In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [3]:
```
#import dataset in python

house = pd.read_excel(r'C:\Users\ashok\Downloads\PG\PGP Data Science\Data_Science_With_Python_2020\Projects\house.xlsx')
```

In [4]:
```
#first few lines
house.head()
```

Out[4]:

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	households	median_in
0	-122.23	37.88	41	880	129.0	322	126	8
1	-122.22	37.86	21	7099	1106.0	2401	1138	8
2	-122.24	37.85	52	1467	190.0	496	177	7
3	-122.25	37.85	52	1274	235.0	558	219	5
4	-122.25	37.85	52	1627	280.0	565	259	3

In [6]:
```
#exploration of data
house.size
```

Out[6]:
```
206400
```

In [7]:
```
house.shape
```

Out[7]:
```
(20640, 10)
```

In [8]:
```
#get column names

house.columns
```

Out[8]:
```
Index(['longitude', 'latitude', 'housing_median_age', 'total_rooms',
       'total_bedrooms', 'population', 'households', 'median_income',
       'ocean_proximity', 'median_house_value'],
      dtype='object')
```

In [10]:
```
# structure of the dataframe
house.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20640 entries, 0 to 20639
Data columns (total 10 columns):
 #   Column              Non-Null Count  Dtype  
---  ------              --------------  -----  
 0   longitude           20640 non-null  float64
 1   latitude            20640 non-null  float64
 2   housing_median_age  20640 non-null  int64  
 3   total_rooms         20640 non-null  int64  
 4   total_bedrooms      20433 non-null  float64
 5   population          20640 non-null  int64  
 6   households          20640 non-null  int64  
 7   median_income       20640 non-null  float64
 8   ocean_proximity     20640 non-null  object 
 9   median_house_value  20640 non-null  int64  
dtypes: float64(4), int64(5), object(1)
memory usage: 1.6+ MB
```

In [11]:
```
#find missing value
house['total_bedrooms'].isnull().sum()
```

Out[11]:
```
207
```

In [12]:
```
house.isnull().sum()
```

Out[12]:
```
longitude               0
latitude                0
housing_median_age      0
total_rooms             0
total_bedrooms        207
population              0
households              0
median_income           0
ocean_proximity         0
median_house_value      0
dtype: int64
```

In [13]:
```
# descriptive statistic
house.describe()
```

Out[13]:

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	hous
count	20640.000000	20640.000000	20640.000000	20640.000000	20433.000000	20640.000000	20640.
mean	-119.569704	35.631861	28.639486	2635.763081	537.870553	1425.476744	499.
std	2.003532	2.135952	12.585558	2181.615252	421.385070	1132.462122	382.
min	-124.350000	32.540000	1.000000	2.000000	1.000000	3.000000	1.
25%	-121.800000	33.930000	18.000000	1447.750000	296.000000	787.000000	280.
50%	-118.490000	34.260000	29.000000	2127.000000	435.000000	1166.000000	409.
75%	-118.010000	37.710000	37.000000	3148.000000	647.000000	1725.000000	605.
max	-114.310000	41.950000	52.000000	39320.000000	6445.000000	35682.000000	6082.

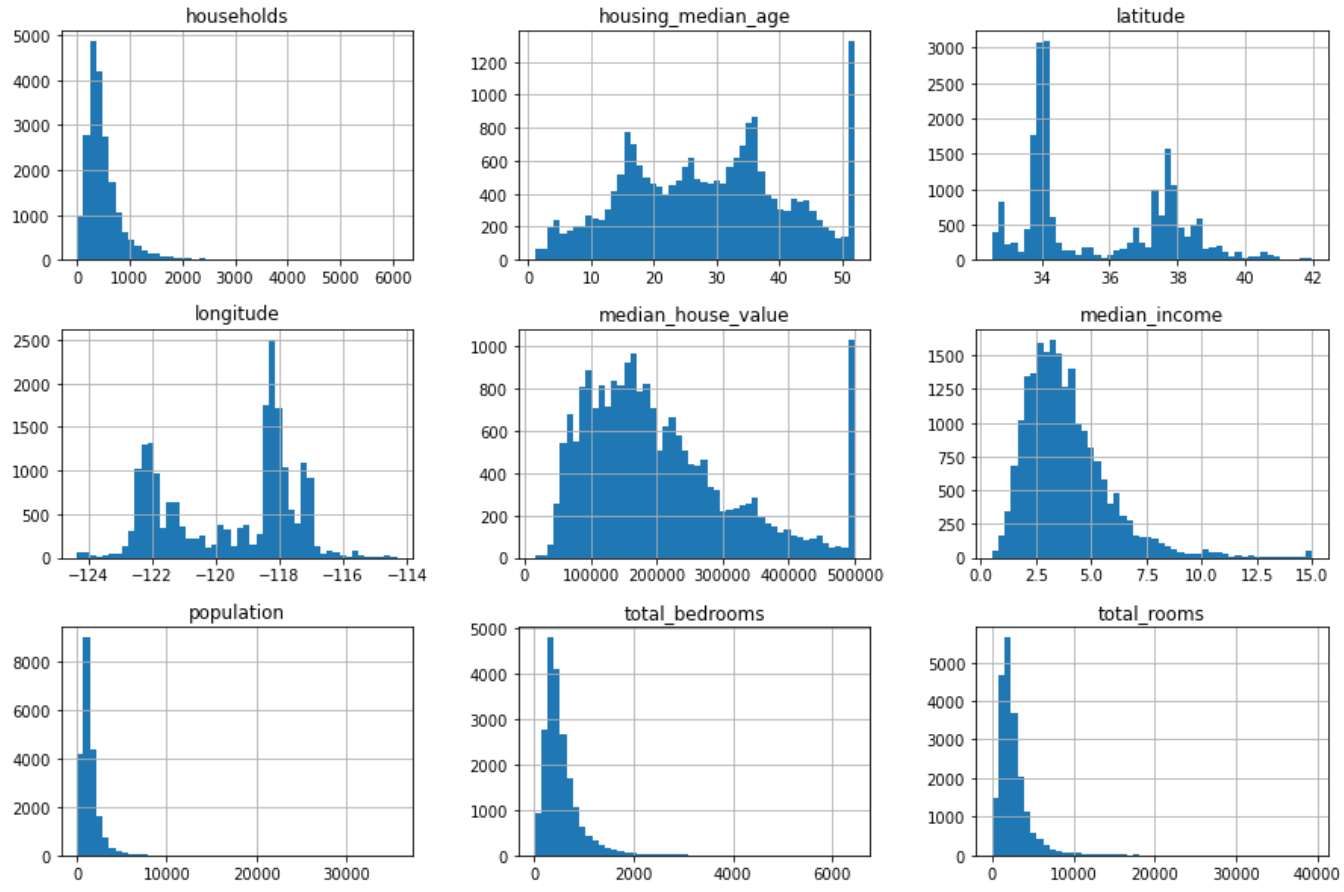
In [16]:
```
# histogram for all numeric variables

plt.figure(figsize=(8,8))

house.hist(bins=50, figsize=(15,10))
```

Out[16]:
```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x000001D10EE2B8E0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x000001D1100AE910>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x000001D10DE6C9D0>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x000001D10EA16E20>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x000001D10E97E2B0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x000001D10E99A640>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x000001D10E99A730>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x000001D10E9DBBE0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x000001D10E967430>]],
      dtype=object)
```

```
<Figure size 576x576 with 0 Axes>
```

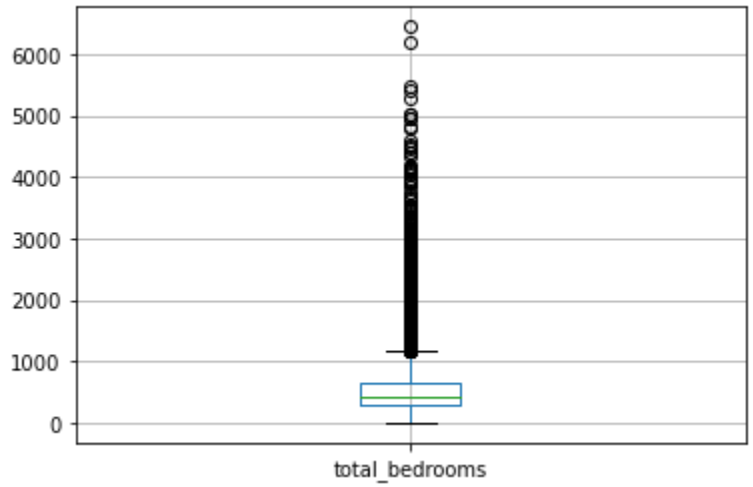


In [17]:
```
house['total_bedrooms'].mean()
```

Out[17]:
```
537.8705525375618
```

In [19]:
```
house.boxplot(column='total_bedrooms')
```

Out[19]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1d1117a35b0>
```



In [20]:
```
# handle missing values

#mean to fill the missing values

house['total_bedrooms']=np.where(house['total_bedrooms'].isnull(),house['total_bedrooms'
].mean(),house['total_bedrooms'])
```

In [21]:
```
#check missing values
house.isnull().sum()
```

Out[21]:
```
longitude             0
latitude              0
housing_median_age    0
total_rooms           0
total_bedrooms        0
population            0
households            0
median_income         0
ocean_proximity       0
median_house_value    0
dtype: int64
```

In [22]:
```
# avg=house['total_bedrooms'].mean()
# house['total_bedrooms'].fillna(avg, inplace=True)

#np.where(condition, if true then, if false then)
```

In [24]:
```
#convert categorical data into numerical data

#from sklearn import preprocessing
#le = preprocessing.LabelEncoder()
#house['area_label']=le.fit_transform(house['ocean_proximity'])

#use pd.get_dummies to convert the categorical values into the dummy variables

ocean_dummy=pd.get_dummies(house['ocean_proximity'])
ocean_dummy
```

Out[24]:

	<1H OCEAN	INLAND	ISLAND	NEAR BAY	NEAR OCEAN
0	0	0	0	1	0
1	0	0	0	1	0
2	0	0	0	1	0
3	0	0	0	1	0
4	0	0	0	1	0
...	...	...	...	...	...
20635	0	1	0	0	0
20636	0	1	0	0	0
20637	0	1	0	0	0
20638	0	1	0	0	0
20639	0	1	0	0	0

20640 rows × 5 columns

In [25]:
```
# merge data by rows
house_1=pd.concat([house,ocean_dummy], axis=1)
```

In [26]:
```
house_1.head()
```

Out[26]:

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	households	median_in
0	-122.23	37.88	41	880	129.0	322	126	8
1	-122.22	37.86	21	7099	1106.0	2401	1138	8
2	-122.24	37.85	52	1467	190.0	496	177	7
3	-122.25	37.85	52	1274	235.0	558	219	5
4	-122.25	37.85	52	1627	280.0	565	259	3

In [30]:
```
# remove ocean_proximity
house_1.drop('ocean_proximity', axis=1, inplace=True)
```

In [31]:
```
house_1.head()
```

Out[31]:

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	households	median_in
0	-122.23	37.88	41	880	129.0	322	126	8
1	-122.22	37.86	21	7099	1106.0	2401	1138	8
2	-122.24	37.85	52	1467	190.0	496	177	7
3	-122.25	37.85	52	1274	235.0	558	219	5
4	-122.25	37.85	52	1627	280.0	565	259	3

In [32]:
```
# split data into training and test data

from sklearn.model_selection import train_test_split
```

In [ ]:
```
# X = list of independent variables in the form of a df
# y= dependent vatiable in the form of a series
```

In [33]:
```
# from house_1 remove median_house_value

X=house_1.drop('median_house_value', axis=1)
type(X)
```

Out[33]:
```
pandas.core.frame.DataFrame
```

In [34]:
```
y=house_1['median_house_value']
y[:5]
```

Out[34]:
```
0    452600
1    358500
2    352100
3    341300
4    342200
Name: median_house_value, dtype: int64
```

In [35]:
```
type(y)
```

Out[35]:
```
pandas.core.series.Series
```

In [36]:
```
# training dataset to fit the model function
# train size=0.8, test size=0.2
Xtrain,Xtest,ytrain,ytest=train_test_split(X,y,test_size=0.2,random_state=100)
```

In [37]:
```
Xtrain.shape
```

Out[37]:
```
(16512, 13)
```

In [39]:
```
Xtest.shape
```

Out[39]:
```
(4128, 13)
```

In [40]:
```
ytrain.shape
```

Out[40]:
```
(16512,)
```

In [41]:
```
#standardization of data

from sklearn.preprocessing import StandardScaler
```

In [42]:
```
sc=StandardScaler()
```

In [43]:
```
Xtrain=sc.fit_transform(Xtrain)
```

In [45]:
```
# check standardize

Xtrain.mean(axis=0)
```

Out[45]:
```
array([-8.29708825e-16,  3.25014563e-15,  6.23962553e-17,  2.28069071e-17,
        9.63914564e-17, -7.91786963e-17, -4.28167407e-17, -1.76592160e-16,
        1.04997836e-16, -3.35648821e-17, -2.58191401e-18,  1.03276560e-17,
        2.60342996e-17])
```

In [46]:
```
Xtrain.std(axis=0)
```

Out[46]:
```
array([1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.])
```

In [47]:
```
# transform test data
Xtest=sc.transform(Xtest)
```

In [48]:
```
#perform linear regression on training data

from sklearn import linear_model
```

In [49]:
```
# create an instance of LinearRegression()

lin_model=linear_model.LinearRegression(fit_intercept=True, n_jobs=1)
```

In [50]:
```
lin_model
```

Out[50]:
```
LinearRegression(n_jobs=1)
```

In [51]:
```
# we will fit the training data on the model

lin_model.fit(Xtrain,ytrain)
```

Out[51]:
```
LinearRegression(n_jobs=1)
```

In [52]:
```
# now model has been trained on training data

# for getting the values of coefficient and intercept

lin_model.intercept_
```

Out[52]:
```
207141.48977201237
```

In [53]:
```
lin_model.coef_
```

Out[53]:
```
array([-5.33389237e+04, -5.40436854e+04,  1.31483794e+04, -1.01060310e+04,
        3.06962652e+04, -4.29737826e+04,  2.69125325e+04,  7.31409260e+04,
        1.45635633e+17,  1.36310780e+17,  4.56610491e+15,  9.28062684e+16,
        9.93231093e+16])
```

In [54]:
```
#predict output for the dataset using the fitted model
#fitted_model_name.predict(test data)

ypred=lin_model.predict(Xtest)
ypred
```

Out[54]:
```
array([222557.48977201, 157837.48977201, 182829.48977201, ...,
       308813.48977201, 106621.48977201, 173133.48977201])
```

In [55]:
```
# find root mean square error

from sklearn.metrics import mean_squared_error
```

In [60]:
```
# mean_squared_error(actual, test)

mse=mean_squared_error(ytest,ypred)
```

In [61]:
```
import math
```

In [63]:
```
rmse=math.sqrt(mse)
rmse
```

Out[63]:
```
67150.72410002595
```

In [64]:
```
# to check rsq on the test data

lin_model.score(X=Xtest, y=ytest)
```

Out[64]:
```
0.6653385090022187
```

In [65]:
```
# extract just median_income
# [[]] - for dataframe

X=house_1[['median_income']]
y=house_1['median_house_value']
```

In [66]:
```
X.head()
```

Out[66]:

	median_income
0	8.3252
1	8.3014
2	7.2574
3	5.6431
4	3.8462

In [67]:
```
# train size=0.8, test size=0.2
Xtrain,Xtest,ytrain,ytest=train_test_split(X,y,test_size=0.2,random_state=100)
```

In [68]:
```
Xtrain.columns
```

Out[68]:
```
Index(['median_income'], dtype='object')
```

In [69]:
```
Xtrain=sc.fit_transform(Xtrain)
```

In [70]:
```
#use trained dataset to fit the data
Xtest=sc.transform(Xtest)
```

In [71]:
```
ln1=linear_model.LinearRegression(n_jobs=1)
```

In [72]:
```
ln1
```

Out[72]:
```
LinearRegression(n_jobs=1)
```

In [74]:
```
ln1.fit(Xtrain,ytrain)
```

Out[74]:
```
LinearRegression(n_jobs=1)
```

In [75]:
```
# intercept and coefficient

ln1.intercept_
```

Out[75]:
```
207155.73843265505
```

In [76]:
```
ln1.coef_
```

Out[76]:
```
array([78867.25810699])
```

In [78]:
```
#use fit model to predict

ypred=ln1.predict(Xtest)
ypred
```

Out[78]:
```
array([200340.08428824,  98240.5532477 , 247053.23916854, ...,
       186901.99647577, 117998.53384326, 219037.81971296])
```

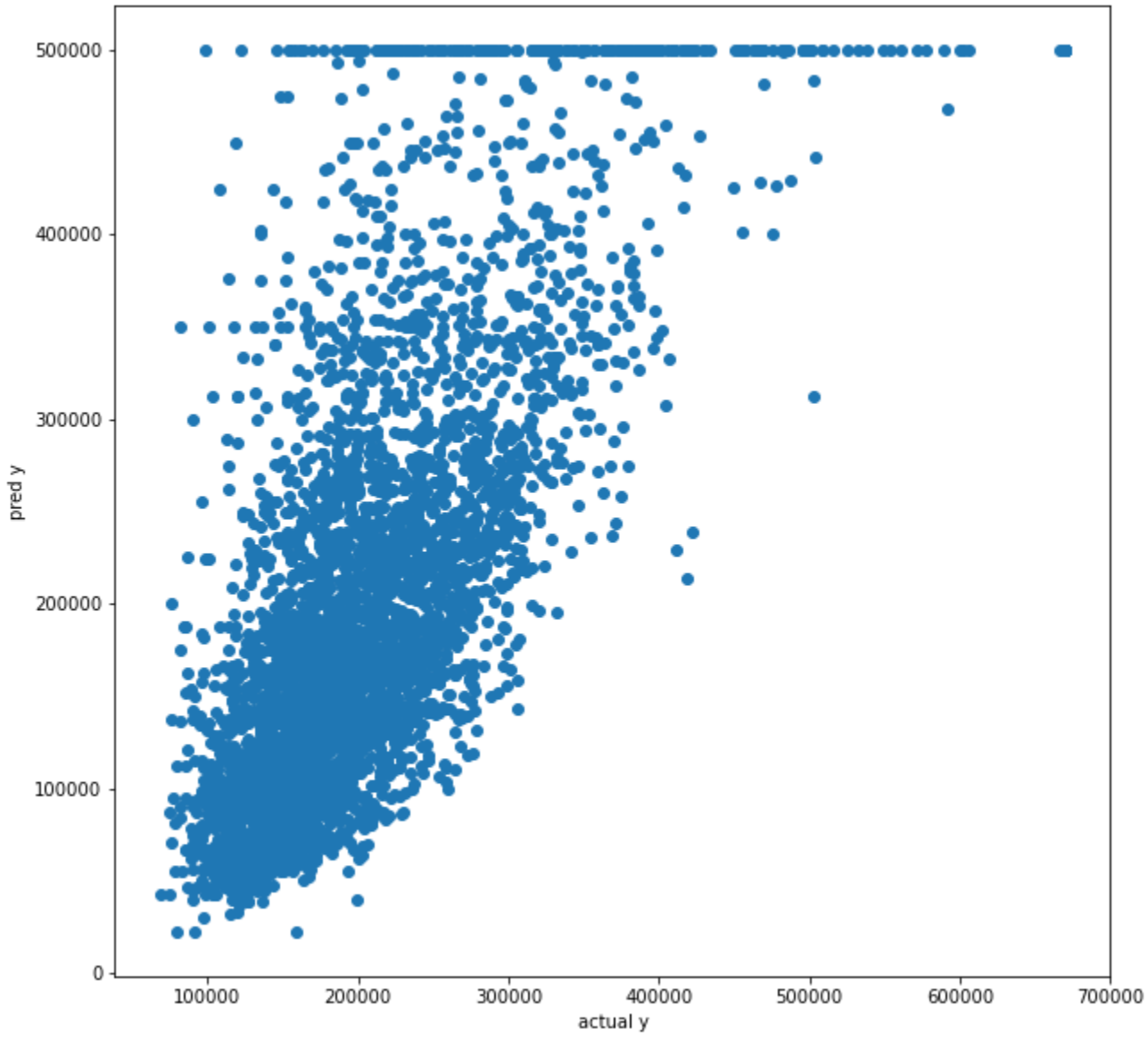
In [79]:
```
# calculate rsq
ln1.score(X=Xtest,y=ytest)
```

Out[79]:
```
0.49258838196670596
```

In [82]:
```
# plot pred vs actual for test
plt.figure(figsize=(10,10))

plt.scatter(ypred,ytest)
plt.xlabel('actual y')
plt.ylabel('pred y')
```

Out[82]:
```
Text(0, 0.5, 'pred y')
```



In [83]:
```
ypred1=ln1.predict(Xtrain)
ypred1
```

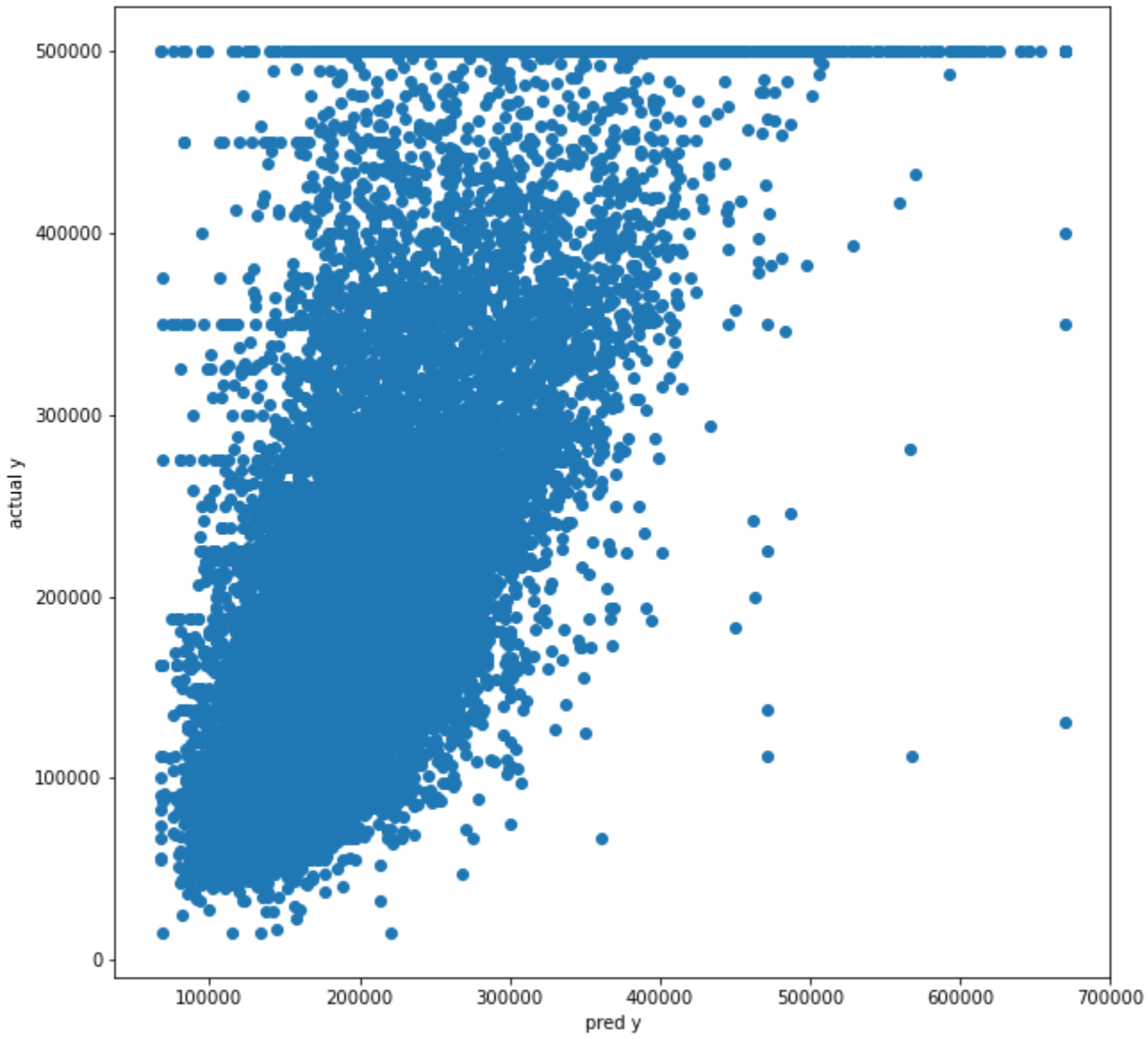
Out[83]:
```
array([187442.51362169, 180361.73901011, 185658.80704015, ...,
       280910.40162428, 145377.80619633, 238671.06558254])
```

In [89]:
```
# plot pred vs actual for train data

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

plt.scatter(ypred1,ytrain)
plt.xlabel('pred y')
plt.ylabel('actual y')
```

Out[89]:
```
Text(0, 0.5, 'actual y')
```



In [ ]:
```

```