In [1]:

```
# House Price Prediction
# using Linear Regression Suprevised Machine Learning Algorithm
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

sns.set_style("whitegrid")
plt.style.use("fivethirtyeight")
```

In [2]:

```
# Check out the Data
USAhousing = pd.read_csv('USA_Housing.csv')
USAhousing.head()
```

Out[2]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Addr
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Ferry 674\nLaurabury, 37(
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Vi Suite 079\nL Kathleen, C
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Elizal Stravenue\nDanielto WI 064
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPC 44
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nF AE 09

In [3]:

```
USAhousing.info()
```

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

In [4]:

```
USAhousing.describe()
```

Out[4]:

	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 [5]:

```
USAhousing.columns
```

Out[5]:

```
Index(['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of Room
s',
       'Avg. Area Number of Bedrooms', 'Area Population', 'Price', 'Addres
s'],
      dtype='object')
```

In [6]:

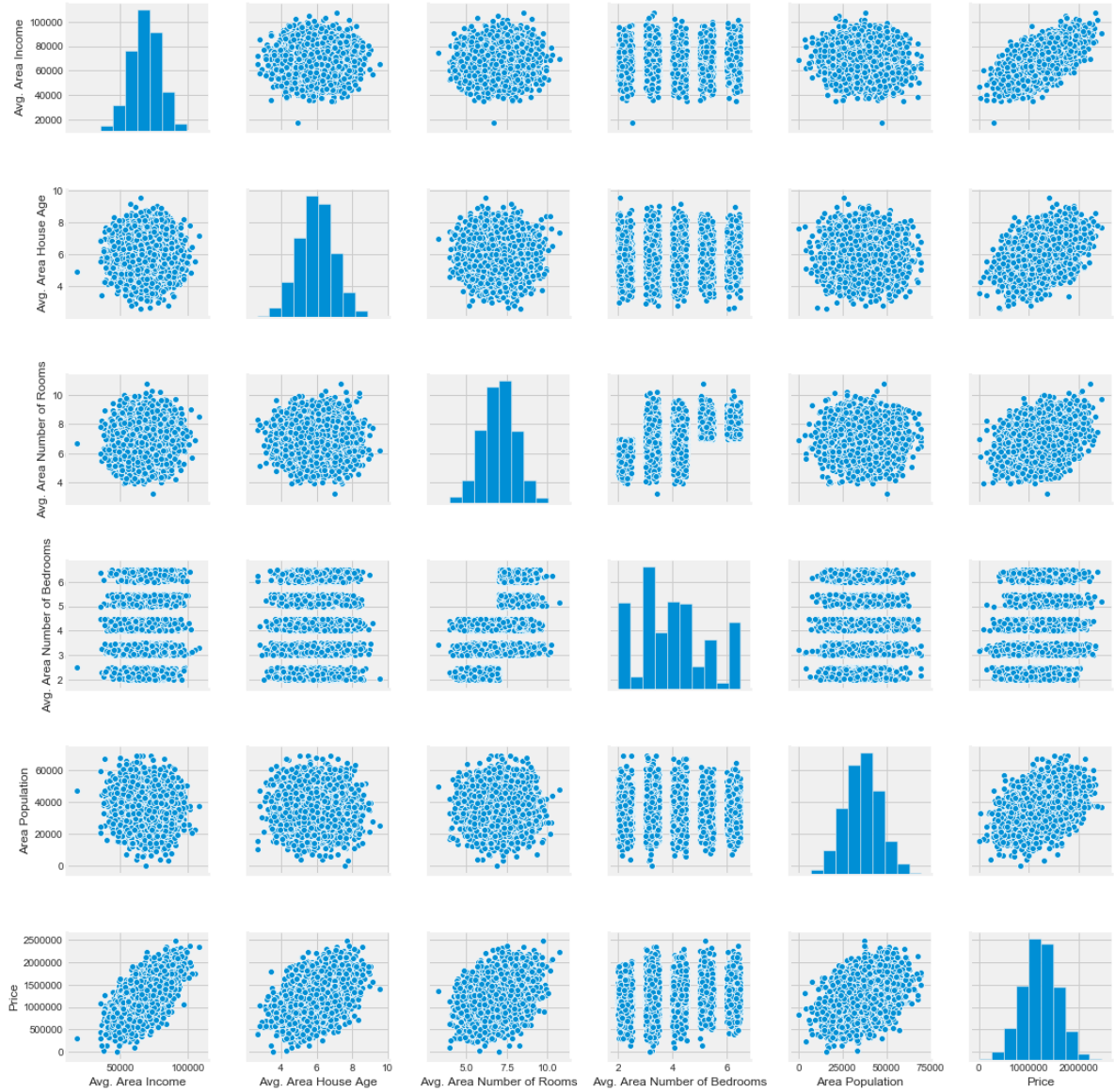
```
# Exploratory Data Analysis (EDA)
```

In [7]:

```
sns.pairplot(USAhousing)
```

Out[7]:

```
<seaborn.axisgrid.PairGrid at 0x14562b39248>
```

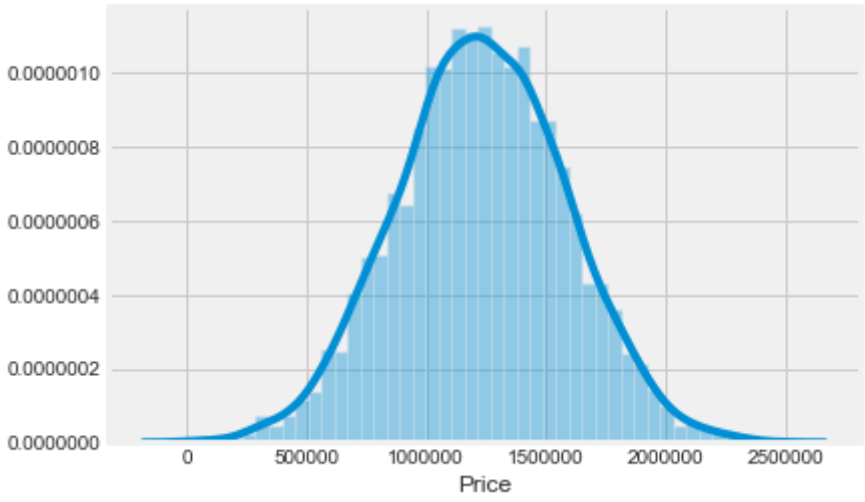


In [8]:

```
sns.distplot(USAhousing['Price'])
```

Out[8]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x14563c85f48>
```

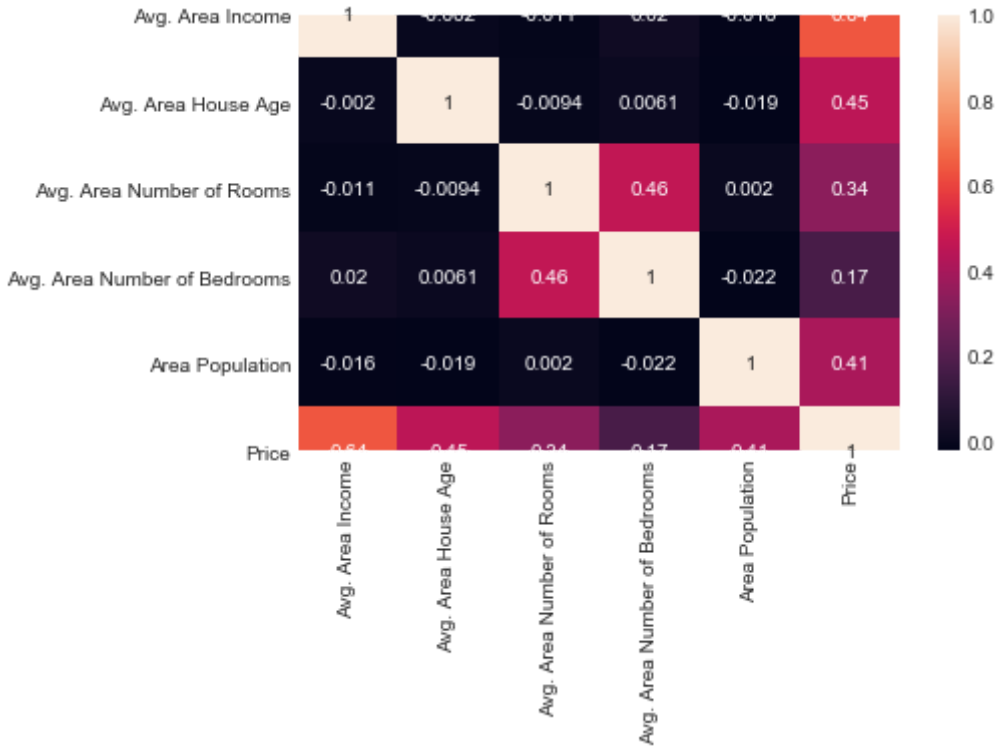


In [9]:

```
sns.heatmap(USAhousing.corr(), annot=True)
```

Out[9]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x14564459848>
```



In [10]:

```
# Training a Linear Regression Model
```

In [11]:

```
# X and y arrays
X = USAhousing[['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of Rooms',
                'Avg. Area Number of Bedrooms', 'Area Population']]
y = USAhousing['Price']
```

In [12]:

```
# Train Test Split
```

In [13]:

```
from sklearn.model_selection import train_test_split
```

In [14]:

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=42)
```

In [15]:

```
from sklearn import metrics
from sklearn.model_selection import cross_val_score

def cross_val(model):
    pred = cross_val_score(model, X, y, cv=10)
    return pred.mean()

def print_evaluate(true, predicted):
    mae = metrics.mean_absolute_error(true, predicted)
    mse = metrics.mean_squared_error(true, predicted)
    rmse = np.sqrt(metrics.mean_squared_error(true, predicted))
    r2_square = metrics.r2_score(true, predicted)
    print('Mean Aabsolute Error:', mae)
    print('Mean Squared Error:', mse)
    print('Root Mean Squared Error:', rmse)
    print('R2 Square', r2_square)

def evaluate(true, predicted):
    mae = metrics.mean_absolute_error(true, predicted)
    mse = metrics.mean_squared_error(true, predicted)
    rmse = np.sqrt(metrics.mean_squared_error(true, predicted))
    r2_square = metrics.r2_score(true, predicted)
    return mae, mse, rmse, r2_square
```

In [16]:

```
# Preparing Data For Linear Regression
```

In [17]:

```
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import Pipeline

pipeline = Pipeline([
    ('std_scalar', StandardScaler())
])

X_train = pipeline.fit_transform(X_train)
X_test = pipeline.transform(X_test)
```

In [18]:

```
# Linear Regression
from sklearn.linear_model import LinearRegression

lin_reg = LinearRegression(normalize=True)
lin_reg.fit(X_train,y_train)
```

Out[18]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=Tru
e)
```

In [19]:

```
# Model Evaluation
```

In [20]:

```
# print the intercept
print(lin_reg.intercept_)
```

```
1228219.1492415662
```

In [21]:

```
coeff_df = pd.DataFrame(lin_reg.coef_, X.columns, columns=['Coefficient'])
coeff_df
```

Out[21]:

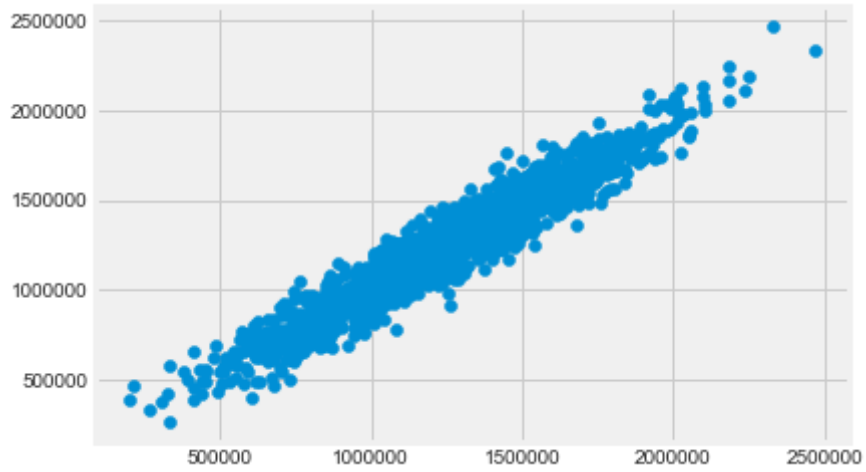
	Coefficient
Avg. Area Income	232679.724643
Avg. Area House Age	163841.046593
Avg. Area Number of Rooms	121110.555478
Avg. Area Number of Bedrooms	2892.815119
Area Population	151252.342377

In [22]:

```
# Predictions from our Model
pred = lin_reg.predict(X_test)
plt.scatter(y_test, pred)
```

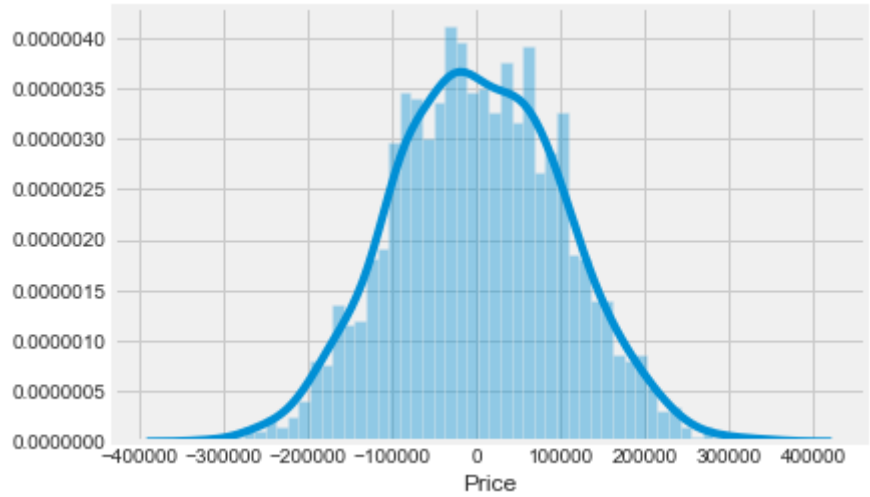
Out[22]:

```
<matplotlib.collections.PathCollection at 0x14565f33188>
```



In [23]:

```
# Residual Histogram
sns.distplot((y_test - pred), bins=50);
```



In [24]:

```
# Regression Evaluation Metrics
test_pred = lin_reg.predict(X_test)
train_pred = lin_reg.predict(X_train)

print('Test set evaluation:\n_____________________________________')
print_evaluate(y_test, test_pred)
print('====================================')
print('Train set evaluation:\n_____________________________________')
print_evaluate(y_train, train_pred)
```

```
Test set evaluation:

_____________________________________
Mean Aabsolute Error: 81135.56609336878
Mean Squared Error: 10068422551.40088
Root Mean Squared Error: 100341.52954485436
R2 Square 0.9146818498754016
====================================
Train set evaluation:

_____________________________________
Mean Aabsolute Error: 81480.4997317489
Mean Squared Error: 10287043161.197224
Root Mean Squared Error: 101425.06180031257
R2 Square 0.9192986579075526
```

In [25]:

```
results_df = pd.DataFrame(data=[["Linear Regression", *evaluate(y_test, test_pred) , cross_
                          columns=['Model', 'MAE', 'MSE', 'RMSE', 'R2 Square', "Cross Valid
results_df
```

Out[25]:

	Model	MAE	MSE	RMSE	R2 Square	Cross Validation
0	Linear Regression	81135.566093	1.006842e+10	100341.529545	0.914682	0.917379

In [ ]: