Data Analysis

Linear Regressions Analysis (USA_HOUSING)

James Bond 12/17/2019

In [57]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import PolynomialFeatures
from sklearn.model_selection import train_test_split
```

In [2]:

```
US_house = pd.read_csv("./USA_Housing.csv")
```

In [3]:

```
print(f"Data Shape: {US_house.shape}")
```

```
Data Shape: (5000, 7)
```

In [4]:

```
print(US_house.columns)
```

```
Index(['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of
Rooms',
       'Avg. Area Number of Bedrooms', 'Area Population', 'Price', 'Add
ress'],
      dtype='object')
```

first five rows of the data set

In [5]:

```
US_house.head(5)
```

Out[5]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Addre
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Ferry A 674\nLaurabury, N 3701
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Vie Suite 079\nLa Kathleen, CA
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Elizabe Stravenue\nDanieltow WI 06482
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPO 448
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nFF AE 093

Description & Info

In [6]:

```
print(US_house.description)
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-6-8181bf280ed1> in <module>
----> 1 print(US_house.description)

~/.local/share/virtualenvs/401-YopfmMgc/lib/python3.7/site-packages/pandas/core/generic.py in __getattr__(self, name)
   5177             if self._info_axis._can_hold_identifiers_and_holds_name(name):
   5178                 return self[name]
-> 5179             return object.__getattribute__(self, name)
   5180 
   5181     def __setattr__(self, name, value):

AttributeError: 'DataFrame' object has no attribute 'description'
```

In [7]:

```
print(US_house.info)
```

```
<bound method DataFrame.info of       Avg. Area Income  Avg. Area House
Age  Avg. Area Number of Rooms  \
0         79545.458574           5.682861                   7.009188
1         79248.642455           6.002900                   6.730821
2         61287.067179           5.865890                   8.512727
3         63345.240046           7.188236                   5.586729
4         59982.197226           5.040555                   7.839388
...                ...                ...                        ...
4995      60567.944140           7.830362                   6.137356
4996      78491.275435           6.999135                   6.576763
4997      63390.686886           7.250591                   4.805081
4998      68001.331235           5.534388                   7.130144
4999      65510.581804           5.992305                   6.792336

      Avg. Area Number of Bedrooms  Area Population         Price  \
0                             4.09     23086.800503  1.059034e+06
1                             3.09     40173.072174  1.505891e+06
2                             5.13     36882.159400  1.058988e+06
3                             3.26     34310.242831  1.260617e+06
4                             4.23     26354.109472  6.309435e+05
...                            ...              ...           ...
4995                          3.46     22837.361035  1.060194e+06
4996                          4.02     25616.115489  1.482618e+06
4997                          2.13     33266.145490  1.030730e+06
4998                          5.44     42625.620156  1.198657e+06
4999                          4.07     46501.283803  1.298950e+06

                                                Address
0     208 Michael Ferry Apt. 674\nLaurabury, NE 3701...
1     188 Johnson Views Suite 079\nLake Kathleen, CA...
2     9127 Elizabeth Stravenue\nDanieltown, WI 06482...
3                             USS Barnett\nFPO AP 44820
4                            USNS Raymond\nFPO AE 09386
...                                                 ...
4995                     USNS Williams\nFPO AP 30153-7653
4996                PSC 9258, Box 8489\nAPO AA 42991-3352
4997  4215 Tracy Garden Suite 076\nJoshualand, VA 01...
4998                          USS Wallace\nFPO AE 73316
4999  37778 George Ridges Apt. 509\nEast Holly, NV 2...

[5000 rows x 7 columns]>
```

Comparisons Between Ave. Income & Price of House

While Test Size is 20%

In [8]:

```
X = US_house['Avg. Area Income'].values
y = US_house['Price'].values
```

In [9]:

```
X
```

Out[9]:

```
array([79545.45857432, 79248.64245483, 61287.06717866, ...,
       63390.6868855 , 68001.33123509, 65510.58180367])
```

In [14]:

```
X=X.reshape(-1,1)
X
```

Out[14]:

```
array([[79545.45857432],
       [79248.64245483],
       [61287.06717866],
       ...,
       [63390.6868855 ],
       [68001.33123509],
       [65510.58180367]])
```

In [15]:

```
x_train, x_test, y_train, y_test = train_test_split(X,y,train_size=0.8,test_size=0.
2,random_state=100)
print(f"X_train shape {x_train.shape}")
print(f"y_train shape {y_train.shape}")
print(f"X_test shape {x_test.shape}")
print(f"y_test shape {y_test.shape}")
print(y_test)
```

```
X_train shape (4000, 1)
y_train shape (4000,)
X_test shape (1000, 1)
y_test shape (1000,)
[ 800809.13168613 1620949.4369106  1219637.36651886 1172133.48684149
  864483.75849638 1153135.22029401 1178272.29747728  821859.06572785
 1266947.26397664 1636559.24060426 1085494.82011087  995783.16248321
 1096938.42790984 1702528.79401861 1443027.26306137  826306.14792423
 2115010.70359761 1112286.04638504 1094069.79812154  905328.7691457
  782656.08041957 1341722.83596915 2119176.26193328 1543966.42644823
  717213.26879895 1538039.5989439  1823498.40687621  964596.74983993
 1593331.70871016  877247.24536775 1111108.50121858 1313304.58773627
 1123753.73420143 1376714.67419885 1988563.99326237 1874415.10704969
 1732196.21679656 1502443.22975094 1078779.49709872  705100.51155545
 1595620.55713363 1814462.35050116 1610577.49664142 1012262.71165943
 1212939.95351759  934408.71428136 1363086.90453256 1450996.03817929
 1850525.57299623 1796009.50404616 1381117.70135143 1139014.19364814
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  816813.53235126 1305210.26495953 1437053.55720162 1553592.97994692
 1223777.49762374 1100152.08776636 1179440.83225322 1891398.25582299
  889113.23886125  671960.64489301  716771.00574888 1046030.11422825
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  803919.80647176 1740719.10656986 1525690.99505673 1095768.73335286
  853750.65294879  973068.55703495 1046442.63447414  676738.71554521
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```

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       1125880.48737074 1263743.97074833  856931.52843532 1448668.42384024
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        874572.16268299 1053891.64486387 1020842.53135241 1476989.18350395
       1361841.95171551  839629.51217447 1540762.26862812 1087802.88776923
        891468.21327911 1299126.82985549 1060193.78588461  778836.92290454
       1098518.13368549 1543357.45351051 1323326.40292215 1072914.9964424
       1192672.33381805 1419536.25894992 1236258.07968267  560598.53843096
       1408074.53029754 1566253.09646638 1412619.70994713  911071.83355307
       1384798.01055846 1444403.6640511   904785.16315604 1389773.87348942
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       1028650.59198459  539483.39661118 1560270.48520998 1522099.83078893
       1768705.12527915 1235226.47783271 1453312.4679298  1306367.81063752
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       1305127.33600235  988123.75534002 1371670.38933798 1037382.57710349
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       1578760.80839776 1358213.90612806 1326946.72501395 1245053.43252749
       1385783.51709252 1273067.03602756 1573580.23383452  962591.6565767
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       1338044.38331259 1468752.65742698  842924.55377262  993725.21718816
       1166600.45662583 1580691.61687316 1268703.8107934  1171989.71780841
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       1073183.75984163 1472539.95826627 1054770.98064753 1321008.59348566
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        828127.02764658 1246218.31006062 1202987.82934714  646248.18336777
       1684537.96115638 1882978.90043677 1073857.06875908 1352018.25350338
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        660364.98133583  764799.88301368 1812765.95739043 1844929.15557624
```

```
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1567368.28495117 1322782.76026948  896246.14622435 1249461.56160075
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 849566.08554459 1112314.30291141  679373.40147197 1439431.45288969
 866142.18393487 1268964.79540154 1841904.24327404 1919693.23049382
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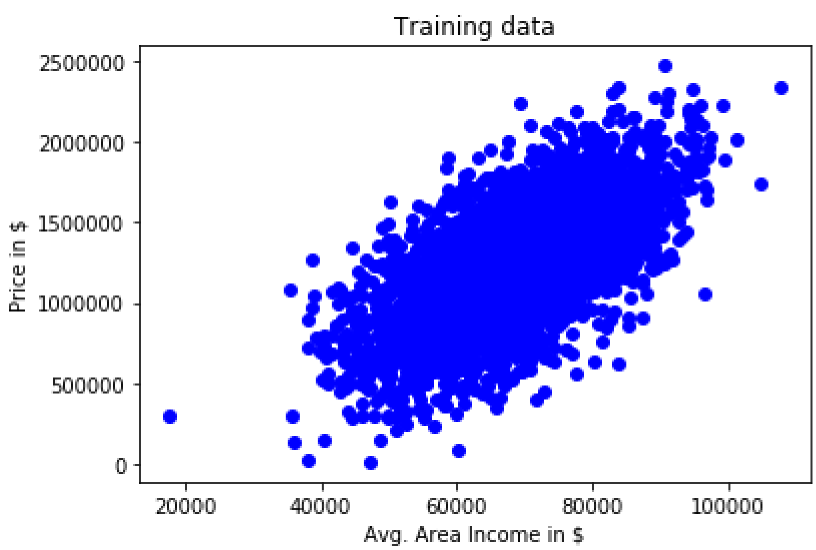
1371527.32701182 1340769.76782914 1573105.98114498 1710612.02954514
1370699.72237291 2013015.74606139 1474379.44008215 1463367.82082537
1102641.11402327 1270869.78317192 1533815.88230216  803689.15193809
1520371.00751546 1226586.92141293 1608889.26337971 1283480.43940074
1448995.11464484 2237778.02570397  541953.90568024 1144507.42322972
1799827.22017044 1460044.54625013 1046191.16493699 1328525.02019627
1381085.72928298  962028.70076464 1294647.58916718 1431915.97700817
 231189.82098986 1408550.41679305 1200764.84420045 1480441.53360472
 313651.50323329 1475700.70966093 1183343.56649345 1316129.30905727
1609092.31792341  268050.81474351 1399466.89776341 1039107.32630562]
```

In [16]:

```
%matplotlib inline
plt.scatter(x_train,y_train,color='blue')
plt.xlabel('Avg. Area Income in $' )
plt.ylabel('Price in $')
plt.title('Training data')
plt.show()
```



In [17]:

```
lm = LinearRegression()
lm.fit(x_train,y_train)
y_predict = lm.predict(x_test)
print(f"Train accuracy {round(lm.score(x_train,y_train)*100,2)} %")
print(f"Test accuracy {round(lm.score(x_test,y_test)*100,2)} %")
```

```
Train accuracy 40.09 %
Test accuracy 44.23 %
```

In [18]:

```
plt.scatter(x_train,y_train,color='red')
plt.plot(x_test,y_predict)
plt.xlabel("Ave Area Income in $")
plt.ylabel("Price in $")
plt.title("Trained model plot")
plt.plot
```

Out[18]:

```
<function matplotlib.pyplot.plot(*args, scalex=True, scaley=True, data=
None, **kwargs)>
```

Comparisons Between Ave. Income & Price of House

While Test Size is 10%

In [19]:

```
x_train, x_test, y_train, y_test = train_test_split(X,y,train_size=0.9,test_size=0.
1,random_state=500)
print(f"X_train shape {x_train.shape}")
print(f"y_train shape {y_train.shape}")
print(f"X_test shape {x_test.shape}")
print(f"y_test shape {y_test.shape}")
print(y_test)
```

```
X_train shape (4500, 1)
y_train shape (4500,)
X_test shape (500, 1)
y_test shape (500,)
[1417403.31186057  946943.03621714 1340769.76782914 1119992.61883545
 1650342.13064281 1309860.05880418  727866.52516791  852703.26367575
 1405495.70997487 1137685.11628548 1111307.06454511 1159953.5929205
 1222041.01583291 1708127.57806546  855667.17930278 1317167.71329326
 1578146.33993396 1529711.13978269  685880.32127708 1035171.0596408
 1281741.16338047  717273.18525768 1007596.04257483 1530480.68787316
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 1296223.70649253 1557914.88977842 1214986.88571544 1162191.79102908
 1329007.20344815 1271396.51800598 1115627.78034952 1706291.99055932
  628870.34564063 1935172.99502019  790802.80103481 1020268.85454366
 1364363.3753659  1159699.96572003 1038153.94873246  673571.34601003
 1283590.45887276  414571.22293662 1326481.67468515  935488.6064948
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 1568700.58552574  742858.63563392 1268421.10418911 1316180.49359149
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 1209287.53549703 1210400.12695473 1668448.09805727 1025417.88751949
 1328701.19413566 1537475.78982883 1869113.61107494 1324470.441475
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  910512.63536174 1057799.24163542 1172619.59705914 1445804.83165148
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```

```
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 877247.24536775 1622837.3530338   934610.39533488 1153321.6041498
1560270.48520998  340605.21131246 2294647.78381303 1029439.23386329
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1030324.918922   1123991.97728077  970044.66564007  768301.80202596
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 885709.76428441  983534.15000672 1466411.79021264 1180325.49878027
1799455.40609275 1472887.24706053 1222412.01985409  603714.7885822
 565680.55280715 1735637.41442567 1295967.38741543 1074296.70364502
1037033.03862142 1043415.99202097 1168627.6508345  1838092.10249886
```

```
  562839.46872064  980141.21910767  911071.83355307 1043548.60910841
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 1642011.34461186 1290784.49085966 1406437.68537389 1580691.61687316
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 1415647.55343724 1753427.9367895  1460364.29988453  873241.98857425
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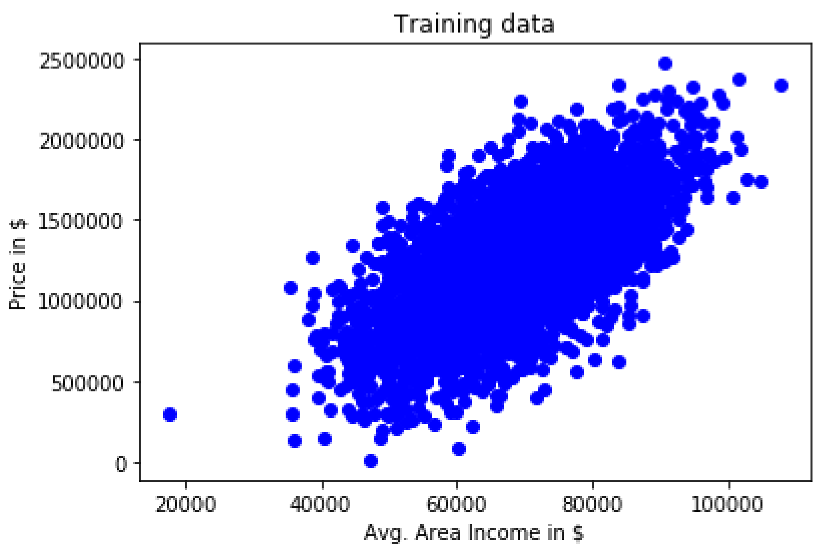
  926880.85055132 1379169.44873068  990725.65175711  679922.25214979
 1411730.47725883 1012321.57384366  828497.06709607 2013015.74606139
  968280.51812382 1103206.75496809 1421715.41534361  961539.05992365]
```

In [20]:

```
%matplotlib inline
plt.scatter(x_train,y_train,color='blue')
plt.xlabel('Avg. Area Income in $' )
plt.ylabel('Price in $')
plt.title('Training data')
plt.show()
```



In [21]:

```
lm = LinearRegression()
lm.fit(x_train,y_train)
y_predict = lm.predict(x_test)
print(f"Train accuracy {round(lm.score(x_train,y_train)*100,2)} %")
print(f"Test accuracy {round(lm.score(x_test,y_test)*100,2)} %")
```

```
Train accuracy 40.97 %
Test accuracy 40.23 %
```

In [22]:

```
plt.scatter(x_train,y_train,color='red')
plt.plot(x_test,y_predict)
plt.xlabel("Ave Area Income in $")
plt.ylabel("Price in $")
plt.title("Trained model plot")
plt.plot
```

Out[22]:

```
<function matplotlib.pyplot.plot(*args, scalex=True, scaley=True, data=
None, **kwargs)>
```

Comparisons Between Ave. Income & Price of House

While Test Size is 30%

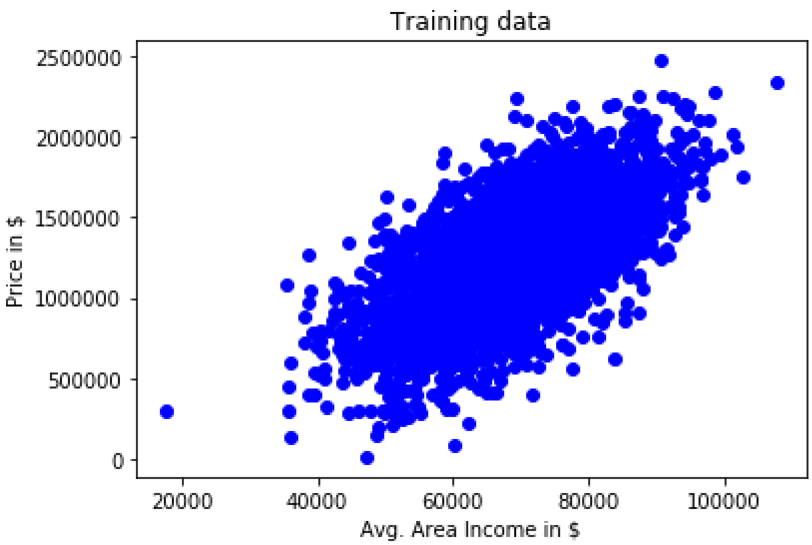
In [23]:

```
x_train, x_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.
3,random_state=100000)
print(f"X_train shape {x_train.shape}")
print(f"y_train shape {y_train.shape}")
print(f"X_test shape {x_test.shape}")
print(f"y_test shape {y_test.shape}")
print(y_test)
```

```
X_train shape (3500, 1)
y_train shape (3500,)
X_test shape (1500, 1)
y_test shape (1500,)
[1525533.40662551 1369006.11488144 1096912.03579858 ... 1154917.3936116
4
 1214262.69927372 1023595.11287068]
```

In [24]:

```
%matplotlib inline
plt.scatter(x_train,y_train,color='blue')
plt.xlabel('Avg. Area Income in $' )
plt.ylabel('Price in $')
plt.title('Training data')
plt.show()
```



In [25]:

```
lm = LinearRegression()
lm.fit(x_train,y_train)
y_predict = lm.predict(x_test)
print(f"Train accuracy {round(lm.score(x_train,y_train)*100,2)} %")
print(f"Test accuracy {round(lm.score(x_test,y_test)*100,2)} %")
```

```
Train accuracy 40.03 %
Test accuracy 42.94 %
```

In [26]:

```
plt.scatter(x_train,y_train,color='red')
plt.plot(x_test,y_predict)
plt.xlabel("Ave Area Income in $")
plt.ylabel("Price in $")
plt.title("Trained model plot")
plt.plot
```

Out[26]:

```
<function matplotlib.pyplot.plot(*args, scalex=True, scaley=True, data=
None, **kwargs)>
```

Comparisons Price of House & Area Population

While Test Size is 10%

In [27]:

```
X = US_house['Area Population'].values
y = US_house['Price'].values
```

In [28]:

```
X
```

Out[28]:

```
array([23086.80050269, 40173.07217364, 36882.1593997 , ...,
       33266.14548965, 42625.62015585, 46501.28380314])
```

In [29]:

```
X=X.reshape(-1,1)
X
```

Out[29]:

```
array([[23086.80050269],
       [40173.07217364],
       [36882.1593997 ],
       ...,
       [33266.14548965],
       [42625.62015585],
       [46501.28380314]])
```

In [30]:

```
x_train, x_test, y_train, y_test = train_test_split(X,y,train_size=0.9,test_size=0.
1,random_state=100)
print(f"X_train shape {x_train.shape}")
print(f"y_train shape {y_train.shape}")
print(f"X_test shap {x_test.shape}")
print(f"y_test shape {y_test.shape}")
print(y_test)
```

```
X_train shape (4500, 1)
y_train shape (4500,)
X_test shap (500, 1)
y_test shape (500,)
[ 800809.13168613 1620949.4369106  1219637.36651886 1172133.48684149
  864483.75849638 1153135.22029401 1178272.29747728  821859.06572785
 1266947.26397664 1636559.24060426 1085494.82011087  995783.16248321
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```

```
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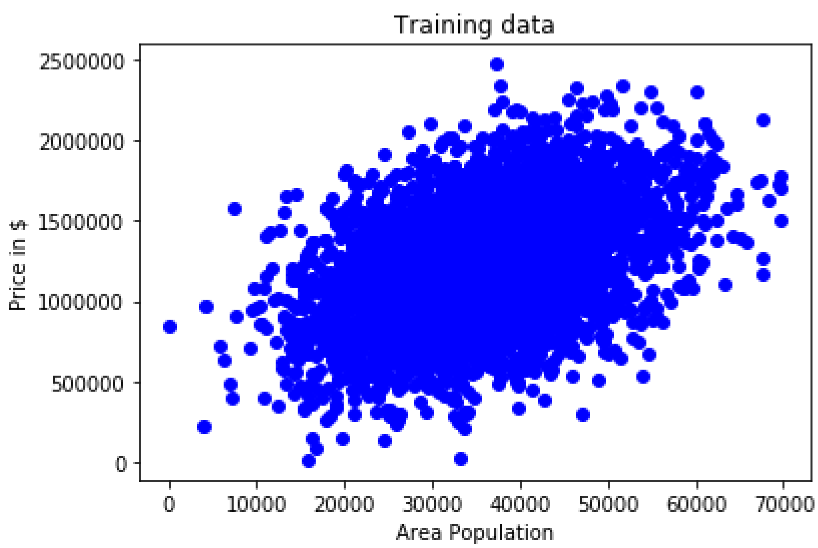
 1072874.61021656 1145351.16123256 1126137.68140858 1380353.88759813
 1113373.52000173 1598615.97448642 1162746.62108136 1280230.62536823]
```

In [31]:

```
%matplotlib inline
plt.scatter(x_train,y_train,color='blue')
plt.xlabel('Area Population')
plt.ylabel('Price in $')
plt.title('Training data')
plt.show()
```



In [32]:

```
lm = LinearRegression()
lm.fit(x_train,y_train)
y_predict = lm.predict(x_test)
print(f"Train accuracy {round(lm.score(x_train,y_train)*100,2)} %")
print(f"Test accuracy {round(lm.score(x_test,y_test)*100,2)} %")
```

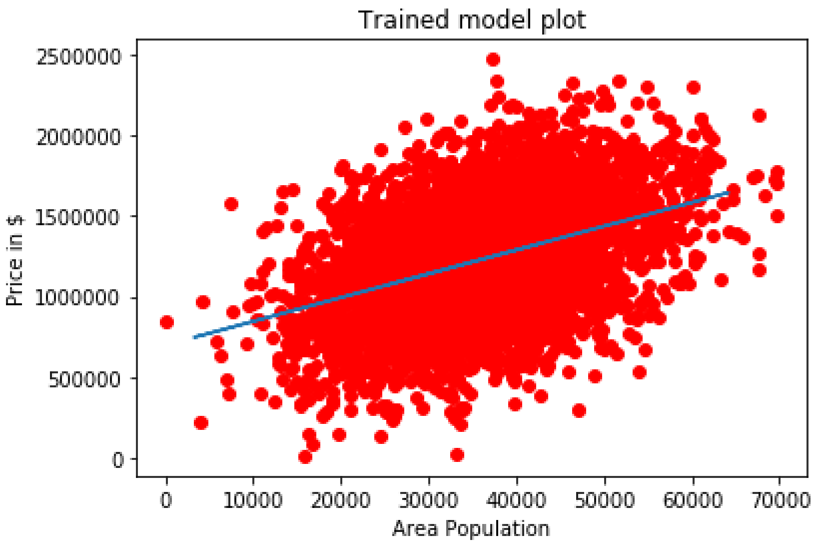
```
Train accuracy 17.11 %
Test accuracy 12.9 %
```

In [33]:

```
plt.scatter(x_train,y_train,color='red')
plt.plot(x_test,y_predict)
plt.xlabel("Area Population")
plt.ylabel("Price in $")
plt.title("Trained model plot")
plt.plot
```

Out[33]:

```
<function matplotlib.pyplot.plot(*args, scalex=True, scaley=True, data=
None, **kwargs)>
```



Comparisons Price of House & Area Population

While Test Size is 20%

In [34]:

```
x_train, x_test, y_train, y_test = train_test_split(X,y,train_size=0.8,test_size=0.
2,random_state=1000)
print(f"X_train shape {x_train.shape}")
print(f"y_train shape {y_train.shape}")
print(f"X_test shap {x_test.shape}")
print(f"y_test shape {y_test.shape}")
print(y_test)
```

```
X_train shape (4000, 1)
y_train shape (4000,)
X_test shap (1000, 1)
y_test shape (1000,)
[1277380.52860853  849153.12252829 1224397.42724927 2016910.73970733
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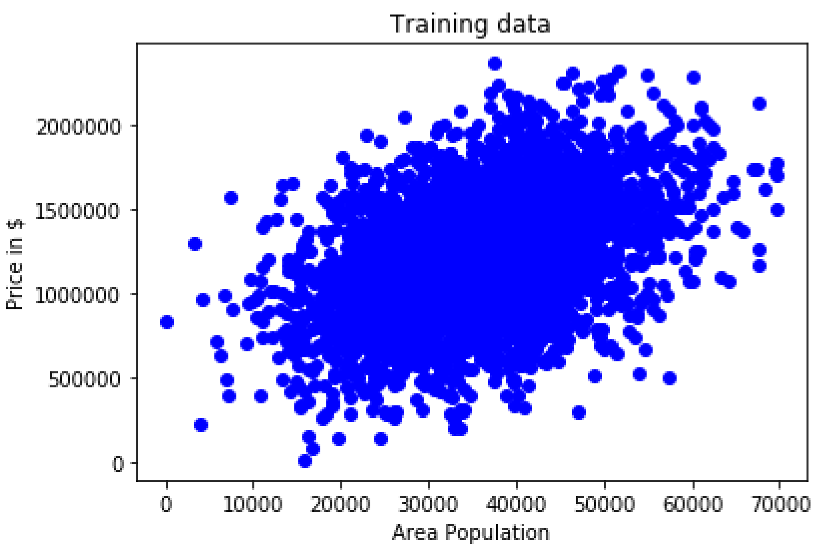
1276448.79204297 1134273.42452143 1529281.84011934 1128403.36605923
 573434.66423432 1131040.70232425 1133139.92617632 1636414.89207332]
```

In [35]:

```
%matplotlib inline
plt.scatter(x_train,y_train,color='blue')
plt.xlabel('Area Population')
plt.ylabel('Price in $')
plt.title('Training data')
plt.show()
```



In [36]:

```
lm = LinearRegression()
lm.fit(x_train,y_train)
y_predict = lm.predict(x_test)
print(f"Train accuracy {round(lm.score(x_train,y_train)*100,2)} %")
print(f"Test accuracy {round(lm.score(x_test,y_test)*100,2)} %")
```

```
Train accuracy 17.33 %
Test accuracy 14.17 %
```

In [37]:

```
plt.scatter(x_train,y_train,color='red')
plt.plot(x_test,y_predict)
plt.xlabel("Area Population")
plt.ylabel("Price in $")
plt.title("Trained model plot")
plt.plot
```

Out[37]:

```
<function matplotlib.pyplot.plot(*args, scalex=True, scaley=True, data=None, **kwargs)>
```

Comparisons Price of House & Area Population

While Test Size is 30%

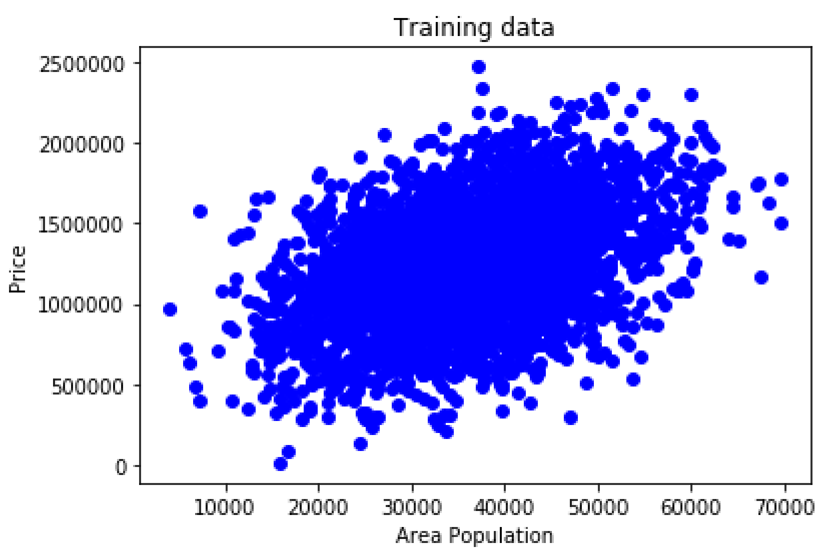
In [38]:

```
x_train, x_test, y_train, y_test = train_test_split(X,y,train_size=0.7,test_size=0.
3,random_state=100)
print(f"X_train shape {x_train.shape}")
print(f"y_train shape {y_train.shape}")
print(f"X_test shap {x_test.shape}")
print(f"y_test shape {y_test.shape}")
print(y_test)
```

```
X_train shape (3500, 1)
y_train shape (3500,)
X_test shap (1500, 1)
y_test shape (1500,)
[ 800809.13168613 1620949.4369106  1219637.36651886 ... 1647216.5936644
5
  412057.44010889  942508.96223867]
```

In [39]:

```
%matplotlib inline
plt.scatter(x_train,y_train,color='blue')
plt.xlabel('Area Population')
plt.ylabel('Price')
plt.title('Training data')
plt.show()
```



In [40]:

```
lm = LinearRegression()
lm.fit(x_train,y_train)
y_predict = lm.predict(x_test)
print(f"Train accuracy {round(lm.score(x_train,y_train)*100,2)} %")
print(f"Test accuracy {round(lm.score(x_test,y_test)*100,2)} %")
```

```
Train accuracy 16.72 %
Test accuracy 16.62 %
```

In [ ]:

```
plt.scatter(x_train,y_train,color='red')
plt.plot(x_test,y_predict)
plt.xlabel("Area Population")
plt.ylabel("Price in $")
plt.title("Trained model plot")
plt.plot
```

Comparisons Ave. Income & Ave. Area of Bedrooms

While Test Size is 10%

In [41]:

```
X = US_house['Avg. Area Income'].values
y = US_house['Avg. Area Number of Rooms'].values
```

In [42]:

```
X
```

Out[42]:

```
array([79545.45857432, 79248.64245483, 61287.06717866, ...,
       63390.6868855 , 68001.33123509, 65510.58180367])
```

In [43]:

```
X=X.reshape(-1,1)
X
```

Out[43]:

```
array([[79545.45857432],
       [79248.64245483],
       [61287.06717866],
       ...,
       [63390.6868855 ],
       [68001.33123509],
       [65510.58180367]])
```

In [44]:

```
x_train, x_test, y_train, y_test = train_test_split(X,y,train_size=0.9,test_size=0.
1,random_state=1000)
print(f"X_train shape {x_train.shape}")
print(f"y_train shape {y_train.shape}")
print(f"X_test shap {x_test.shape}")
print(f"y_test shape {y_test.shape}")
print(y_test)
```

```
X_train shape (4500, 1)
y_train shape (4500,)
X_test shap (500, 1)
y_test shape (500,)
[7.67098283 6.02452319 7.65651167 8.76661274 6.46252334 6.52222048
 8.50065931 6.03645802 7.13125578 7.22911211 7.88847287 5.96140678
 5.16486548 6.65816348 8.56001888 8.54176845 7.3182145  7.316551
 8.46146827 6.9096769  7.74683647 6.15220352 8.8615771  7.8410663
 8.4513549  8.38320811 7.80189707 7.47067235 7.67923057 6.73400688
 8.00644913 8.59824688 5.74405984 5.58679444 5.0427468  6.12940457
 8.84066791 7.12398966 7.97987782 7.50381655 6.13419293 7.87459883
 7.23704281 6.31106491 6.66953171 7.47284985 6.81364961 7.16132931
 7.54589692 5.65425637 6.79627685 6.5413757  7.03385222 8.50933677
 7.24990524 8.08412347 7.73486203 7.8452404  6.42408542 6.50394588
 6.73255173 7.27878258 7.87896295 7.29698406 7.03666701 8.25904432
 7.64896367 4.98021947 6.18284258 4.9673884  5.56435288 7.40068467
 8.00541729 6.9682825  5.78918815 6.11019169 6.94214348 6.91430889
 7.42768912 6.87615033 8.28908486 5.07967061 7.51138304 6.02020121
 7.08507236 6.04232838 5.71544106 6.68668613 5.01279289 8.91606569
 7.41078451 7.51820433 6.95202667 8.1052283  6.47600734 8.69531316
 5.22798817 6.809013   6.25567488 6.13548984 7.6987646  6.36475668
 8.30330169 6.70105955 6.9225152  5.67113634 4.67913425 7.13315074
 7.51863612 6.33728559 7.60001598 6.67780569 9.26945262 8.36606762
 6.36827869 7.57964206 7.79586819 7.4804088  7.18252748 7.4843437
 4.99468979 6.22641197 7.51882743 6.49496655 6.70312502 7.19144435
 7.96045754 6.11432319 8.36090689 7.347288   6.72864277 8.56260323
 7.02125235 6.40013174 7.10384015 8.53996217 6.70264287 5.82540547
 7.42789161 7.40487042 7.8059037  7.15721495 7.88384041 6.97930778
 6.56120428 7.35139752 5.58803088 8.27338677 9.46876637 5.64536314
 6.123813   7.49269975 5.72300868 6.57165542 6.5900353  5.94839209
 7.39019749 6.7656924  7.13895771 6.65298344 8.76548129 5.91117641
 8.20329527 7.48132111 5.34530334 6.64519128 7.34936292 6.88139814
 6.92040927 7.27610229 5.82970368 6.69072862 7.08838588 7.03947718
 8.35354165 7.61038621 7.07359289 5.58104069 6.26153528 8.15737889
 8.31777468 8.39948615 7.31484847 6.97512803 7.2123397  7.55440649
 6.46959427 8.36254785 7.04682565 6.34607205 6.31145247 5.57104279
 6.50961621 7.7753357  4.41438087 7.24286605 7.11986208 6.31790688
 9.0381508  4.52542103 8.70042833 6.99074475 6.8242861  7.77004618
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 8.9044547  6.50254083 6.98885176 8.33541863 6.49953359 5.79358981
 5.05585786 6.97315103 4.40683594 6.74487309 8.14775959 6.54983602
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 6.32261086 6.47694199 7.3491215  7.71668807 8.33620873 7.84432552
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```

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 7.42577752 8.45736227 7.55551872 6.21089502 7.84230638 8.47992133
 7.21535475 8.06565992 6.78415351 5.3729923  6.15970522 7.20450454
 8.34052442 7.55361501 8.60845681 6.04598402 6.38836263 5.91195308
 7.21225427 5.81482265 7.16650165 8.05950533 4.70501539 6.96576449
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 5.68706258 5.71553335 7.52809801 5.38299815 6.8339559  7.50127508
 6.76612964 6.29181815 7.93551076 5.82897549 5.63531521 6.59459228
 7.21365908 7.21726847 7.31212466 7.29172807 5.33226457 5.69808252
 6.41219784 7.05219498 5.72161852 6.26259715 8.61042055 6.9963361
 7.48109117 6.77498642 6.97442448 7.1952462  6.82668629 6.40733952
 7.68134202 9.14124198 6.32480683 7.79782478 6.965111   6.35862933
 7.7344186  7.01525297 7.08983177 6.47103518 7.78813838 7.38712583
 7.8395525  6.97168639 7.3729051  4.46053037 7.90367488 6.36072222
 6.50983678 8.42582069 6.28721317 8.04075452 8.73721569 7.54543845
 7.81629481 6.97946629 5.79312283 6.92132036 5.61383427 5.56407186
 7.35417683 7.05392715 6.37640125 5.45706093 7.11665503 6.91567232
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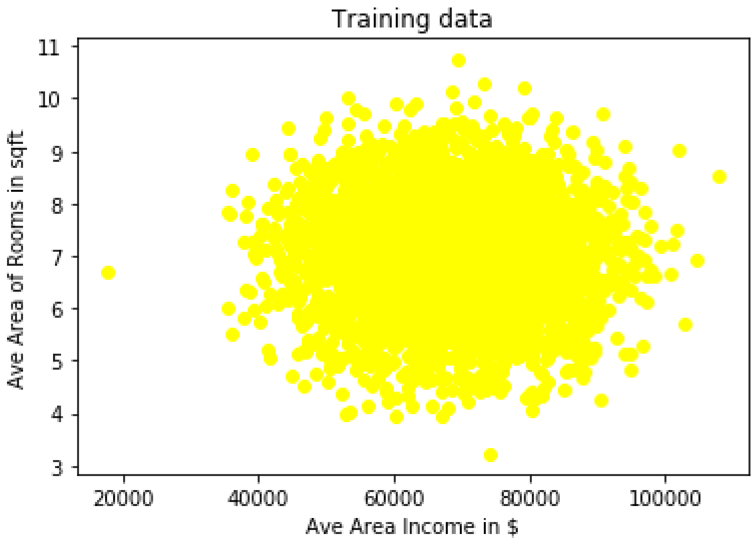
 7.60409213 8.45788691 7.13049789 6.18512925 9.1663504  8.20529421
 6.28035876 6.95671919 6.69528101 7.21196293 8.12688859 7.08015374
 8.90838054 8.30860311 6.88117365 9.1520729  6.9812466  5.73767586
 6.564423   4.97716915 6.87237955 6.54460275 6.40694457 6.86779281
 7.17576954 5.76166985 5.78685535 6.28520689 7.27213154 6.39910671
 5.37038661 6.28657948 7.29836739 7.19091541 5.90945193 8.0676457
 6.92785868 5.86571615 7.87875675 9.29351324 7.38410589 5.35501255
 7.88113752 6.28981291 8.4693801  7.53413621 5.75067192 6.03156091
 6.19461305 6.33024341]
```

In [45]:

```
%matplotlib inline
plt.scatter(x_train,y_train,color='yellow')
plt.xlabel('Ave Area Income in $')
plt.ylabel('Ave Area of Rooms in sqft')
plt.title('Training data')
plt.show()
```



In [46]:

```
lm = LinearRegression()
lm.fit(x_train,y_train)
y_predict = lm.predict(x_test)
print(f"Train accuracy {round(lm.score(x_train,y_train)*100,2)} %")
print(f"Test accuracy {round(lm.score(x_test,y_test)*100,2)} %")
```

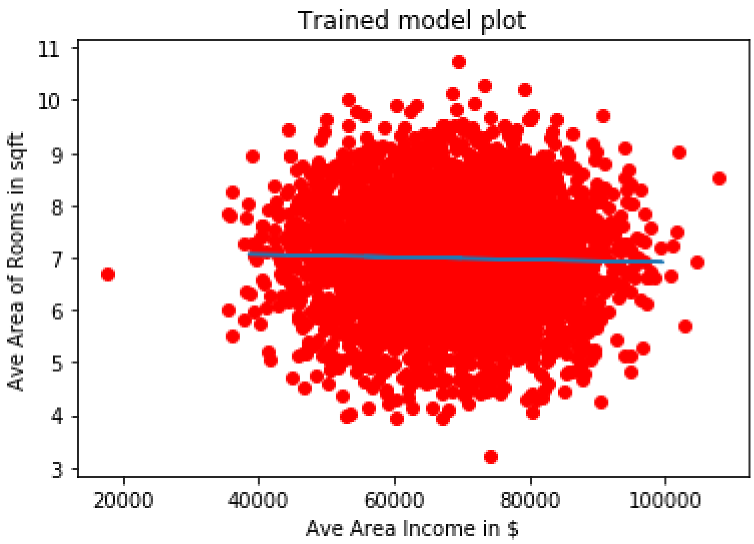
```
Train accuracy 0.07 %
Test accuracy -0.74 %
```

In [47]:

```
plt.scatter(x_train,y_train,color='red')
plt.plot(x_test,y_predict)
plt.xlabel('Ave Area Income in $')
plt.ylabel('Ave Area of Rooms in sqft')
plt.title("Trained model plot")
plt.plot
```

Out[47]:

```
<function matplotlib.pyplot.plot(*args, scalex=True, scaley=True, data=
None, **kwargs)>
```



Comparisons Ave. Income & Ave. Area of Bedrooms

While Test Size is 20%

In [48]:

```
x_train, x_test, y_train, y_test = train_test_split(X,y,train_size=0.8,test_size=0.
2,random_state=1000)
print(f"X_train shape {x_train.shape}")
print(f"y_train shape {y_train.shape}")
print(f"X_test shap {x_test.shape}")
print(f"y_test shape {y_test.shape}")
print(y_test)
```

```
X_train shape (4000, 1)
y_train shape (4000,)
X_test shap (1000, 1)
y_test shape (1000,)
[7.67098283 6.02452319 7.65651167 8.76661274 6.46252334 6.52222048
 8.50065931 6.03645802 7.13125578 7.22911211 7.88847287 5.96140678
 5.16486548 6.65816348 8.56001888 8.54176845 7.3182145  7.316551
 8.46146827 6.9096769  7.74683647 6.15220352 8.8615771  7.8410663
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 8.00644913 8.59824688 5.74405984 5.58679444 5.0427468  6.12940457
 8.84066791 7.12398966 7.97987782 7.50381655 6.13419293 7.87459883
 7.23704281 6.31106491 6.66953171 7.47284985 6.81364961 7.16132931
 7.54589692 5.65425637 6.79627685 6.5413757  7.03385222 8.50933677
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 7.64896367 4.98021947 6.18284258 4.9673884  5.56435288 7.40068467
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 8.30330169 6.70105955 6.9225152  5.67113634 4.67913425 7.13315074
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 7.42789161 7.40487042 7.8059037  7.15721495 7.88384041 6.97930778
 6.56120428 7.35139752 5.58803088 8.27338677 9.46876637 5.64536314
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 8.35354165 7.61038621 7.07359289 5.58104069 6.26153528 8.15737889
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 6.90882967 5.89844743 8.21977112 7.33696283 7.56542067 4.63516111
```

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```

```
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 5.56549407 8.0103969  6.8236738  5.91846383 6.99350408 7.86448228
 9.91652843 6.64961024 8.47338077 5.88068495 7.84069797 7.57410261
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 7.74438535 6.74948872 6.93654802 7.31643648 7.50948472 5.98789644
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 8.06591976 7.89947708 7.6934021  7.16078798 7.35488319 7.52135853
 6.80887893 7.65416271 7.9095452  6.12246523 7.69016918 7.89415042
 7.38555504 8.0662199  7.98951567 6.02916087 7.14649989 6.80707758
 6.16415145 6.99769954 7.99781793 7.62644406 7.36045528 6.37606022
 7.57044711 7.84737579 7.99904764 5.60480342 7.98194165 6.39488032
 7.56019912 6.88291844 8.65734264 7.48193032 6.85153583 7.35028508
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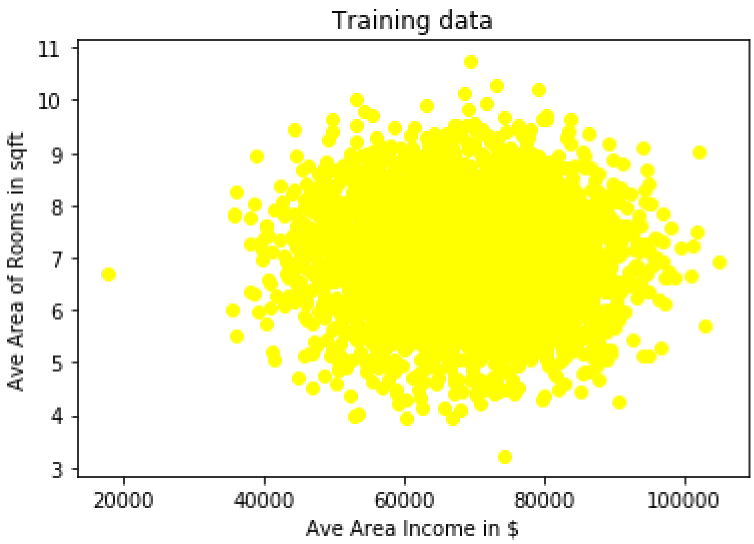
```

In [49]:

```
%matplotlib inline
plt.scatter(x_train,y_train,color='yellow')
plt.xlabel('Ave Area Income in $')
plt.ylabel('Ave Area of Rooms in sqft')
plt.title('Training data')
plt.show()
```



In [50]:

```
lm = LinearRegression()
lm.fit(x_train,y_train)
y_predict = lm.predict(x_test)
print(f"Train accuracy {round(lm.score(x_train,y_train)*100,2)} %")
print(f"Test accuracy {round(lm.score(x_test,y_test)*100,2)} %")
```

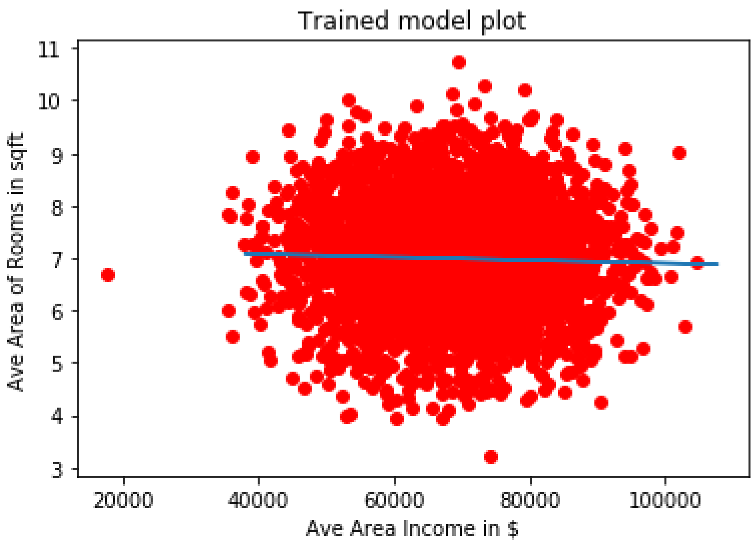
```
Train accuracy 0.1 %
Test accuracy -0.63 %
```

In [51]:

```
plt.scatter(x_train,y_train,color='red')
plt.plot(x_test,y_predict)
plt.xlabel('Ave Area Income in $')
plt.ylabel('Ave Area of Rooms in sqft')
plt.title("Trained model plot")
plt.plot
```

Out[51]:

```
<function matplotlib.pyplot.plot(*args, scalex=True, scaley=True, data=
None, **kwargs)>
```



Comparisons Ave. Income & Ave. Area of Bedrooms

Polynomial Regression Method

While Test Size is 20%

In [58]:

```
X = US_house['Avg. Area Income'].values
y = US_house['Avg. Area Number of Rooms'].values
```

In [59]:

```
X
```

Out[59]:

```
array([79545.45857432, 79248.64245483, 61287.06717866, ...,
       63390.6868855 , 68001.33123509, 65510.58180367])
```

In [60]:

```
X=X.reshape(-1,1)
X
```

Out[60]:

```
array([[79545.45857432],
       [79248.64245483],
       [61287.06717866],
       ...,
       [63390.6868855 ],
       [68001.33123509],
       [65510.58180367]])
```

In [61]:

```
x_train, x_test, y_train, y_test = train_test_split(X,y,train_size=0.8,test_size=0.
2,random_state=1000)
print(f"X_train shape {x_train.shape}")
print(f"y_train shape {y_train.shape}")
print(f"X_test shap {x_test.shape}")
print(f"y_test shape {y_test.shape}")
print(y_test)
```

```
X_train shape (4000, 1)
y_train shape (4000,)
X_test shap (1000, 1)
y_test shape (1000,)
[7.67098283 6.02452319 7.65651167 8.76661274 6.46252334 6.52222048
 8.50065931 6.03645802 7.13125578 7.22911211 7.88847287 5.96140678
 5.16486548 6.65816348 8.56001888 8.54176845 7.3182145  7.316551
 8.46146827 6.9096769  7.74683647 6.15220352 8.8615771  7.8410663
 8.4513549  8.38320811 7.80189707 7.47067235 7.67923057 6.73400688
 8.00644913 8.59824688 5.74405984 5.58679444 5.0427468  6.12940457
 8.84066791 7.12398966 7.97987782 7.50381655 6.13419293 7.87459883
 7.23704281 6.31106491 6.66953171 7.47284985 6.81364961 7.16132931
 7.54589692 5.65425637 6.79627685 6.5413757  7.03385222 8.50933677
 7.24990524 8.08412347 7.73486203 7.8452404  6.42408542 6.50394588
 6.73255173 7.27878258 7.87896295 7.29698406 7.03666701 8.25904432
 7.64896367 4.98021947 6.18284258 4.9673884  5.56435288 7.40068467
 8.00541729 6.9682825  5.78918815 6.11019169 6.94214348 6.91430889
 7.42768912 6.87615033 8.28908486 5.07967061 7.51138304 6.02020121
 7.08507236 6.04232838 5.71544106 6.68668613 5.01279289 8.91606569
 7.41078451 7.51820433 6.95202667 8.1052283  6.47600734 8.69531316
 5.22798817 6.809013   6.25567488 6.13548984 7.6987646  6.36475668
 8.30330169 6.70105955 6.9225152  5.67113634 4.67913425 7.13315074
 7.51863612 6.33728559 7.60001598 6.67780569 9.26945262 8.36606762
 6.36827869 7.57964206 7.79586819 7.4804088  7.18252748 7.4843437
 4.99468979 6.22641197 7.51882743 6.49496655 6.70312502 7.19144435
 7.96045754 6.11432319 8.36090689 7.347288   6.72864277 8.56260323
 7.02125235 6.40013174 7.10384015 8.53996217 6.70264287 5.82540547
 7.42789161 7.40487042 7.8059037  7.15721495 7.88384041 6.97930778
 6.56120428 7.35139752 5.58803088 8.27338677 9.46876637 5.64536314
 6.123813   7.49269975 5.72300868 6.57165542 6.5900353  5.94839209
 7.39019749 6.7656924  7.13895771 6.65298344 8.76548129 5.91117641
 8.20329527 7.48132111 5.34530334 6.64519128 7.34936292 6.88139814
 6.92040927 7.27610229 5.82970368 6.69072862 7.08838588 7.03947718
 8.35354165 7.61038621 7.07359289 5.58104069 6.26153528 8.15737889
 8.31777468 8.39948615 7.31484847 6.97512803 7.2123397  7.55440649
 6.46959427 8.36254785 7.04682565 6.34607205 6.31145247 5.57104279
 6.50961621 7.7753357  4.41438087 7.24286605 7.11986208 6.31790688
 9.0381508  4.52542103 8.70042833 6.99074475 6.8242861  7.77004618
 6.57835207 7.00912859 5.17862848 9.71572267 7.795375   7.77504924
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 6.08432247 6.56122047 6.94676293 6.62377571 8.87724004 7.00371544
 8.44100893 7.00480304 5.83241183 5.40178683 6.88540385 8.32989418
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 7.92637224 6.67325638 6.22945854 8.00591367 7.70392045 6.64968387
 7.50827158 6.38247203 5.93561862 6.70551375 6.24885445 5.55074587
 8.9044547  6.50254083 6.98885176 8.33541863 6.49953359 5.79358981
 5.05585786 6.97315103 4.40683594 6.74487309 8.14775959 6.54983602
 6.00565649 7.17691728 4.99375978 5.29682702 7.54290995 7.59452876
 6.964616   6.84471227 7.45618504 5.4485801  5.37016214 6.10451244
 5.65297424 8.36657044 6.85184183 7.28033734 8.21060212 7.93153954
 5.81643633 8.40436325 7.18867902 5.58090594 8.20087222 6.66712651
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 5.60489361 8.10567172 5.73698335 7.11149677 8.11400139 5.82073184
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```

```
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```

```
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8.15953758 5.83173897 8.77666081 5.09352674 7.06620874 8.27198289
8.06591976 7.89947708 7.6934021  7.16078798 7.35488319 7.52135853
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6.61798687 6.1005507  7.30991938 6.69199648 7.39790527 6.61175592
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8.69272343 5.56934016 5.37021133 7.43854426 7.61959376 6.03009799
8.48231689 9.79489831 7.2043689  5.31076127 6.61601171 6.01062793
6.11002147 7.59132805 9.08657347 7.39157655]
```

In [65]:

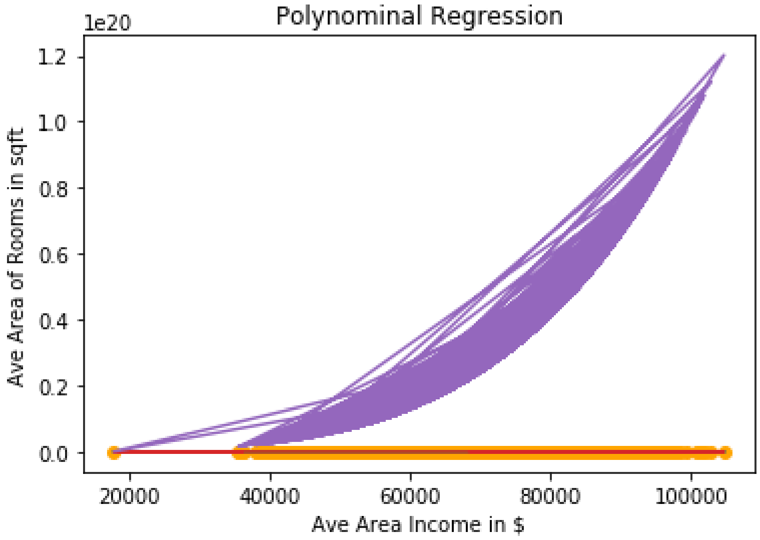
```
poly = PolynomialFeatures(degree = 4)
X_poly = poly.fit_transform(x_train)
poly.fit(X_poly,y_train)
```

Out[65]:

```
PolynomialFeatures(degree=4, include_bias=True, interaction_only=False,
                   order='C')
```

In [70]:

```
%matplotlib inline
plt.scatter(x_train,y_train,color='orange')
plt.plot(x_train, poly.fit_transform(x_train))
plt.xlabel('Ave Area Income in $')
plt.ylabel('Ave Area of Rooms in sqft')
plt.title('Polynominal Regression')
plt.show()
```



In [ ]:

```

```

In [ ]:

```

```