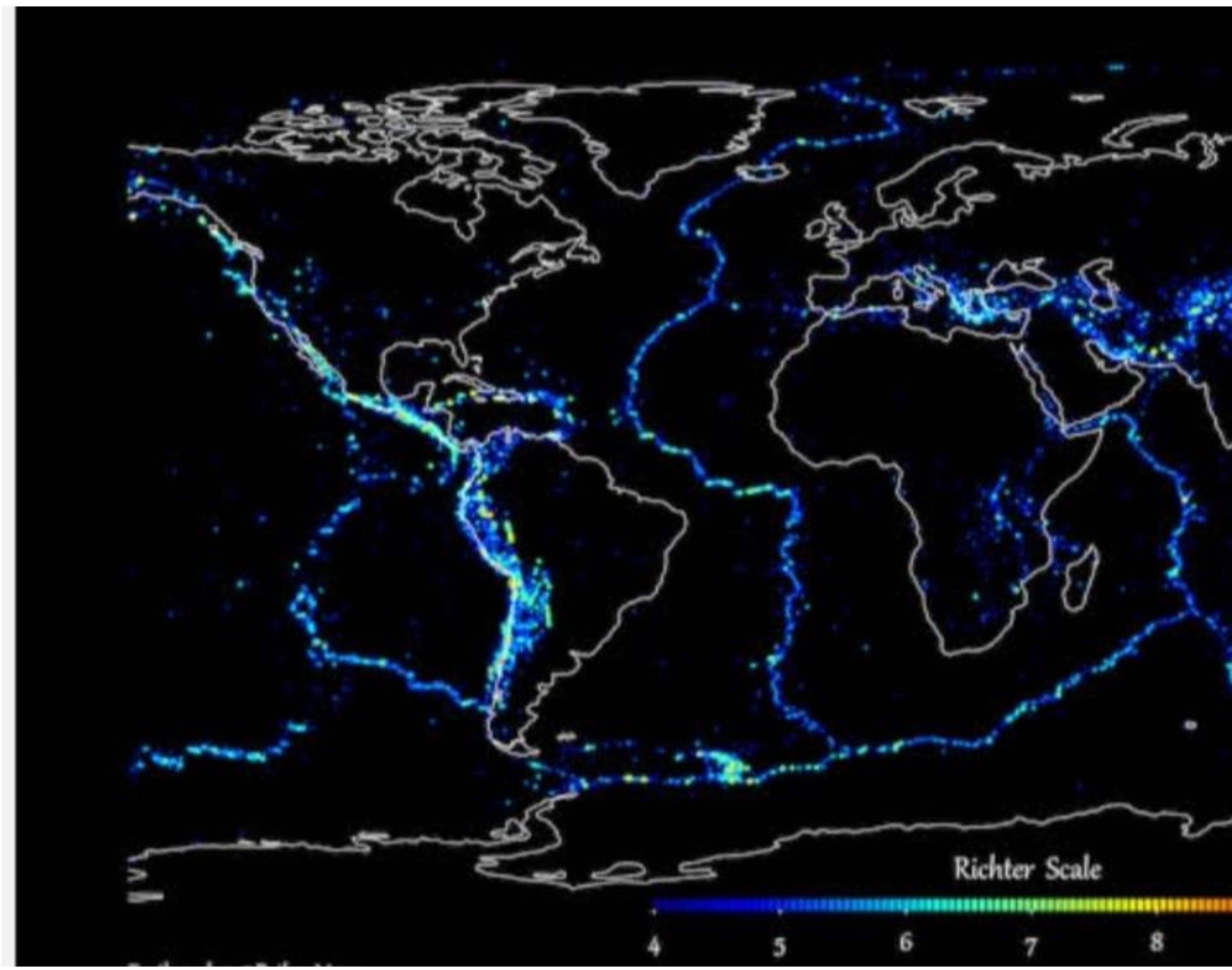
PREPROCESSING OF DATASET IN PREDICTION OF EARTHQUAKE USING PYTHON:



```python
import numpy as np
import pandas as pd
import requests
from sklearn import preprocessing
import matplotlib.pyplot as plt
import seaborn as sns
from pandas.plotting import scatter_matrix
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing MinMaxScaler
import time

from google.colab import drive
drive.mount('/content/drive')
df = pd.read_csv("/content/drive/MyDrive/Colab Notebooks/earthquake_prediction/earthquake1.csv")
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 24007 entries, 0 to 24006
```

Data columns (total 17 columns):

#	Column	Non-Null Count		Dtype
---	------	--------------		-----
0	id	24007	non-null	float64
1	date	24007	non-null	object
2	time	24007	non-null	object
3	lat	24007	non-null	float64
4	long	24007	non-null	float64
5	country	24007	non-null	object
6	city	11754	non-null	object
7	area	12977	non-null	object
8	direction	10062	non-null	object
9	dist	10062	non-null	float64
10	depth	24007	non-null	float64
11	xm	24007	non-null	float64
12	md	24007	non-null	float64
13	richter	24007	non-null	float64
14	mw	5003	non-null	float64
15	ms	24007	non-null	float64
16	mb	24007	non-null	float64

```
dtypes: float64(11), object(6)
memory usage: 3.1+ MB
```

```
df.describe()
```

```
df.describe()
```

OUTPUT:

	Id	lat	long	dist	depth	xm	md	richter	mw	ms	mb
Count	2.400700e+04	24007.000000	24007.000000	10062.000000	24007.000000	24007.000000	24007.000000	24007.000000	5003.000000	24007.000000	24007.000000
Mean	1.991982e+13	37.929474	30.773229	3.175015	18.491773	4.056038	1.912346	2.196826	4.478973	0.677677	1.690561
std	2.060396e+11	2.205605	6.584596	4.715461	23.218553	0.574085	2.059780	2.081417	1.048085	1.675708	2.146108
min	1.910000e+13	29.740000	18.340000	0.100000	0.000000	3.500000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	1.980000e+13	36.190000	26.195000	1.400000	5.000000	3.600000	0.000000	0.000000	4.100000	0.000000	0.000000
50%	2.000000e+13	38.200000	28.350000	2.300000	10.000000	3.900000	0.000000	3.500000	4.700000	0.000000	0.000000
75%	2.010000e+13	39.360000	33.855000	3.600000	22.400000	4.400000	3.800000	4.000000	5.000000	0.000000	4.100000

max	2.020000e+13	46.350000	48.000000	95.400000	225.000000	7.900000	7.400000	7.200000	7.700000	7.900000	7.100000

```
df.shape
output:

(24007, 17)
df.head()
```

`OUTPUT:`

	id	date	time	lat	long	country	city	area	direction	dist	depth	xm	md	richter	mw	ms	mb
0	2.000000e+13	2003.05.20	12:17:44 AM	39.04	40.38	turkey	bingol	baliklicay	west	0.1	10.0	4.1	4.1	0.0	NaN	0.0	0.0
1	2.010000e+13	2007.08.01	12:03:08 AM	40.79	30.09	turkey	kocaeli	bayraktar_izmit	west	0.1	5.2	4.0	3.8	4.0	NaN	0.0	0.0
2	1.980000e+13	1978.05.07	12:41:37 AM	38.58	27.61	turkey	manisa	hamzabeyli	south_west	0.1	0.0	3.7	0.0	0.0	NaN	0.0	3.7
3	2.000000e+13	1997.03.22	12:31:45	39.47	36.44	turkey	sivas	kahvepinar_sarkisla	south_west	0.1	10.0	3.5	3.5	0.0	NaN	0.0	0.0

			AM														
4	2.000000e+13	2000.04.02	12:57:38 AM	40.80	30.24	turkey	sakarya	meseli_serdivan	south_west	0.1	7.0	4.3	4.3	0.0	NaN	0.0	0.0

```
df.columns
```

OUTPUT:

```
Index(['id', 'date', 'time', 'lat', 'long', 'country', 'city', 'area',
       'direction', 'dist', 'depth', 'xm', 'md', 'richter', 'mw', 'ms', 'mb'],
      dtype='object')
```

Data Preprocessing:

```
df = df.drop('id',axis=1)

import datetime
import time

timestamp = []
for d, t in zip(df['date'], df['time']):
  ts = datetime.datetime.strptime(d+' '+t, '%Y.%m.%d %I:%M:%S %p')
  timestamp.append(time.mktime(ts.timetuple()))
timeStamp = pd.Series(timestamp)
df['Timestamp'] = timeStamp.values
final_data = df.drop(['date', 'time'], axis=1)
final_data = final_data[final_data.Timestamp != 'ValueError']
df = final_data
df.head()
```

OUTPUT:

lat	long		country	city	area	direction	dist	depth	xm
0	39.04	40.38	turkey	bingol	baliklicay	west	0.1	10.0	4.
1	40.79	30.09	turkey	kocaeli	bayraktar_izmit	west	0.1	5.2	4.
2	38.58	27.61	turkey	manisa	hamzabeyli	south_west	0.1	0.0	3.
3	39.47	36.44	turkey	sivas	kahvepinar_sarkisla	south_west	0.1	10.0	3.
4	40.80	30.24	turkey	sakarya	meseli_serdivan	south_west	0.1	7.0	4.

df.dtype:

```
lat            float64
long           float64
country         object
city            object
area            object
direction       object
dist           float64
depth          float64
xm             float64
md             float64
richter        float64
mw             float64
ms             float64
mb             float64
Timestamp      float64
dtype: object
```

```
# Data Encoding
label_encoder = preprocessing.LabelEncoder()
for col in df.columns:
    if df[col].dtype == 'object':
      label_encoder.fit(df[col])
      df[col] = label_encoder.transform(df[col])
df.dtypes
```

OUTPUT:

```
lat            float64
```

lat	long	country	city	area	direction	dist	depth	xm

```
long          float64
country         int64
city            int64
area            int64
direction       int64
dist          float64
depth         float64
xm            float64
md            float64
richter       float64
mw            float64
ms            float64
mb            float64
Timestamp     float64
```

```
dtype: object
df.isnull().sum()
```

OUTPUT:

```
lat               0
long              0
country           0
city              0
area              0
direction         0
dist          13945
depth             0
xm                0
md                0
richter           0
mw            19004
ms                0
mb                0
Timestamp         0
dtype: int64
```

```
# Imputing Missing Values with Mean
si=SimpleImputer(missing_values = np.nan, strategy="mean")
si.fit(df[["dist","mw"]])
df[["dist","mw"]] = si.transform(df[["dist","mw"]])
df.isnull().sum()
```

```
lat          0
long         0
country      0
city         0
```

lat	long	country	city	area	direction	dist	depth	xm

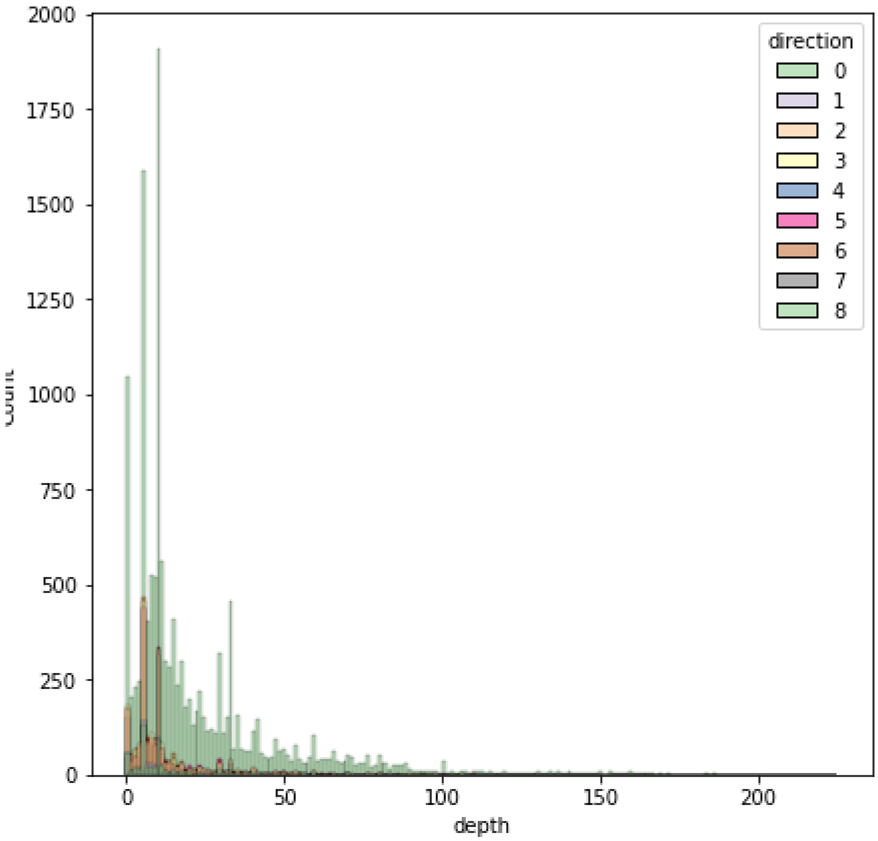
```
area          0
direction     0
dist          0
depth         0
xm            0
md            0
richter       0
mw            0
ms            0
mb            0
Timestamp     0
dtype: int64
```

Data Visualization

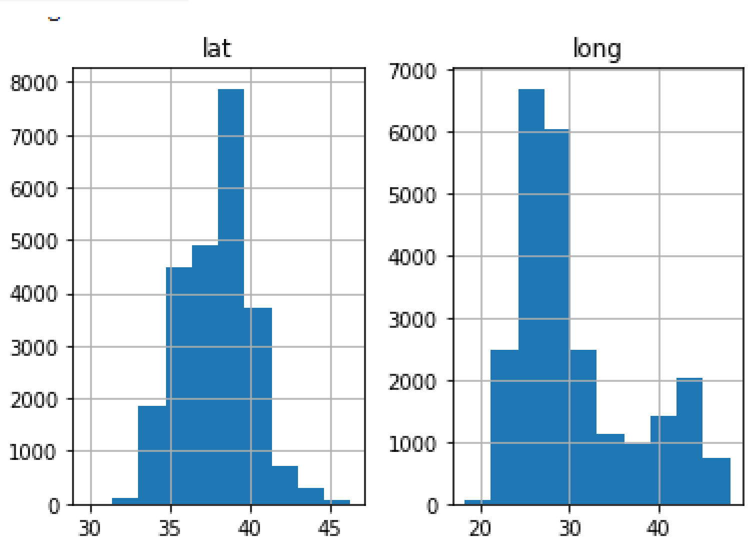
```
import plotly.express as px
px.scatter(df, x='richter',y='xm', color="direction")
```

```
plt.figure(figsize=(7,7))
sns.histplot(data=df, x='depth', hue='direction',palette = 
'Accent')
plt.show()
```

lat	long	country	city	area	direction	dist	depth	xm



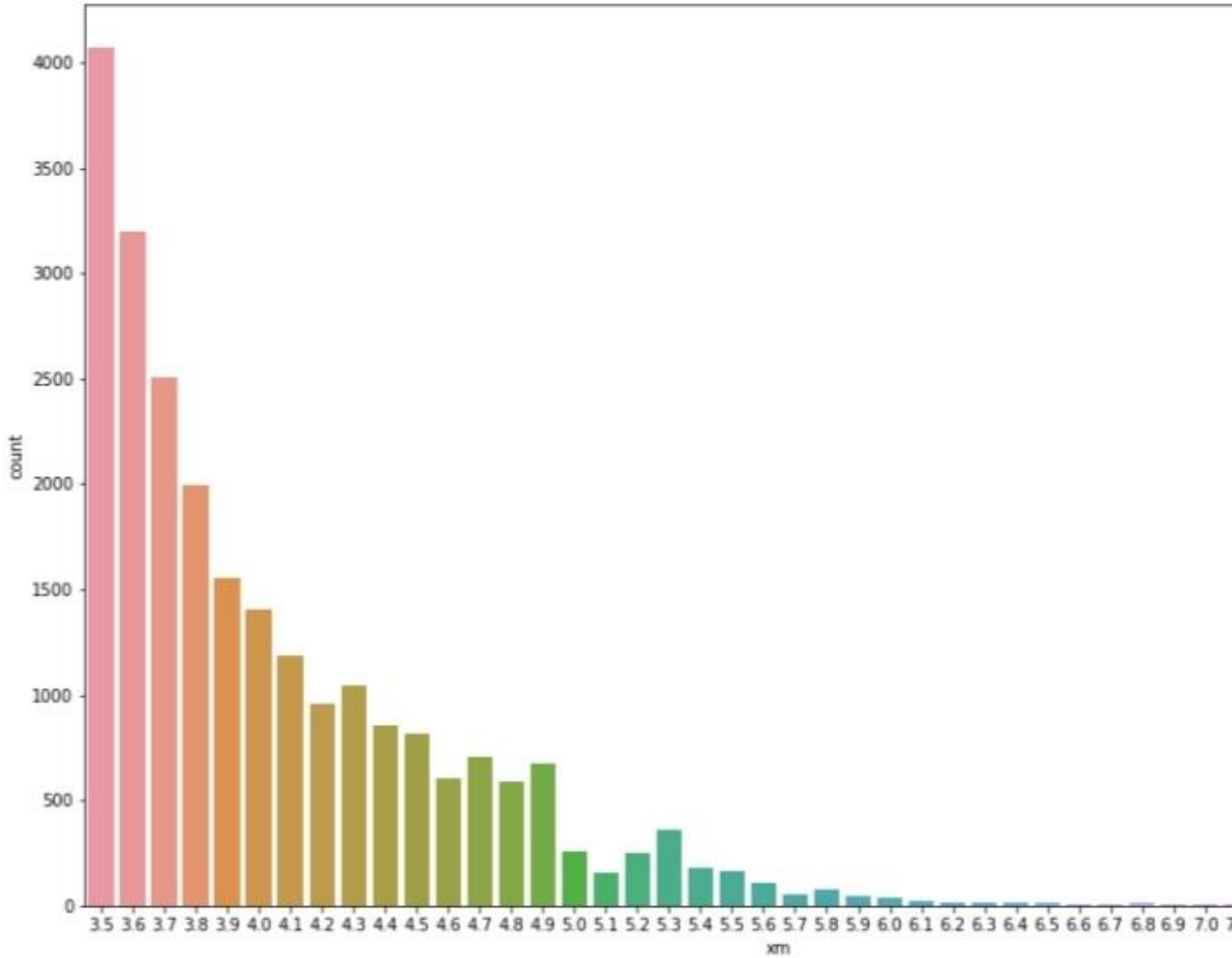

```
plt.figure(figsize=(7,7))
df[['lat','long']].hist()
plt.show()
```



lat long country city area direction dist depth xm

```
plt.figure(figsize=(15,10))
sns.countplot(df.xm)
```

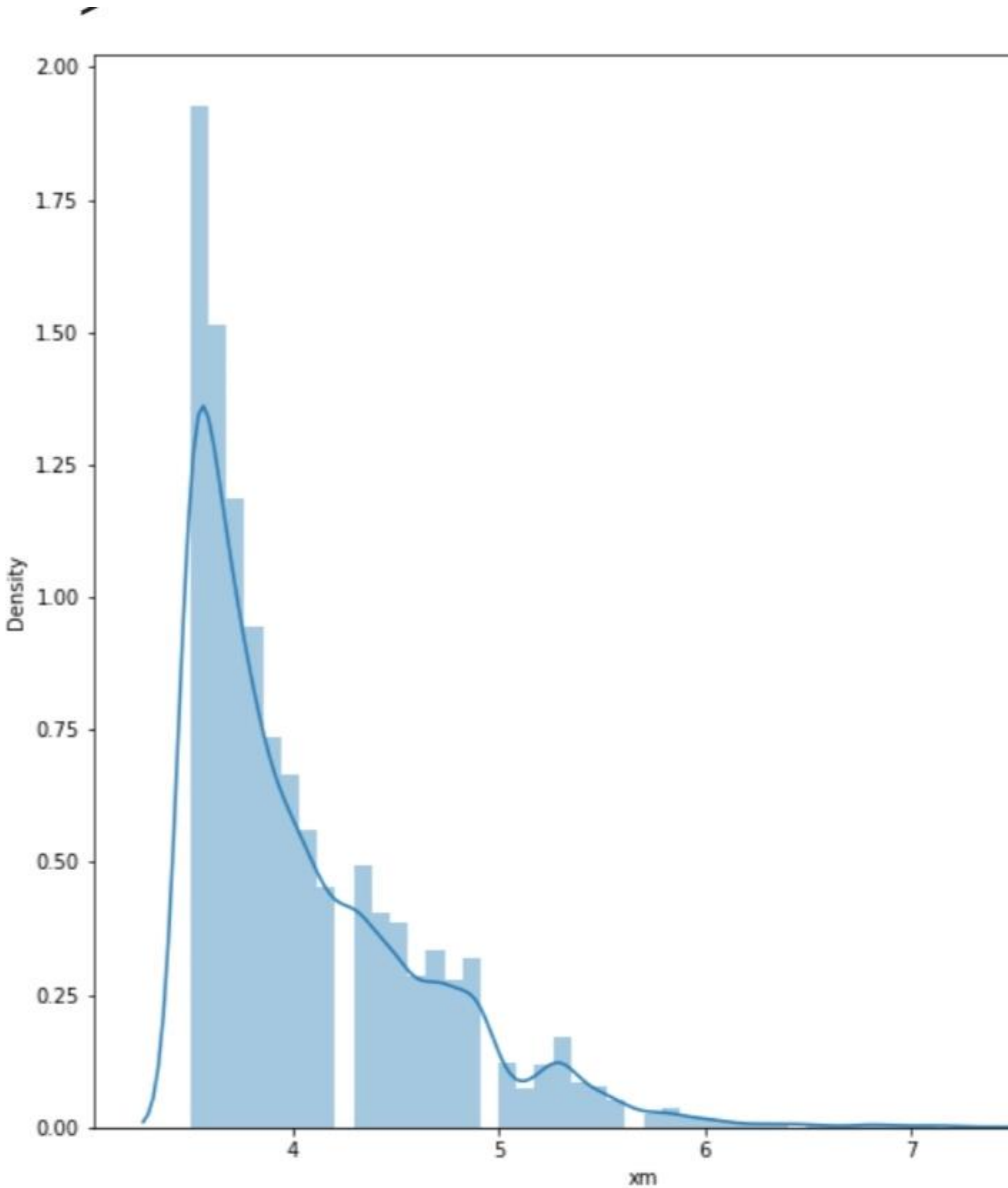
```
output:
<matplotlib.axes._subplots.AxesSubplot at 0x7f3d2346d400>
```




```
plt.figure(figsize=(10,10))
sns.distplot(df.xm)
```

OUTPUT:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f3d242a4d00>
```

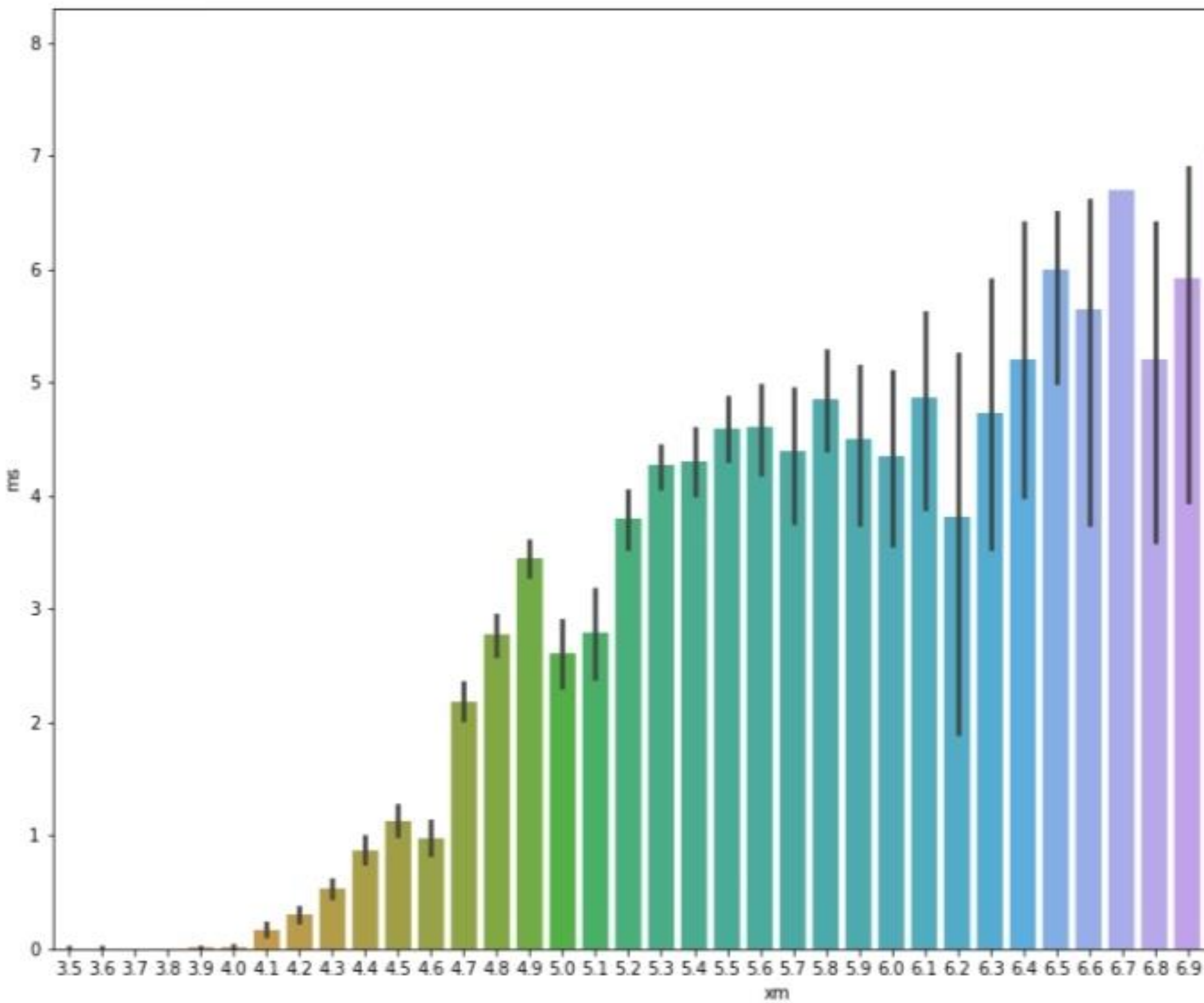


2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Density
4
5
6
7
xm

```
plt.figure(figsize=(15,10))
sns.barplot(x=df['xm'], y=df['ms'])
plt.xlabel('xm')
plt.ylabel('ms')
```

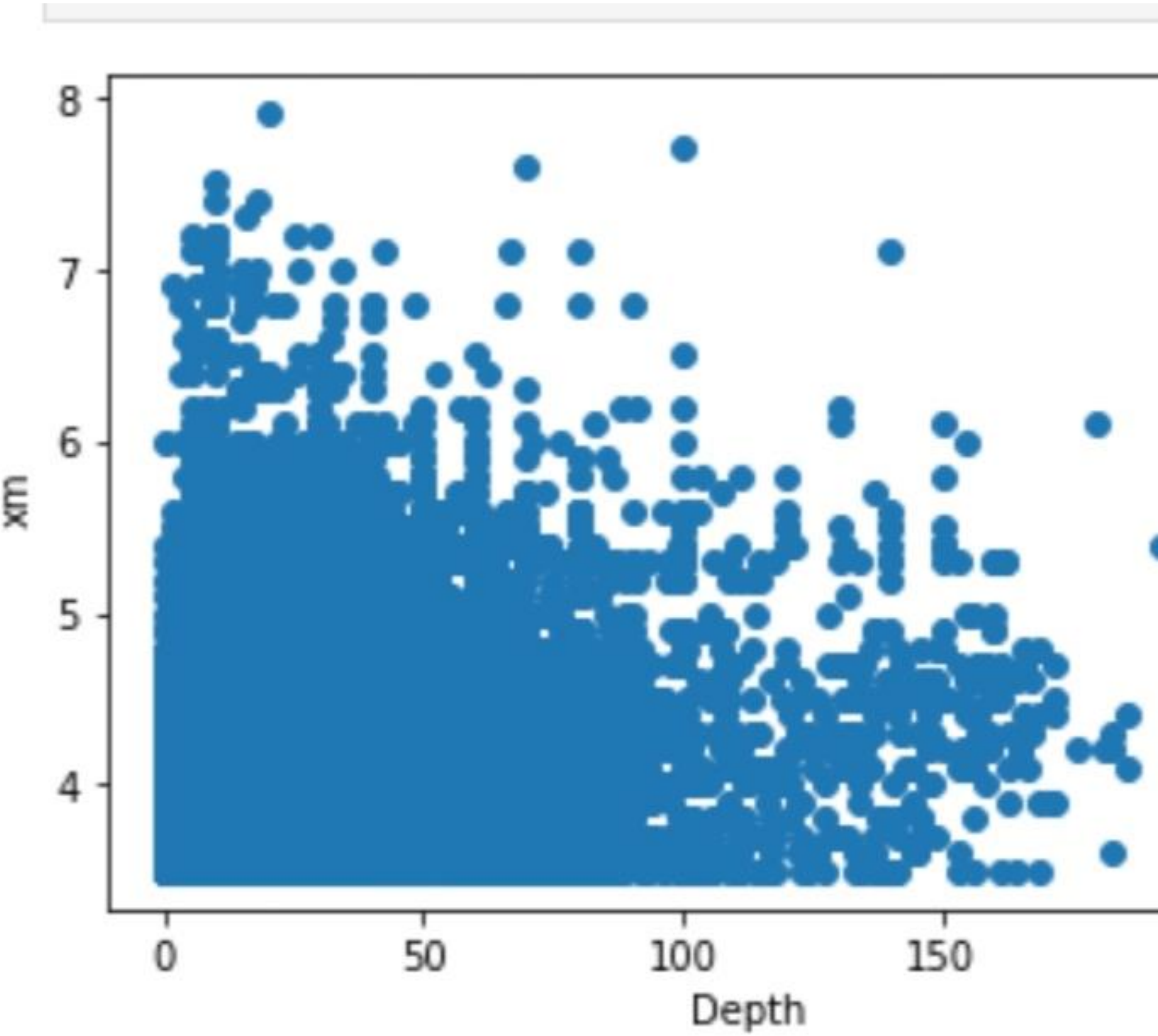
OUTPUT:

Text(0, 0.5, 'ms')

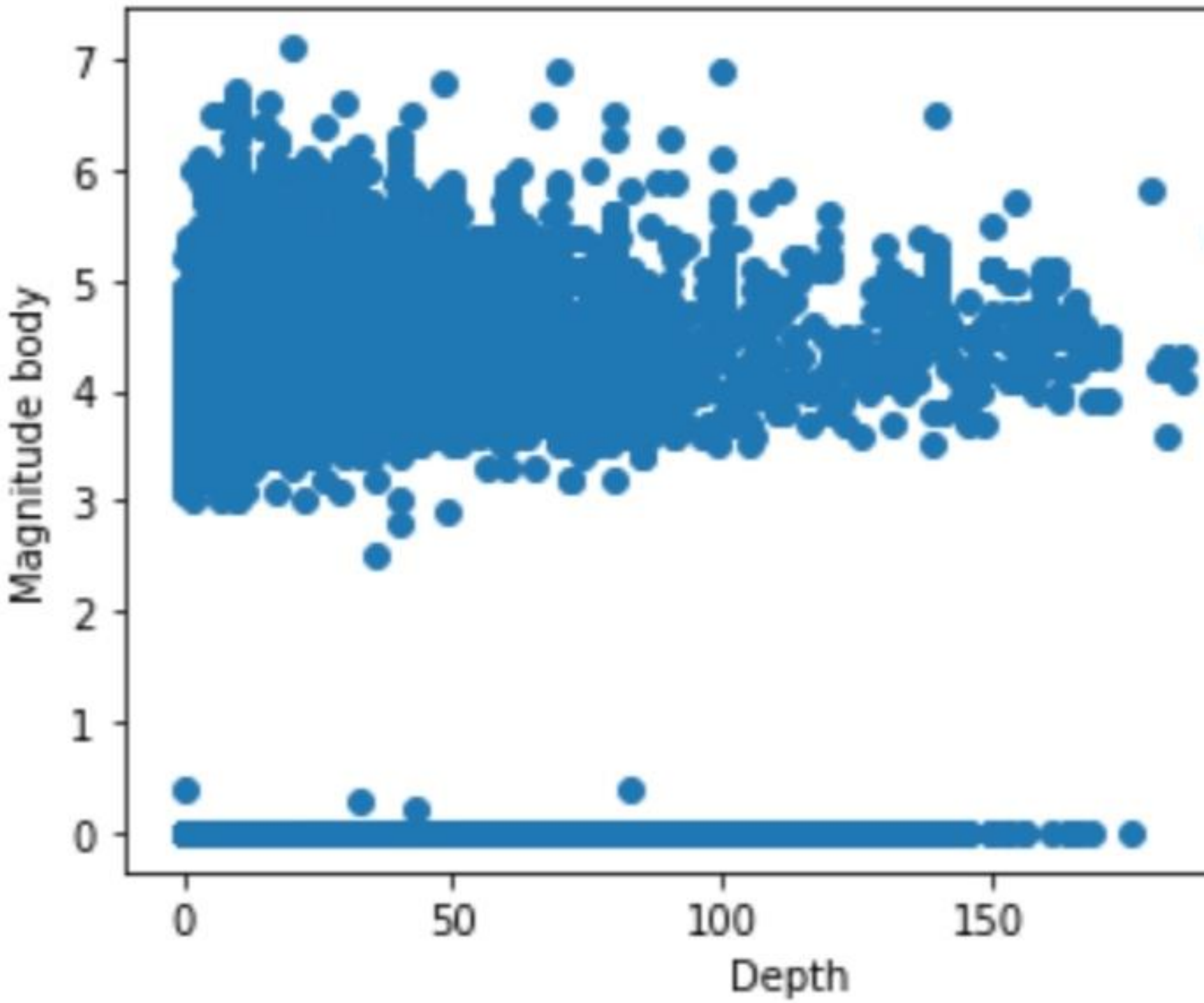



```
plt.scatter(df.depth, df.xm)
plt.xlabel("Depth")
plt.ylabel("xm")
```

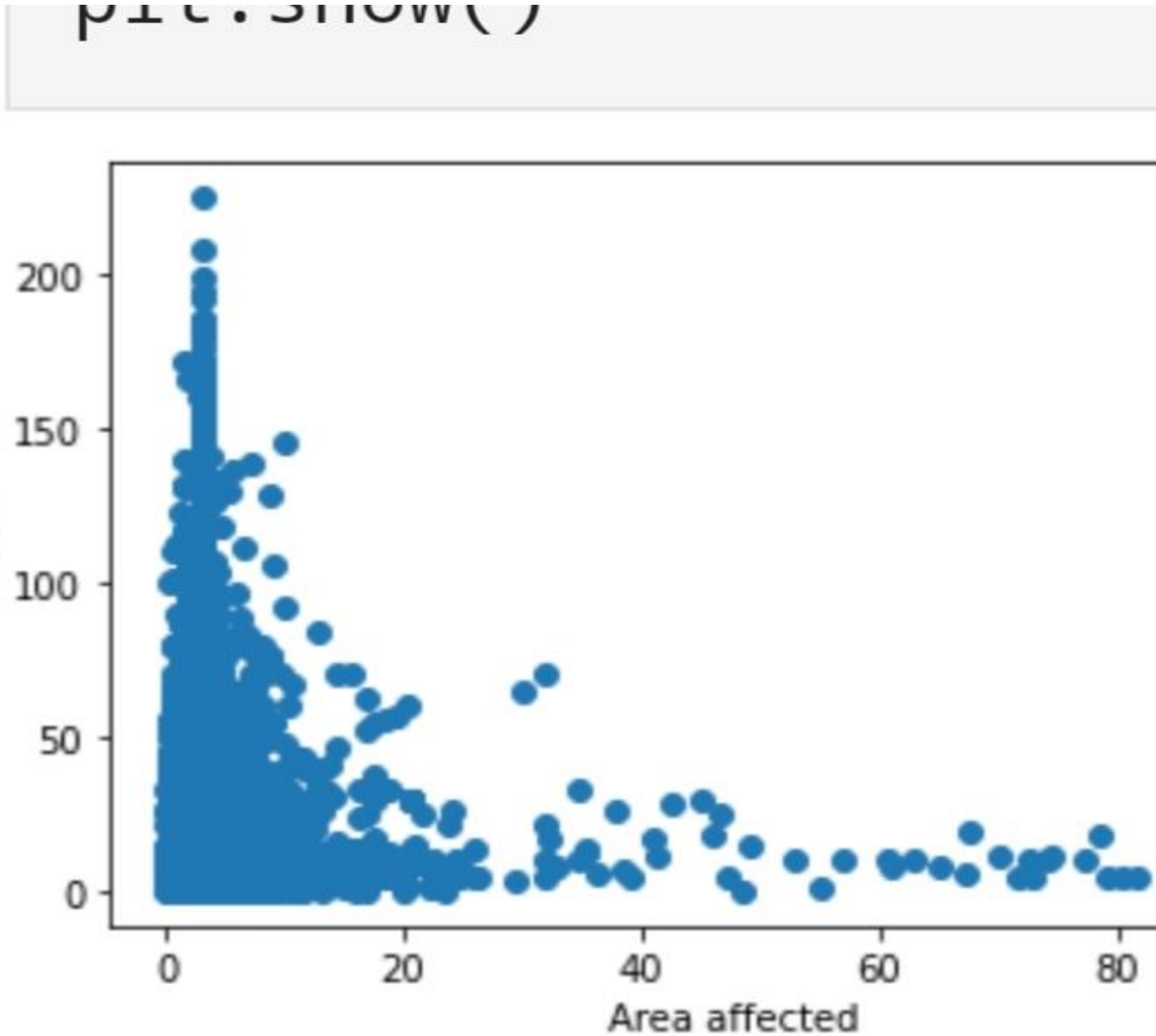
```
plt.show()
```



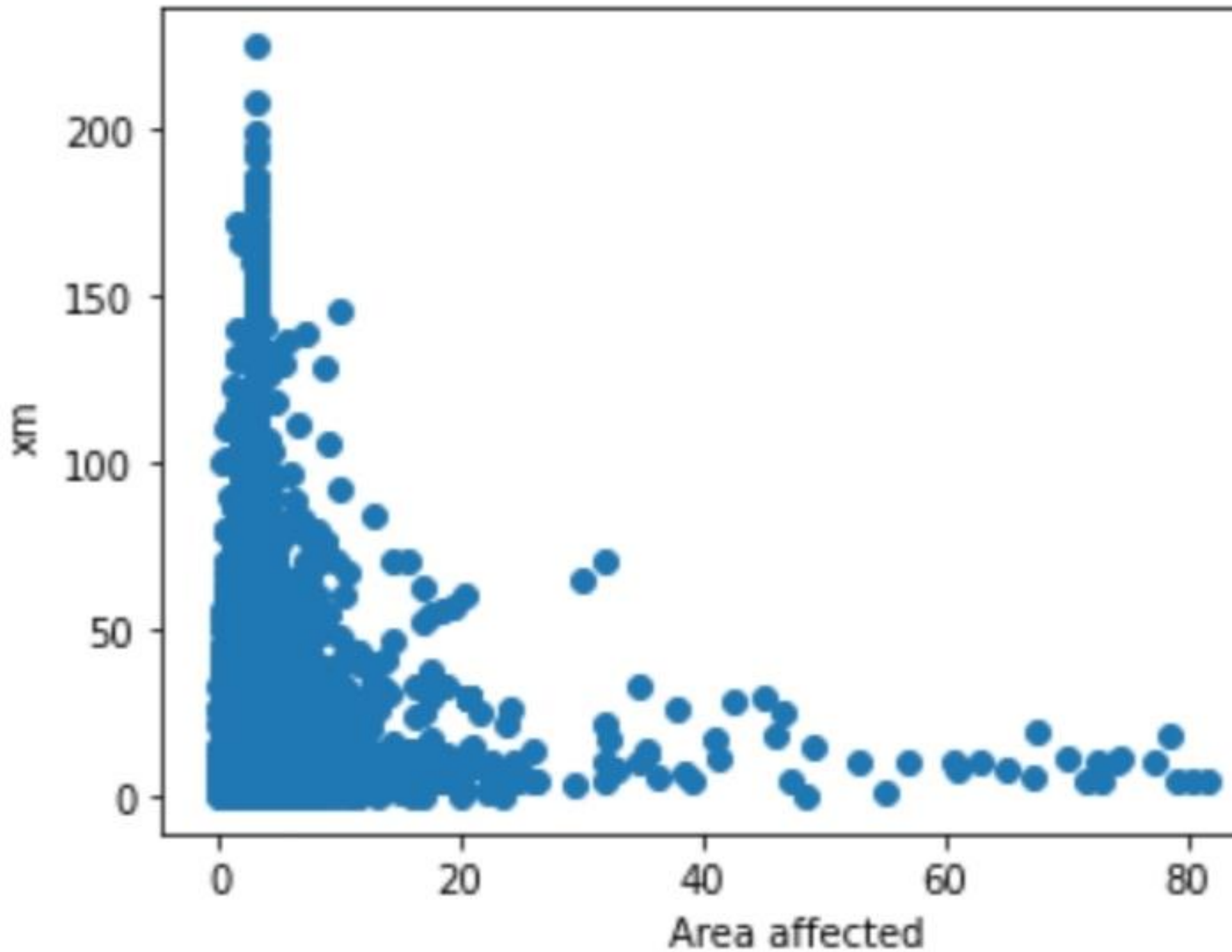

```
plt.scatter(df.depth, df.mb)
plt.xlabel("Depth")
plt.ylabel("Magnitude body")
plt.show()
```




```
plt.scatter(df.dist, df.depth)
plt.xlabel("Area affected")
plt.ylabel("Depth")
plt.show()
```




```
\
plt.scatter(df.dist, df.depth)
plt.xlabel("Area affected")
plt.ylabel("xm")
plt.show()
```



Correlation between Attributes

```
most_correlated = df.corr()['xm'].sort_values(ascending=False)
most_correlated
```

OUTPUT:

```
xm          1.000000
ms          0.699579
mb          0.628382
richter     0.426653
mw          0.420695
depth       0.302926
```

```
md           0.241432
area         0.125275
city         0.107436
direction    0.087696
long         0.071856
dist         0.002853
lat         -0.010347
country     -0.056115
Timestamp   -0.542092
Name: xm, dtype: float64
```

```python
plt.figure(figsize=(20,20))
dataplot=sns.heatmap(df.corr(),annot=True)
plt.show()
```

lat
1 0.23 0.023 -0.3 -0.21 -0.3 0.029 -0.24 -0.01 0.051 -0.032 0.021 0.056 0.015
long
0.23 1 0.34 -0.21 -0.22 -0.31 0.016 -0.065 0.072 0.11 -0.14 0.05 0.044 0.0034
country
0.023 0.34 1 -0.59 -0.52 -0.55 9.4e-16 -0.075 -0.056 0.16 -0.19 0.016 -0.026 -0.081
city
-0.3 -0.21 -0.59 1 0.57 0.62 -0.019 0.17 0.11 -0.18 0.23 -0.0062 0.045 0.1
area
-0.21 -0.22 -0.52 0.57 1 0.53 0.0017 0.16 0.13 -0.089 0.14 0.05 0.068 0.13
direction
-0.3 -0.31 -0.55 0.62 0.53 1 -0.023 0.19 0.088 -0.16 0.19 -0.025 0.022 0.08
dist
0.029 0.016 9.4e-16 -0.019 0.0017 -0.023 1 0.012 0.0029 -0.0027 0.004 -0.0029 -0.0056
depth
-0.24 -0.065 -0.075 0.17 0.16 0.19 0.012 1 0.3 0.043 0.15 0.12 0.26 0.31
xm
-0.01 0.072 -0.056 0.11 0.13 0.088 0.0029 0.3 1 0.24 0.43 0.42 0.7 0.63
md
0.051 0.11 0.16 -0.18 -0.089 -0.16 -0.0027 0.043 0.24 1 -0.24 0.33 0.46 -0.023
richter
-0.032 -0.14 -0.19 0.23 0.14 0.19 0.004 0.15 0.43 -0.24 1 0.09 0.42 0.24
mw
0.021 0.05 0.016 -0.0062 0.05 -0.025 -0.0029 0.12 0.42 0.33 0.09 1 0.41 0.31
ms
0.056 0.044 -0.026 0.045 0.068 0.022 -0.0056 0.26 0.7 0.46 0.42 0.41 1 0.59
mb
0.015 0.0034 -0.081 0.1 0.13 0.08 -5.7e-05 0.31 0.63 -0.023 0.24 0.31 0.59 1
Timestamp
-0.065 0.11 0.085 -0.042 -0.12 -0.048 0.0032 -0.2 -0.54 -0.39 -0.15 -0.44 -0.68 -0.62
lat long country city area direction dist depth xm md richter mw ms mb

Normalization of data:

```
# Using MinMaxScaler
scaler = preprocessing.MinMaxScaler()
d = scaler.fit_transform(df)
df = pd.DataFrame(d, columns=df.columns)
df.head()
```

lat	**long**	**country**	**City**	**area**	**direction**	**dist**	**depth**	**xm**	**md**	**richter**	**mw**	**ms**	**mb**	**Timestamp**	
0	0.559904	0.743088	0.76	0.172043	0.116144	0.875	0.0	0.044444	0.136364	0.554054	0.000000	0.581685	0.0	0.000000	0.866875
1	0.665262	0.396156	0.76	0.612903	0.132306	0.875	0.0	0.023111	0.113636	0.513514	0.555556	0.581685	0.0	0.000000	0.906252
2	0.532210	0.312542	0.76	0.677419	0.459500	0.750	0.0	0.000000	0.045455	0.000000	0.000000	0.581685	0.0	0.521127	0.632149
3	0.585792	0.610249	0.76	0.870968	0.513061	0.750	0.0	0.044444	0.000000	0.472973	0.000000	0.581685	0.0	0.000000	0.809118
4	0.665864	0.401214	0.76	0.806452	0.689344	0.750	0.0	0.031111	0.181818	0.581081	0.000000	0.581685	0.0	0.000000	0.837535

Splitting the Dataset

```
y=np.array(df['xm'])
```

```
X=np.array(df.drop('xm',axis=1))
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2
,random_state=2)
```

Creating Models

1. Linear Regression

```
from sklearn.linear_model import LinearRegression
start1 = time.time()
linear=LinearRegression()
linear.fit(X_train,y_train)
ans1 = linear.predict(X_test)
end1 = time.time()
t1 = end1-start1

accuracy1=linear.score(X_test,y_test)
print("Accuracy of Linear Regression model is:",accuracy1)
```

Accuracy of Linear Regression model is: 0.63134131503029

```
from sklearn import metrics
print("Linear Regression")
print('Mean Absolute Error:',
metrics.mean_absolute_error(y_test, ans1))
print('Mean Squared Error:', metrics.mean_squared_error(y_test,
ans1))
print('Root Mean Squared Error:',
np.sqrt(metrics.mean_squared_error(y_test, ans1)))
```

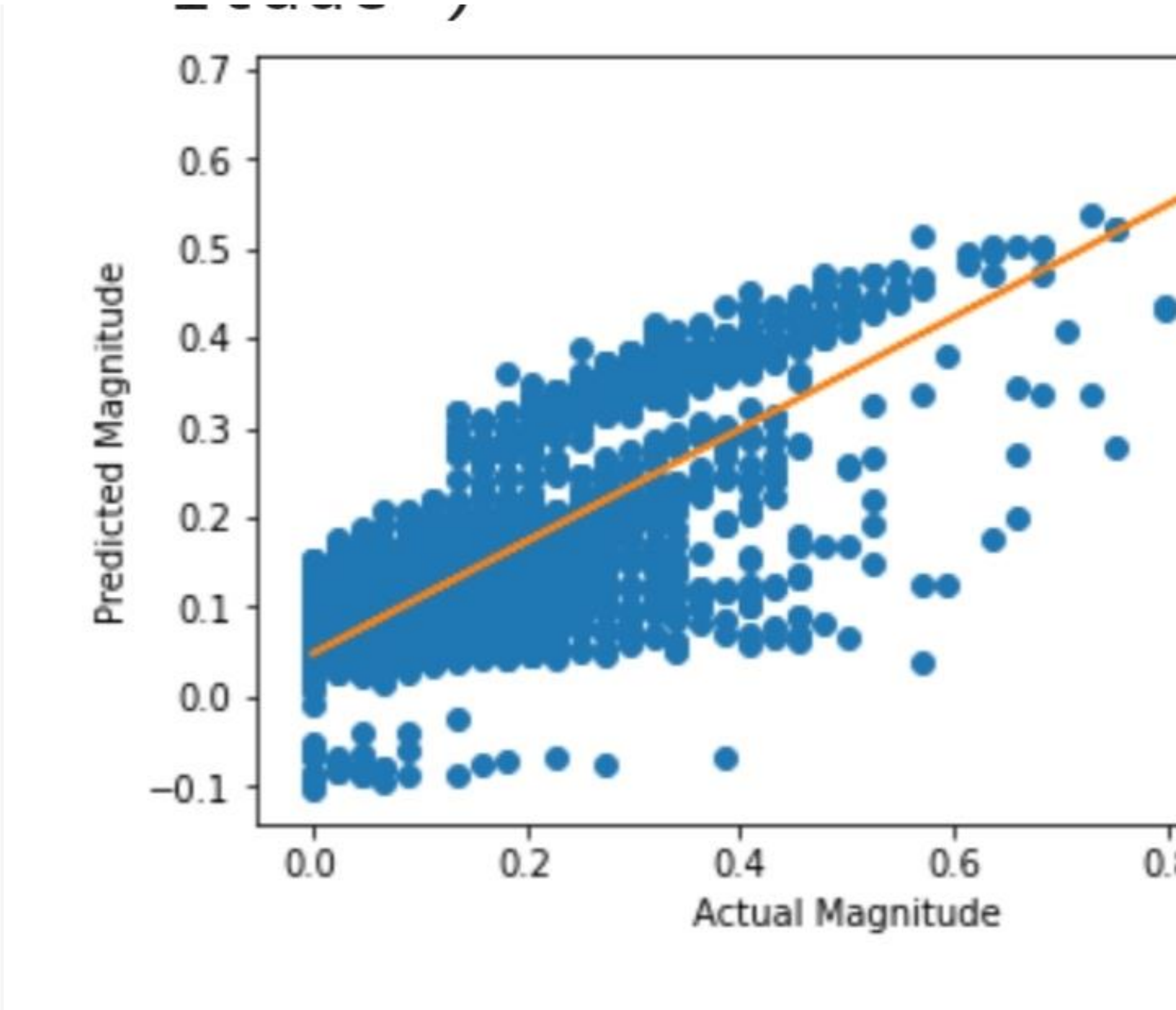
Linear Regression

```
Mean Absolute Error: 0.05878246463205686
Mean Squared Error: 0.00625827169726636
Root Mean Squared Error: 0.07910923901331854
```

```
plt.plot(y_test, ans1, 'o')
m, b = np.polyfit(y_test,ans1, 1)
plt.plot(y_test, m*y_test + b)
plt.xlabel("Actual Magnitude")
plt.ylabel("Predicted Magnitude")
```

OUTPUT:

Text(0, 0.5, 'Predicted Magnitude')



2. Decision Tree

```
from sklearn.tree import DecisionTreeRegressor
```

```
start2 = time.time()
regressor = DecisionTreeRegressor(random_state = 40)
regressor.fit(X_train,y_train)
ans2 = regressor.predict(X_test)
end2 = time.time()
t2 = end2-start2
accuracy2=regressor.score(X_test,y_test)
print("Accuracy of Decision Tree model is:",accuracy2)
```

```
Accuracy of Decision Tree model is: 0.9932960893884235
```

```
print("Decision Tree")
print('Mean Absolute Error:',
metrics.mean_absolute_error(y_test, ans2))
print('Mean Squared Error:', metrics.mean_squared_error(y_test,
ans2))
print('Root Mean Squared Error:',
np.sqrt(metrics.mean_squared_error(y_test, ans2)))
```

Decision Tree

```
Mean Absolute Error: 0.0006909999621372331
Mean Squared Error: 0.00011380416561969702
Root Mean Squared Error: 0.010667903525046383
```

3.KNN Model

```
from sklearn.neighbors import KNeighborsRegressor
start3 = time.time()
knn = KNeighborsRegressor(n_neighbors=6)
knn.fit(X_train, y_train)
ans3 = knn.predict(X_test)
end3 = time.time()
t3 = end3-start3
accuracy3=knn.score(X_test,y_test)
print("Accuracy of KNN model is:",accuracy3)
```

```
Accuracy of KNN model is: 0.8457466919393031
```

```
print("KNN Model")
print('Mean Absolute Error:',
metrics.mean_absolute_error(y_test, ans3))
print('Mean Squared Error:', metrics.mean_squared_error(y_test,
ans3))
```

```python
print('Root Mean Squared Error:',
np.sqrt(metrics.mean_squared_error(y_test, ans3)))
```

KNN Model

```
Mean Absolute Error: 0.03305598677318794
Mean Squared Error: 0.002618571462992348
Root Mean Squared Error: 0.051171979275696854
```

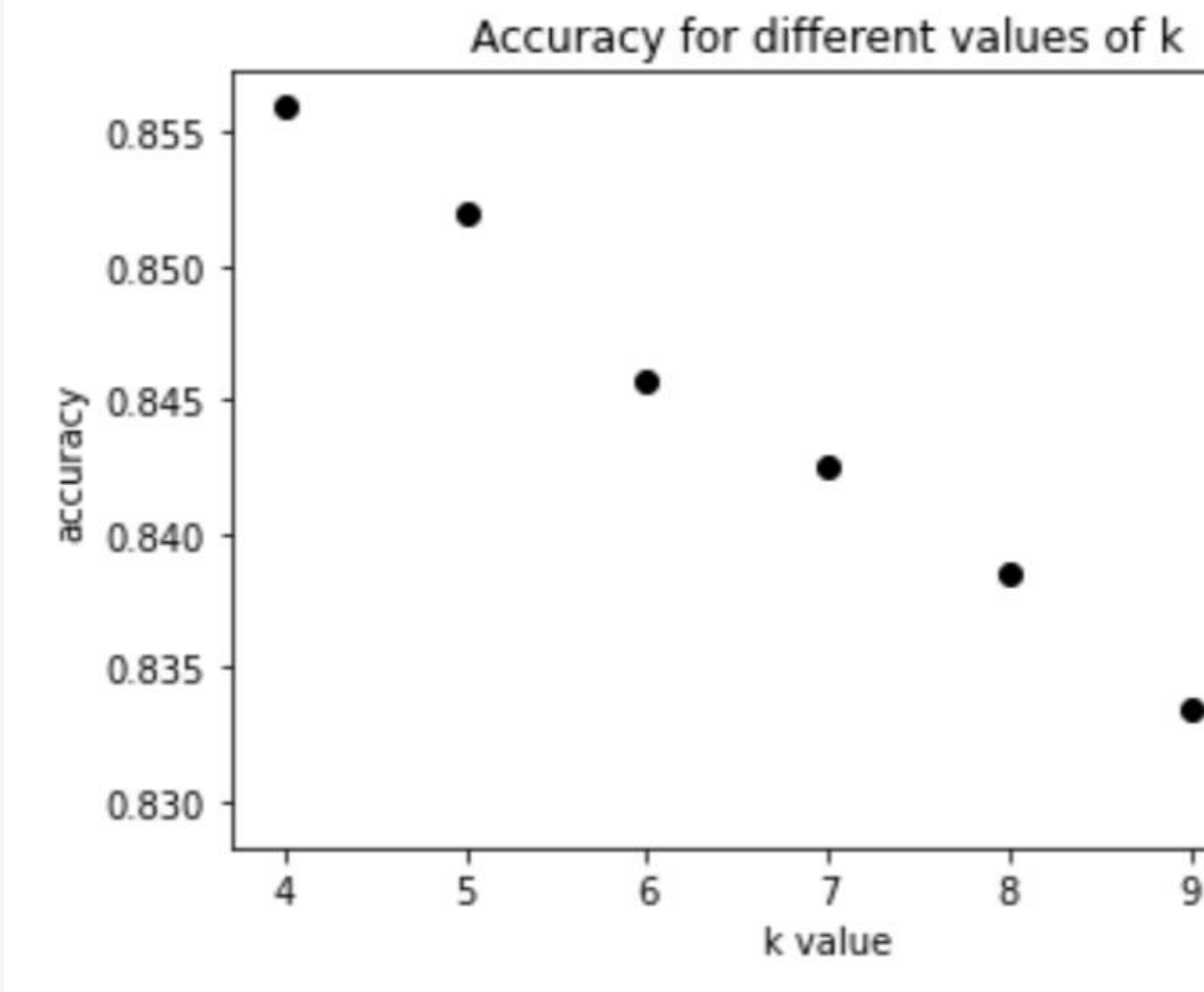
```python
import random
info = {}
for i in range(10):
  k = random.randint(2,10)
  startk = time.time()
  knn = KNeighborsRegressor(n_neighbors=k)
  knn.fit(X_train, y_train)
  ans3 = knn.predict(X_test)
  endk = time.time()
  tk = endk-startk
  acc3=knn.score(X_test,y_test)
  info[k] = [acc3,tk]

for i in info:
  print("for k =",i,": accuracy =",info[i][0])
```

```
for k = 4 : accuracy = 0.8559118607470738
for k = 9 : accuracy = 0.8334625255508568
for k = 8 : accuracy = 0.8384577534478264
for k = 6 : accuracy = 0.8457466919393031
for k = 5 : accuracy = 0.8519381145638621
for k = 10 : accuracy = 0.8296048410841246
for k = 7 : accuracy = 0.8425261199362686
```

```python
x = list(info.keys())
yacc = []
for i in info:
  yacc.append(info[i][0])
plt.plot(x, yacc, 'o', color='black');
plt.xlabel("k value")
plt.ylabel("accuracy");
plt.title("Accuracy for different values of k")
```

OUTPUT:

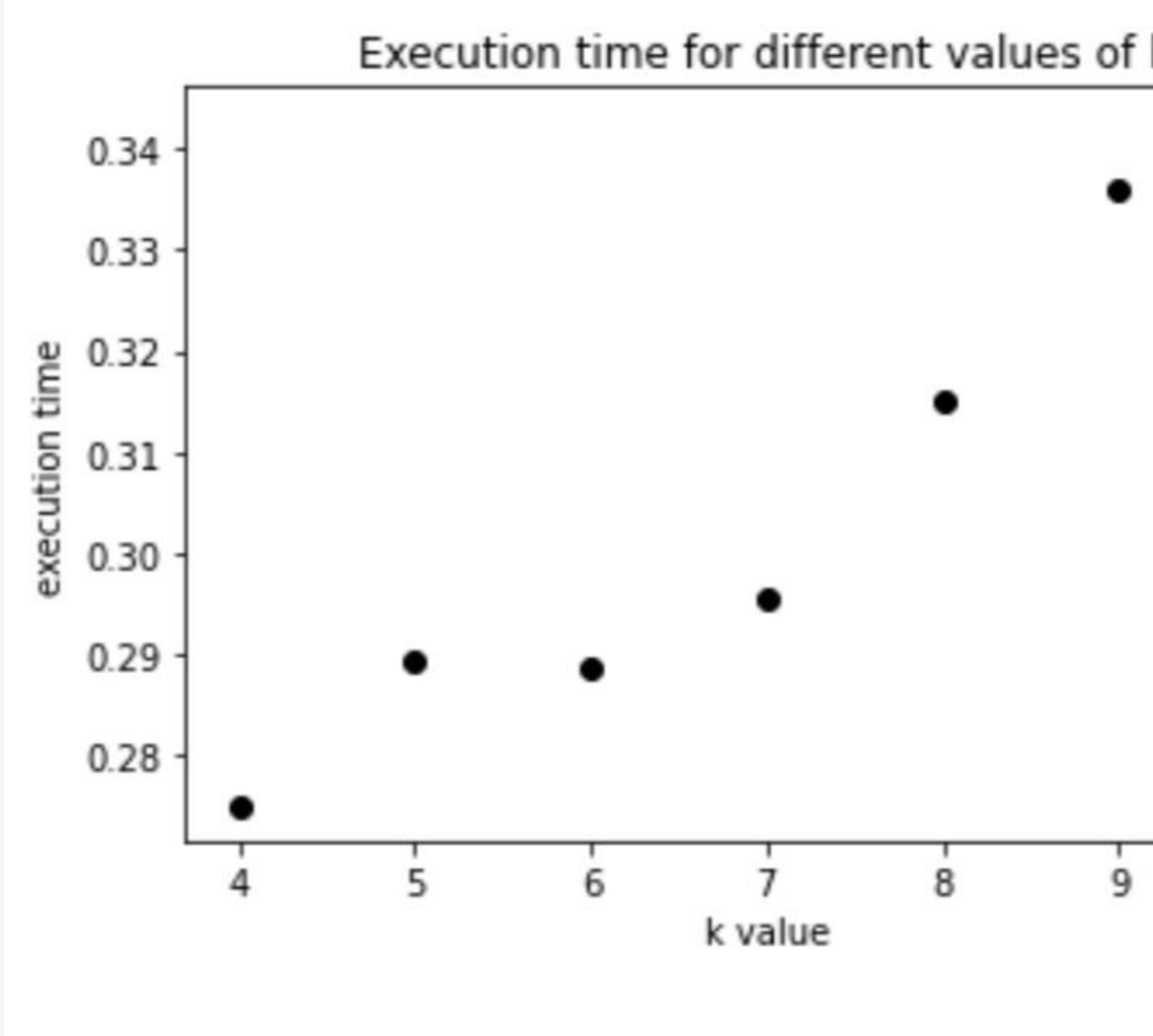
```
Text(0.5, 1.0, 'Accuracy for different values of k')
```




```
yt = []
for i in info:
  yt.append(info[i][1])
plt.plot(x, yt, 'o', color='black');
plt.xlabel("k value")
plt.ylabel("execution time");
plt.title("Execution time for different values of k")
```

output:

```
Text(0.5, 1.0, 'Execution time for different values of k')
```



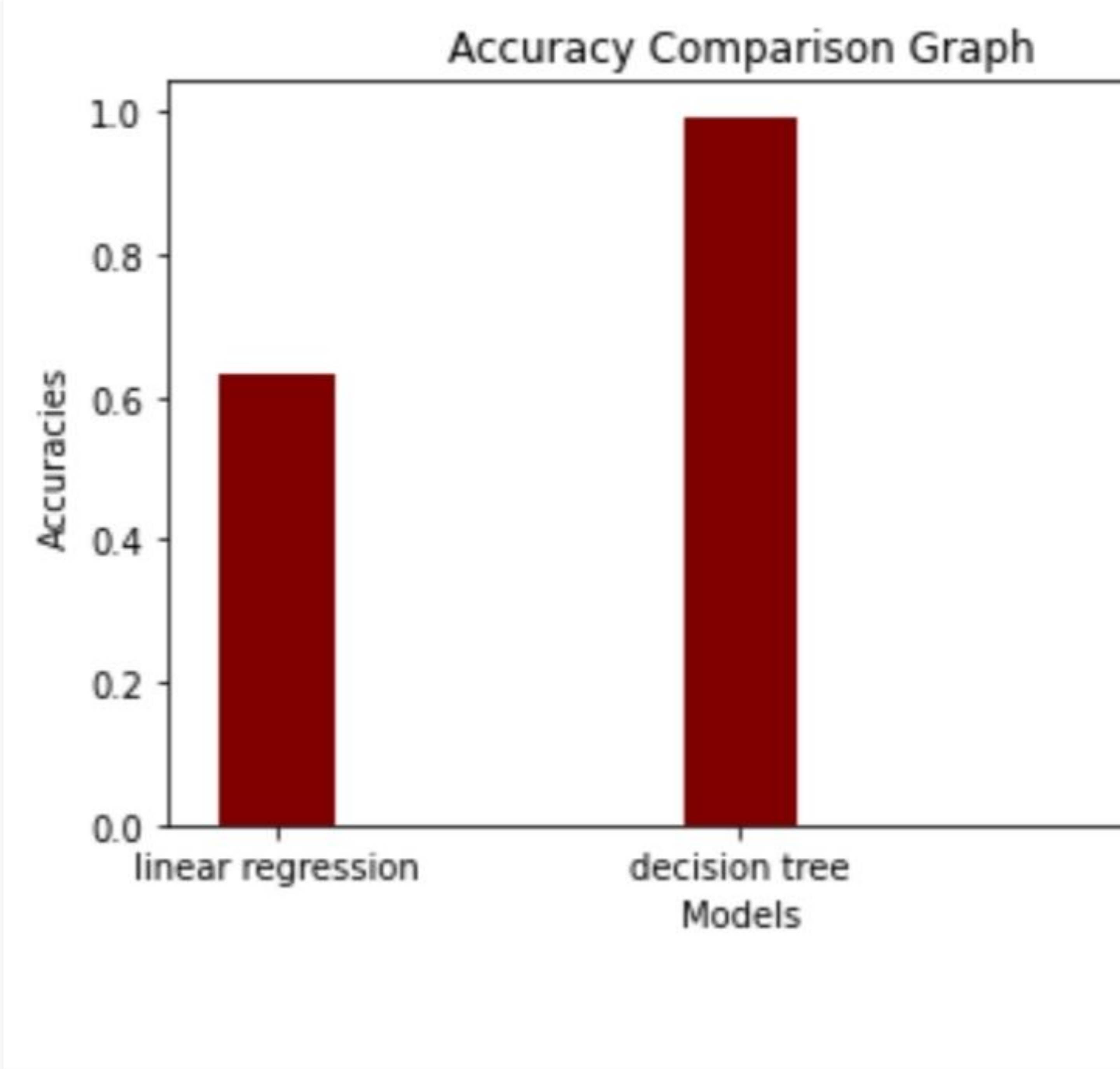
Comparison Graph:

1.Accuracy

```
models = ["linear regression","decision tree","knn"]
accuracies = [accuracy1,accuracy2,accuracy3]
plt.bar(models, accuracies, color ='maroon', width = 0.25)
plt.xlabel("Models")
plt.ylabel("Accuracies")
plt.title("Accuracy Comparison Graph")
```

output:

```
Text(0.5, 1.0, 'Accuracy Comparison Graph')
```



2.Execution Time:

```
times = [t1,t2,t3]
plt.bar(models, times, color ='maroon',
```

```
        width = 0.25)
plt.xlabel("Models")
plt.ylabel("Execution Time")
plt.title("Execution Time Comparison Graph")
```

OUTPUT:

```
Text(0.5, 1.0, 'Execution Time Comparison Graph')
```