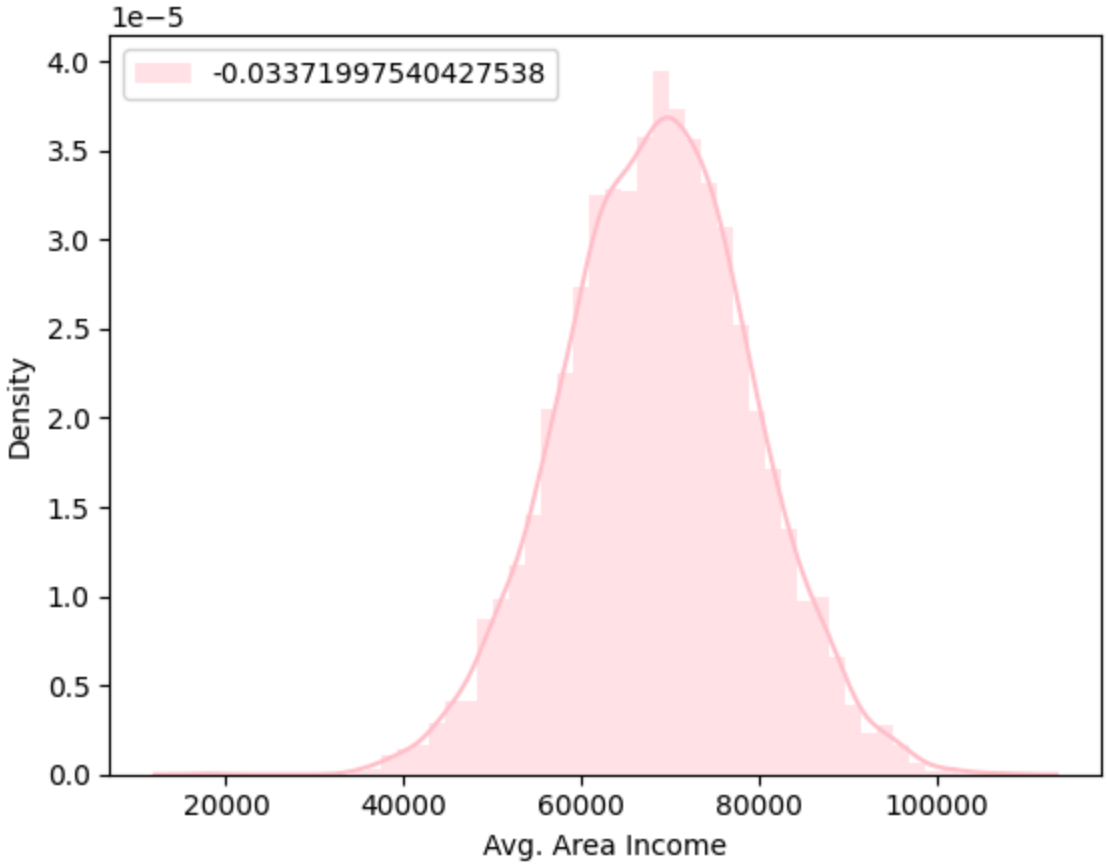
In [62]:
```
df.isnull().sum()
```

Out[62]:
```
Avg. Area Income                0
Avg. Area House Age             0
Avg. Area Number of Rooms       0
Avg. Area Number of Bedrooms    0
Area Population                 0
Price                           0
Address                         0
dtype: int64
```

In [63]:
```
df['Avg. Area Income'].skew()
```

Out[63]:
```
-0.03371997540427538
```

In [64]:
```
sns.distplot(df['Avg. Area Income'], label=df['Avg. Area Income'].skew(),
             color='pink')
plt.legend()
plt.show()
```



In [65]:
```
print(df['Avg. Area Income'].mean())
print(df['Avg. Area Income'].median())
df['Avg. Area Income'].fillna(df['Avg. Area Income'].mean(), inplace=True)
```

```
68583.10898395974
68804.28640371616
```

In [66]:
```
df.isnull().sum()
```

Out[66]:
```
Avg. Area Income                0
Avg. Area House Age             0
Avg. Area Number of Rooms       0
Avg. Area Number of Bedrooms    0
Area Population                 0
Price                           0
Address                         0
dtype: int64
```

duplicate data

In [67]:
```
print(df.duplicated().sum())
df[df.duplicated()]
```

```
0
```

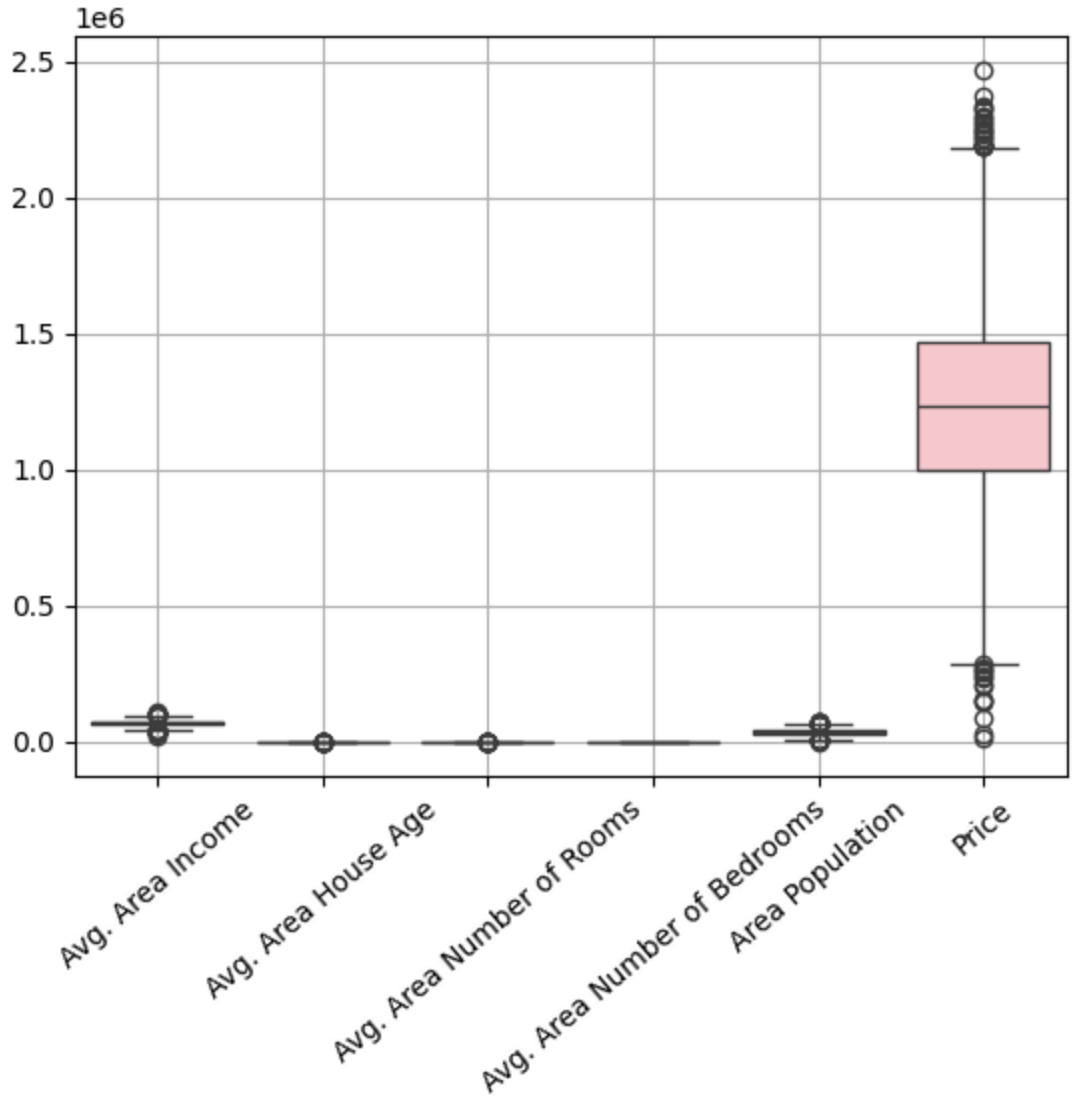
Out[67]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address

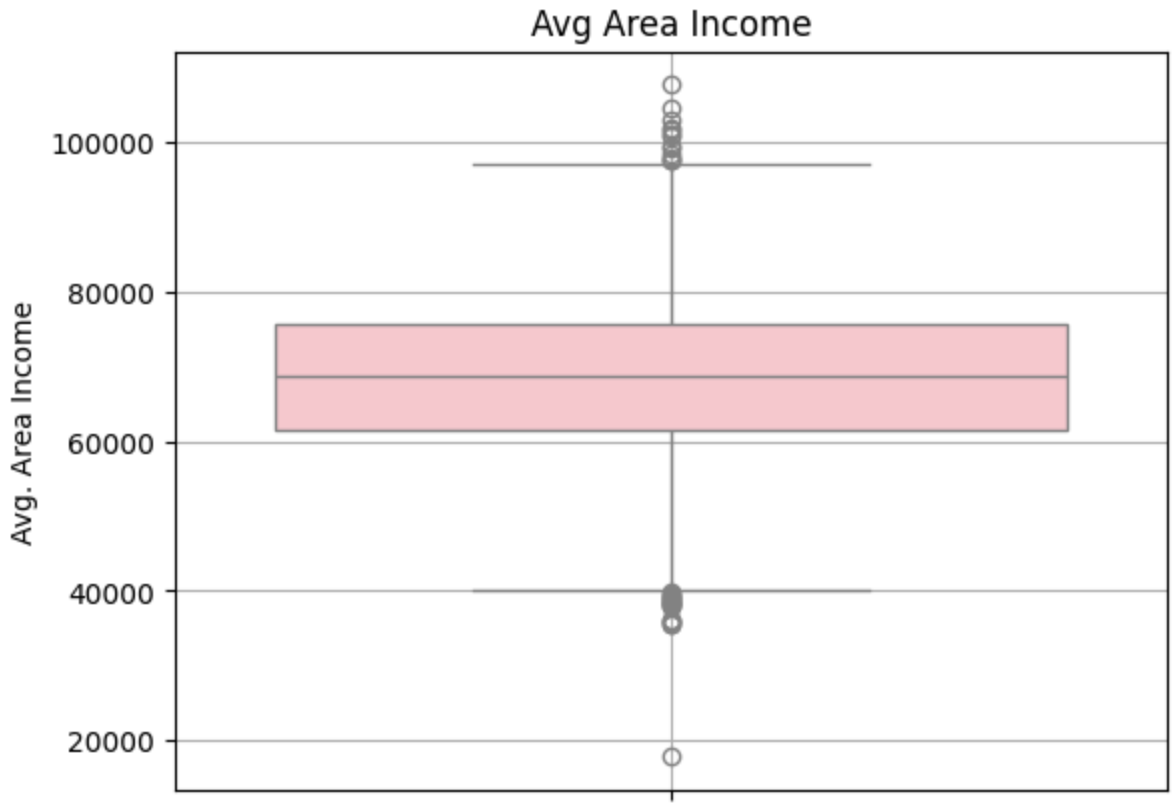
In [68]:
```
df.drop_duplicates(keep='first', inplace=True)
```

outliers

In [69]:
```
sns.boxplot(df,color='pink')
plt.xticks(rotation=40)
plt.grid()
plt.show()
```



In [70]:
```
sns.boxplot(df['Avg. Area Income'],color='pink')
plt.title('Avg Area Income')
plt.grid()
plt.show()
```



In [71]:
```
df[df['Avg. Area Income'] > 97000]
```

Out[71]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
428	97112.361252	5.914725	6.133646	3.10	51470.067638	1.917584e+06	35841 Christine Shore\nWallmouth, NC 98956-5357
558	99629.013581	5.431863	7.351398	5.45	36950.739057	1.883481e+06	PSC 0420, Box 6835\nAPO AE 0835[illegible]
693	107701.748378	7.143522	8.518608	3.29	37619.439929	2.332111e+06	41017 Eri Village\nJonathanport, CO 37205
962	101928.858060	4.829586	9.039382	4.08	22804.991935	1.938866e+06	856 Harris Centers Suite 940\nNicholasport, IL...
1096	97548.310413	5.460973	6.609396	2.50	39089.415712	2.026303e+06	349 Sean Forges\nWhitakerville, WY 85138-4153
1734	104702.724257	5.575523	6.932106	3.22	22560.527135	1.742432e+06	14230 Douglas River Suite 570\nConniechester, ...
1891	101144.323930	6.350845	7.231771	3.09	35772.524007	2.007556e+06	233 Wilson Ranch Suite 086\nWest Christine, IN...
2300	98468.253641	7.035383	6.629233	3.05	50676.312404	2.275455e+06	USNV Hoffman\nFPO AA 45311-5701
2719	101599.670580	7.798746	7.480512	6.39	37523.864670	2.370231e+06	52280 Steven Street\nRobertchester, IA 40405-0504
3483	97881.587279	5.034395	7.575905	5.46	37152.799341	1.859161e+06	01230 Peter Loop Suite 135\nEdwardstad, SC 67538
3541	102881.120902	6.471249	5.693536	3.12	21051.531294	1.754938e+06	784 Arnold Prairie Apt. 787\nJamesside, NM 04270
3798	97669.064491	6.888763	6.739379	4.14	43203.271060	2.102244e+06	0646 Martin Pass\nKimberlyberg, GU 73453
3947	97076.164503	5.960820	6.606164	2.46	39915.656778	1.969194e+06	20831 Heather Common Suite 998\nLake Elizabeth...
4087	100741.298585	5.870726	6.644853	4.33	26041.487616	1.644923e+06	5155 Virginia Station\nFischerberg, PA 75078-8129
4400	99317.823145	5.495861	7.182721	6.03	50350.352292	2.219724e+06	87549 Garcia Path\nSolomonside, ID 72003

In [72]:
```
len(df[df['Avg. Area Income'] > 97000])
```

Out[72]: 15

In [73]:
```
df[df['Avg. Area Income'] < 40000]
```

Out[73]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
12	39033.809237	7.671755	7.250029	3.10	39220.361467	1.042814e+06	209 Natasha Stream Suite 961\nHuffmanland, NE ...
39	17796.631190	4.949557	6.713905	2.50	47162.183643	3.023558e+05	9932 Eric Circles\nLake Martha, WY 34611-6127
411	36100.444227	5.778489	5.497450	2.29	44901.857338	5.995040e+05	842 Duane Brook Apt. 380\nMonicaview, AP 01639.
844	39411.652788	4.385845	7.047435	4.44	45851.398296	5.394834e+05	1085 Michele Glens Apt. 517\nSergiotown, VT 20367
1271	37971.207566	4.291224	5.807510	3.24	33267.767728	3.114052e+04	98398 Terrance Pines\nSouth Joshua, MT 00544-8919
1459	35963.330809	3.438547	8.264122	3.28	24435.777302	1.430274e+05	166 Terry Grove\nSouth Michaelhaven, PR 18054
1597	39294.036523	5.928585	5.960676	4.36	43183.516104	7.811375e+05	829 Bonnie Rue Suite 653\nYorkville, MP 35797-...
2025	38139.919045	5.577267	6.348068	2.13	45899.738402	7.237501e+05	2899 Katherine Junction\nNorth Richardview, SC...
2092	35608.986237	6.935839	7.827589	6.35	20833.007623	4.493316e+05	652 Stanton Island\nAdamsview, VA 56957-9960
2242	38868.250311	6.965104	8.966906	4.22	25432.076773	7.590447e+05	86840 Jonathon Field\nStevenport, KY 45694-2395
2597	38734.005216	5.641762	6.297908	2.31	38890.892760	4.011486e+05	4317 Heather Port\nHicksland, SC 77008-9209
3069	35454.714659	6.855708	6.018647	4.50	59636.402553	1.077806e+06	Unit 4700 Box 1880\nDPO AP 18074
3144	38571.963670	7.425292	5.723009	3.47	47386.793614	9.684116e+05	6613 Cynthia Loop Suite 555\nLake Heatherstad,...
3183	38122.524488	6.336109	7.762551	5.12	38067.552184	8.996093e+05	783 Stacey Glen\nWest Katherineberg, NV 67007-...
4449	39777.606906	5.804627	7.147719	3.16	38725.424303	6.960145e+05	5231 David Shoals\nEast Chaseland, MO 54930-5094
4716	38530.124478	4.265906	8.026969	4.47	67727.229051	1.267987e+06	14763 Jeffrey Islands\nAmytown, WV 47279-7543

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
4744	39653.770031	5.205089	6.951617	2.32	40275.599326	3.959013e+05	58979 Jimmy Place Apt. 907\nEast Bryanbury, MN...
4844	37908.675863	6.233813	7.252916	6.07	39632.079786	8.804028e+05	901 Peter Fort Apt. 157\nTaylorfort, ND 06249-...
4855	35797.323122	5.544221	7.795138	5.00	24844.200190	2.998630e+05	645 Mary Radial\nEast Roberto, CA 23652-5430

In [74]:
```
len(df[df['Avg. Area Income'] < 40000])
```

Out[74]: 19

In [75]:
```
df[(df['Avg. Area Income'] > 97000) | (df['Avg. Area Income'] < 40000)]
```

Out[75]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
12	39033.809237	7.671755	7.250029	3.10	39220.361467	1.042814e+06	209 Natasha Stream Suite 961\nHuffmanland, NE ...
39	17796.631190	4.949557	6.713905	2.50	47162.183643	3.023558e+05	9932 Eric Circles\nLake Martha, WY 34611-6127
411	36100.444227	5.778489	5.497450	2.29	44901.857338	5.995040e+05	842 Duane Brook Apt. 380\nMonicaview, AP 01639.
428	97112.361252	5.914725	6.133646	3.10	51470.067638	1.917584e+06	35841 Christine Shore\nWallmouth, NC 98956-5357
558	99629.013581	5.431863	7.351398	5.45	36950.739057	1.883481e+06	PSC 0420, Box 6835\nAPO AE 08359
693	107701.748378	7.143522	8.518608	3.29	37619.439929	2.332111e+06	41017 Eric Village\nJonathanport, CO 37205
844	39411.652788	4.385845	7.047435	4.44	45851.398296	5.394834e+05	1085 Michele Glens Apt. 517\nSergiotown, VT 20367
962	101928.858060	4.829586	9.039382	4.08	22804.991935	1.938866e+06	856 Harris Centers Suite 940\nNicholasport, IL...
1096	97548.310413	5.460973	6.609396	2.50	39089.415712	2.026303e+06	349 Sean Forges\nWhitakerville, WY 85138-4153
1271	37971.207566	4.291224	5.807510	3.24	33267.767728	3.114052e+04	98398 Terrance Pines\nSouth Joshua, MT 00544-8919
1459	35963.330809	3.438547	8.264122	3.28	24435.777302	1.430274e+05	166 Terry Grove\nSouth Michaelhaven, PR 18054
1597	39294.036523	5.928585	5.960676	4.36	43183.516104	7.811375e+05	829 Bonnie Rue Suite 653\nYorkville, MP 35797-...
1734	104702.724257	5.575523	6.932106	3.22	22560.527135	1.742432e+06	14230 Douglas River Suite 570\nConniechester, ...
1891	101144.323930	6.350845	7.231771	3.09	35772.524007	2.007556e+06	233 Wilson Ranch Suite 086\nWest Christine, IN...
2025	38139.919045	5.577267	6.348068	2.13	45899.738402	7.237501e+05	2899 Katherine Junction\nNorth Richardview, SC...
2092	35608.986237	6.935839	7.827589	6.35	20833.007623	4.493316e+05	652 Stanton Island\nAdamsview, VA 56957-9960
2242	38868.250311	6.965104	8.966906	4.22	25432.076773	7.590447e+05	86840 Jonathon Field\nStevenport, KY 45694-2395
2300	98468.253641	7.035383	6.629233	3.05	50676.312404	2.275455e+06	USNV Hoffman\nFPO AA 45311-5701

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
2597	38734.005216	5.641762	6.297908	2.31	38890.892760	4.011486e+05	4317 Heather Port\nHicksland, SC 77008-9209
2719	101599.670580	7.798746	7.480512	6.39	37523.864670	2.370231e+06	52280 Steven Street\nRobertchester, IA 40405-0504
3069	35454.714659	6.855708	6.018647	4.50	59636.402553	1.077806e+06	Unit 4700 Box 1880\nDPO AP 18074
3144	38571.963670	7.425292	5.723009	3.47	47386.793614	9.684116e+05	6613 Cynthia Loo Suite 555\nLak Heatherstad,...
3183	38122.524488	6.336109	7.762551	5.12	38067.552184	8.996093e+05	783 Stacey Glen\nWest Katherineberg, NV 67007-...
3483	97881.587279	5.034395	7.575905	5.46	37152.799341	1.859161e+06	01230 Peter Loop Suite 135\nEdwardstad, SC 67538
3541	102881.120902	6.471249	5.693536	3.12	21051.531294	1.754938e+06	784 Arnold Prairie Apt. 787\nJamesside, NM 04270
3798	97669.064491	6.888763	6.739379	4.14	43203.271060	2.102244e+06	0646 Martin Pass\nKimberlyberg, GU 73453
3947	97076.164503	5.960820	6.606164	2.46	39915.656778	1.969194e+06	20831 Heather Common Suite 998\nLake Elizabeth...
4087	100741.298585	5.870726	6.644853	4.33	26041.487616	1.644923e+06	5155 Virginia Station\nFischerberg, PA 75078-8129
4400	99317.823145	5.495861	7.182721	6.03	50350.352292	2.219724e+06	87549 Garcia Path\nSolomonside, ID 72003
4449	39777.606906	5.804627	7.147719	3.16	38725.424303	6.960145e+05	5231 David Shoals\nEast Chaseland, MO 54930-5094
4716	38530.124478	4.265906	8.026969	4.47	67727.229051	1.267987e+06	14763 Jeffrey Islands\nAmytown, WV 47279-7543
4744	39653.770031	5.205089	6.951617	2.32	40275.599326	3.959013e+05	58979 Jimmy Place Apt. 907\nEast Bryanbury, MN...
4844	37908.675863	6.233813	7.252916	6.07	39632.079786	8.804028e+05	901 Peter Fort Apt. 157\nTaylorfort, ND 06249-...
4855	35797.323122	5.544221	7.795138	5.00	24844.200190	2.998630e+05	645 Mary Radial\nEast Roberto, CA 23652-5430

In [76]:
```
len(df[(df['Avg. Area Income'] > 97000) | (df['Avg. Area Income'] < 40000)])
```

Out[76]: 34

In [77]:
```
df[(df['Avg. Area Income'] > 97000) | (df['Avg. Area Income'] < 40000)].index
```

Out[77]:
```
Index([  12,   39,  411,  428,  558,  693,  844,  962, 1096, 1271, 1459, 1597,
       1734, 1891, 2025, 2092, 2242, 2300, 2597, 2719, 3069, 3144, 3183, 3483,
       3541, 3798, 3947, 4087, 4400, 4449, 4716, 4744, 4844, 4855],
      dtype='int64')
```

In [78]:
```
df.shape
```

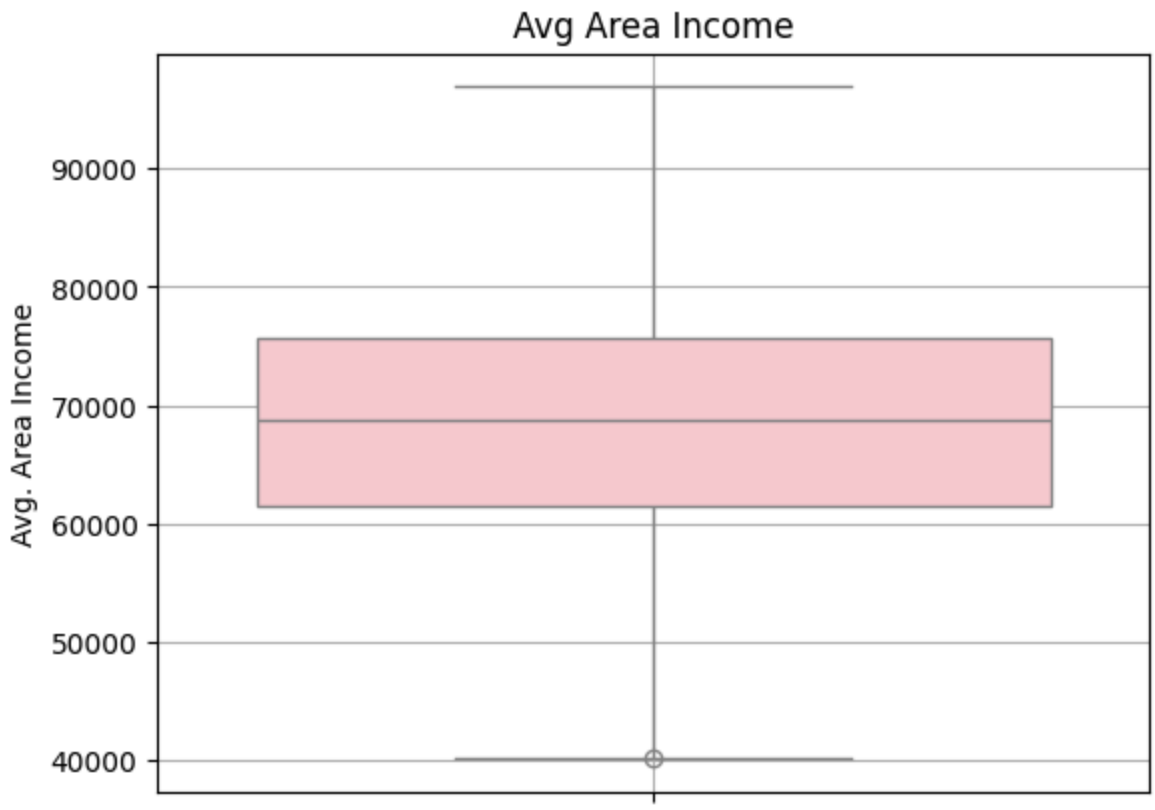
Out[78]: (5000, 7)

In [79]:
```
df.drop(index=[12,   39,  411,  428,  558,  693,  844,  962, 1096, 1271, 1459,
            1597, 1734, 1891, 2025, 2092, 2242, 2300, 2597, 2719, 3069, 3144,
            3183, 3483, 3541, 3798, 3947, 4087, 4400, 4449, 4716, 4744, 4844,
            4855], axis=0, inplace=True)
```

In [80]:
```
df.shape
```

Out[80]: (4966, 7)

In [81]:
```
sns.boxplot(df['Avg. Area Income'], color='pink')
plt.title('Avg Area Income')
plt.grid()
plt.show()
```



In [82]:
```
df[(df['Avg. Area Income'] > 97000) | (df['Avg. Area Income'] < 40000)]
```

Out[82]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address

feature encoding or droping

In [83]:
```
df['Address'].value_counts()
```

Out[83]:
```
Address
208 Michael Ferry Apt. 674\nLaurabury, NE 37010-5101             1
89265 Robert Haven Apt. 492\nSmithburgh, FM 58565-1105           1
PSC 7034, Box 6131\nAPO AA 05662-4293                            1
21042 Wilson Islands Suite 238\nFischerchester, MP 42425-4129    1
Unit 8831 Box 5748\nDPO AE 73012-7314                            1
                                                                ..
054 Carter Crescent Suite 674\nGlennport, WA 11140               1
8460 Kathleen Mission Apt. 482\nPort Amytown, KY 72016           1
3737 Hartman Rue\nReneestad, ID 69250-7718                       1
3465 Latoya Well\nNelsonmouth, MI 55741-4287                     1
37778 George Ridges Apt. 509\nEast Holly, NV 29290-3595          1
Name: count, Length: 4966, dtype: int64
```

In [84]:
```
df.shape
```

Out[84]:
```
(4966, 7)
```

In [85]:
```
df.drop(columns=['Address'],axis=1,inplace=True)
```

In [86]:
```
df
```

Out[86]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05
...	...	...	...	...	...	...
4995	60567.944140	7.830362	6.137356	3.46	22837.361035	1.060194e+06
4996	78491.275435	6.999135	6.576763	4.02	25616.115489	1.482618e+06
4997	63390.686886	7.250591	4.805081	2.13	33266.145490	1.030730e+06
4998	68001.331235	5.534388	7.130144	5.44	42625.620156	1.198657e+06
4999	65510.581804	5.992305	6.792336	4.07	46501.283803	1.298950e+06

4966 rows × 6 columns

correlation

In [87]:
```
df.corr()
```

Out[87]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price
Avg. Area Income	1.000000	-0.006274	-0.012836	0.018610	-0.011947	0.629465
Avg. Area House Age	-0.006274	1.000000	-0.008912	0.005030	-0.018811	0.455607
Avg. Area Number of Rooms	-0.012836	-0.008912	1.000000	0.463133	0.004193	0.340249
Avg. Area Number of Bedrooms	0.018610	0.005030	0.463133	1.000000	-0.021517	0.171979
Area Population	-0.011947	-0.018811	0.004193	-0.021517	1.000000	0.414990
Price	0.629465	0.455607	0.340249	0.171979	0.414990	1.000000

In [88]:
```
df.corr()['Price']
```

Out[88]:
```
Avg. Area Income              0.629465
Avg. Area House Age           0.455607
Avg. Area Number of Rooms     0.340249
Avg. Area Number of Bedrooms  0.171979
Area Population               0.414990
Price                         1.000000
Name: Price, dtype: float64
```

model building

In [89]:
```
X=df.iloc[:,:-1]
y=df['Price']
```

In [90]:
```
X
```

Out[90]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population
0	79545.458574	5.682861	7.009188	4.09	23086.800503
1	79248.642455	6.002900	6.730821	3.09	40173.072174
2	61287.067179	5.865890	8.512727	5.13	36882.159400
3	63345.240046	7.188236	5.586729	3.26	34310.242831
4	59982.197226	5.040555	7.839388	4.23	26354.109472
...	...	...	...	...	.
4995	60567.944140	7.830362	6.137356	3.46	22837.361035
4996	78491.275435	6.999135	6.576763	4.02	25616.115489
4997	63390.686886	7.250591	4.805081	2.13	33266.145490
4998	68001.331235	5.534388	7.130144	5.44	42625.620156
4999	65510.581804	5.992305	6.792336	4.07	46501.283803

4966 rows × 5 columns

In [91]:
```
y
```

Out[91]:
```
0       1.059034e+06
1       1.505891e+06
2       1.058988e+06
3       1.260617e+06
4       6.309435e+05
            ...
4995    1.060194e+06
4996    1.482618e+06
4997    1.030730e+06
4998    1.198657e+06
4999    1.298950e+06
Name: Price, Length: 4966, dtype: float64
```

In [96]:
```
X_train,X_test,y_train,y_test=train_test_split(X,y, test_size=0.2,random_state=42)
```

In [97]:
```
X_train.shape
```

Out[97]:
```
(3972, 5)
```

In [98]:
```
X_test.shape
```

Out[98]:
```
(994, 5)
```

In [99]:
```
y_test.shape
```

Out[99]:
```
(994,)
```

In [100]:
```
y_train.shape
```

Out[100]:
```
(3972,)
```

In [ ]:
```
# linear regression
```

In [101]:
```
lr=LinearRegression()
```

In [102]:
```
lr.fit(X_train,y_train)
```

Out[102]:
```
LinearRegression()
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [104]:
```
print(f'training accuracy : { round(lr.score(X_train,y_train)*100)}%')
print(f'test accuracy : { round(lr.score(X_test,y_test)*100)}%')
```

```
training accuracy : 92%
test accuracy : 92%
```

In [105]:
```
# decision tree
```

In [106]:
```
dt=DecisionTreeRegressor(max_depth=9)
dt.fit(X_train,y_train)
```

Out[106]:
```
DecisionTreeRegressor(max_depth=9)
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [107]:
```
print(f'training accuracy : { round(dt.score(X_train,y_train)*100)}%')
print(f'test accuracy : { round(dt.score(X_test,y_test)*100)}%')
```

```
training accuracy : 92%
test accuracy : 78%
```

In [108]:
```
# gradient boosting regressor
```

In [111]:
```
gb=GradientBoostingRegressor()
gb.fit(X_train,y_train)
```

Out[111]:
```
GradientBoostingRegressor()
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [113]:
```
print(f'training accuracy : { round(gb.score(X_train,y_train)*100)}%')
print(f'test accuracy : { round(gb.score(X_test,y_test)*100)}%')
```

```
training accuracy : 93%
test accuracy : 91%
```

model training

In [114]:
```
y_train_pred=lr.predict(X_train)
y_test_pred=lr.predict(X_test)
```

In [115]:
```
X_train[:3]
```

Out[115]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population
2502	55306.141974	6.125857	6.410318	4.06	32142.947348
2770	84802.787605	5.101614	7.844812	6.04	35748.331474
2521	61909.041438	6.228343	6.593138	4.29	28953.925377

In [116]:
```
y_train[:3]
```

Out[116]:
```
2502    6.479827e+05
2770    1.437984e+06
2521    1.063964e+06
Name: Price, dtype: float64
```

In [117]:
```
y_train_pred[:3]
```

Out[117]:
```
array([ 838521.68881121, 1537885.93430884,  972616.39243308])
```

slopes /coefficients

In [118]:
```
X.columns
```

Out[118]:
```
Index(['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of Rooms',
       'Avg. Area Number of Bedrooms', 'Area Population'],
      dtype='object')
```

In [119]:
```
lr.coef_
```

Out[119]:
```
array([2.16406066e+01, 1.66104091e+05, 1.20673492e+05, 1.75557397e+03,
       1.51408551e+01])
```

In [124]:
```
pd.DataFrame(lr.coef_, index=X.columns ,columns=['Coefficients'])
```

Out[124]:

	Coefficients
Avg. Area Income	21.640607
Avg. Area House Age	166104.090506
Avg. Area Number of Rooms	120673.492264
Avg. Area Number of Bedrooms	1755.573974
Area Population	15.140855

model evaluation

In [126]:
```
#training data
```

In [127]:
```
mean_squared_error(y_train,y_train_pred)
```

Out[127]: 10268623193.67436

In [128]:
```
np.sqrt(mean_squared_error(y_train,y_train_pred))
```

Out[128]: 101334.21531582686

In [129]:
```
mean_absolute_error(y_train,y_train_pred)
```

Out[129]: 81605.20894176647

In [131]:
```
r2_score(y_train,y_train_pred)
```

Out[131]: 0.9161466729297922

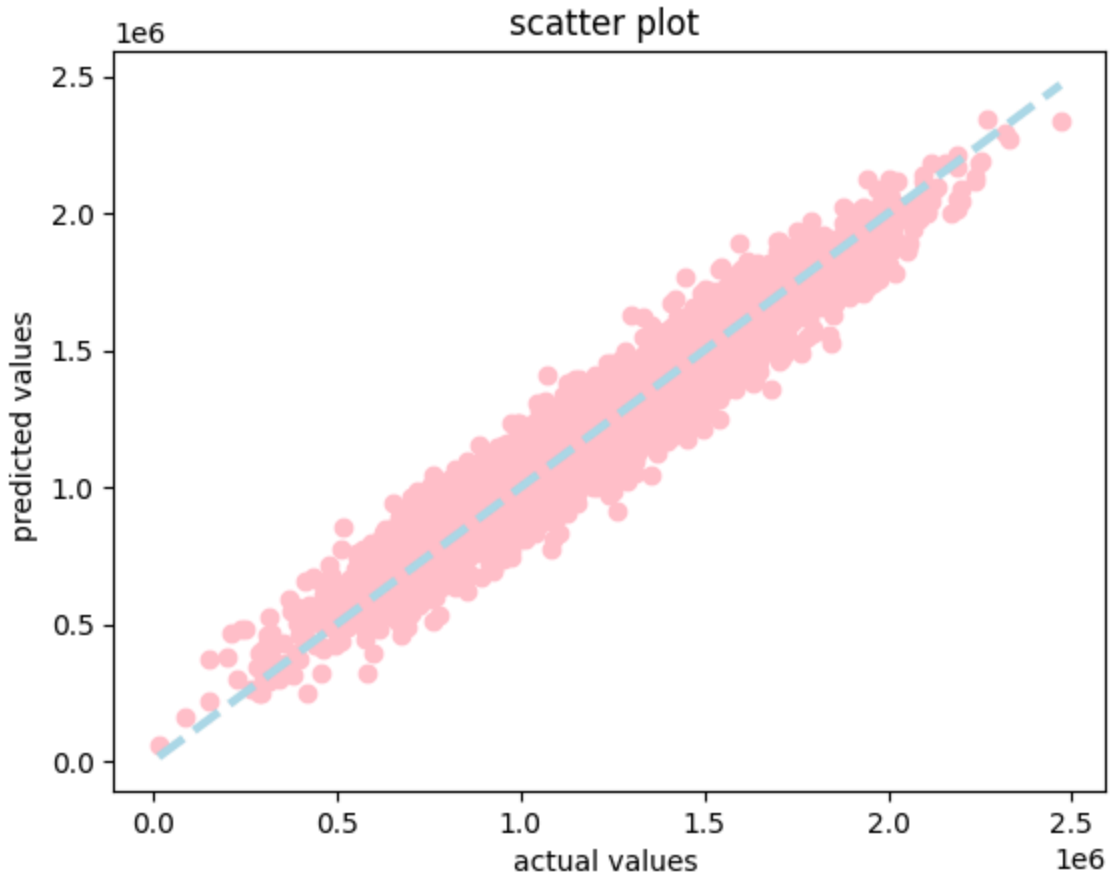
In [138]:
```
def evaluation(actual,predicted):
    mse=mean_squared_error(actual,predicted)
    rmse=np.sqrt(mean_squared_error(actual,predicted))
    mae=mean_absolute_error(actual,predicted)
    r2=r2_score(actual,predicted)

    print(f'MSE : {mse}')
    print(f'RMSE : {rmse}')
    print(f'MAE : {mae}')
    print(f'ACCURACY : {r2}')

    plt.scatter(actual,predicted , color='pink' , marker='o')
    plt.plot([actual.min(),actual.max()],[actual.min(),actual.max()],
             'lightblue',lw=3,ls='--')
    plt.title('scatter plot ')
    plt.xlabel('actual values ')
    plt.ylabel('predicted values ')
    plt.show()
```

In [139]:
```
evaluation(y_train,y_train_pred)
```

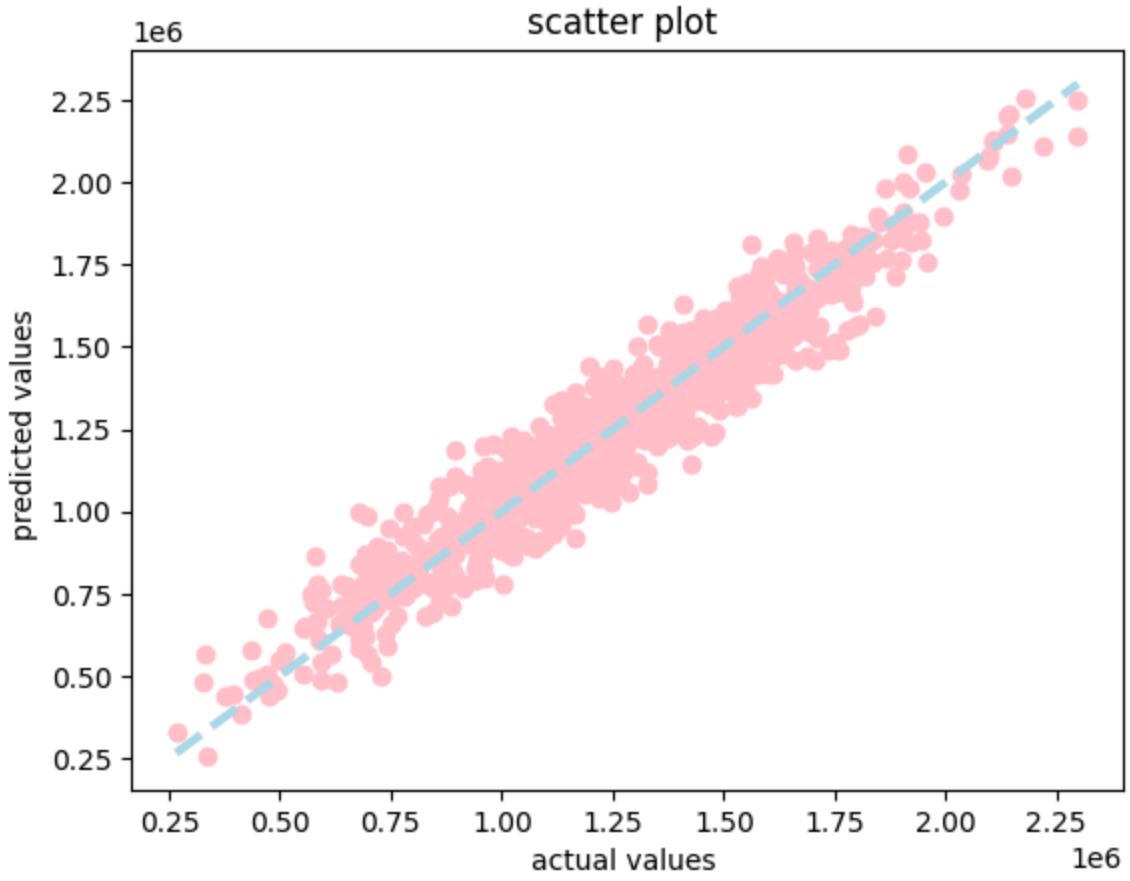
```
MSE : 10268623193.67436
RMSE : 101334.21531582686
MAE : 81605.20894176647
ACCURACY : 0.9161466729297922
```



In [135]:
```
#test data
```

In [140]:
```
evaluation(y_test,y_test_pred)
```

```
MSE : 9769360588.245775
RMSE : 98840.07582072049
MAE : 79388.31116422128
ACCURACY : 0.9180015018430217
```



In [ ]: